TPC Benchmark™ H
Full Disclosure Report

Bull Novascale 3045

Using Microsoft® Windows® Server 2003, Enterprise Edition
for 64-bit Itanium-based Systems SP1
and
Microsoft® SQL Server™ 2005, Enterprise Edition (64-bit) SP1

First Edition
Submitted for Review
March 2007

First Edtion – March 2007

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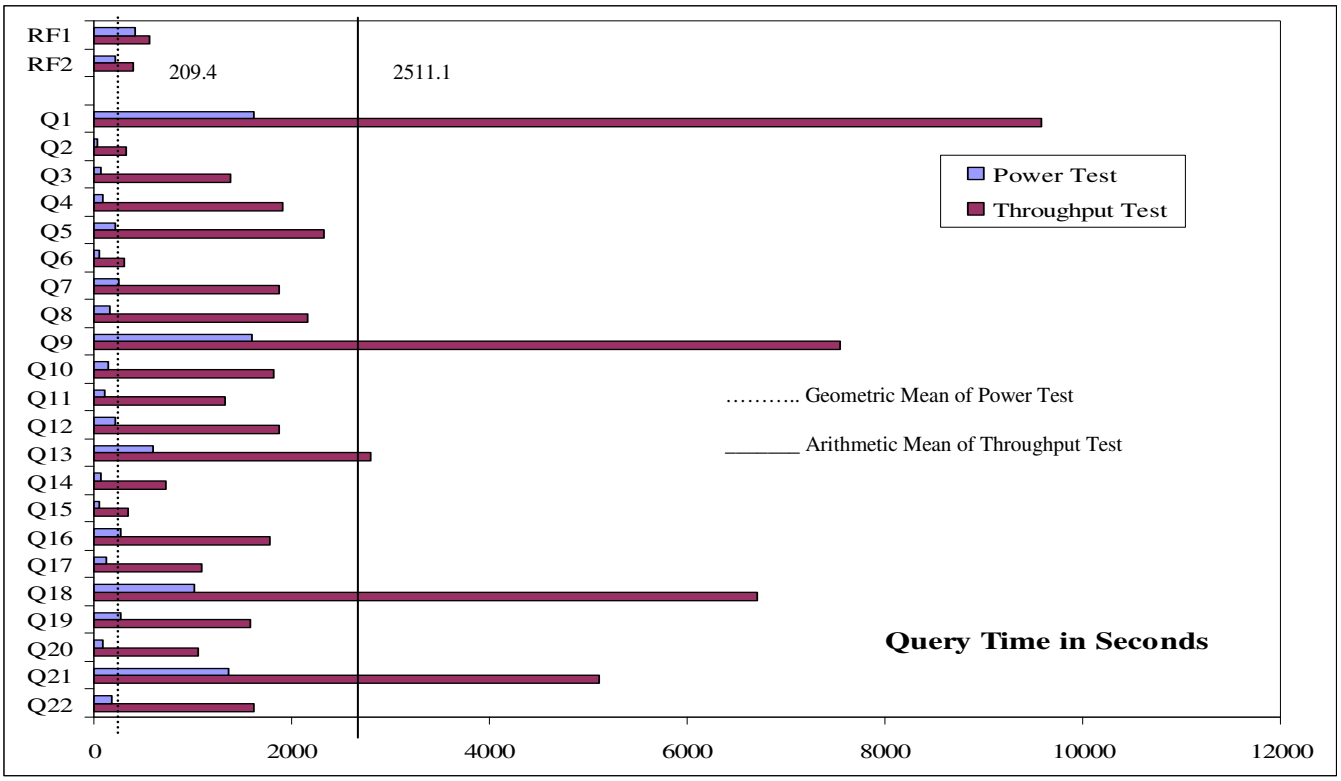
	Bull Novascale 3045	TPC-H Rev. 2.6.0 Report Date: **March 6, 2007**

Total System Cost	Composite Query per Hour Metric	Price / Performance
$151,870	**12,087.4** QphH @ 1000GB	**12.56** $ / QphH@1000GB

Database size	Database Manager	Operating System	Other Software	Availability Date
1000GB	**Microsoft SQL Server 2005 Enterprise IA64 Edition SP1**	**Microsoft Windows Server 2003 Enterprise IA64 Edition SP1**	**Microsoft Visual C++ STD Microsoft Visual Basic .Net Pro.**	**March 6, 2007**



Database Load Time = 27:58:04	Load included backup: Y	Total Data Storage / Database Size = 5.71
RAID (Base tables): N	RAID (Base tables and Auxiliary Data Structures): N	RAID (All): N

System Components	System Total	Per Node
Node:	1	n.a.
Processors (Dual-Core Intel Itanium2 9040, 1.6GHz, 9MB L3 Cache per core):	4	4
Cores:	8	8
Threads:	16	16
Memory:	64GB	64GB
OS Disk Drives (73GB 15krpm HDD SAS):	5	5
Network Interfaces (on-board GigE):	1	1
Host Bus Adapters (LSILogic SAS3442 series HBA):	5	5
Storage Switch:	0	n.a.
Storage Subsystem (Bull StoreWay OPTIMA RS-1603-E3-EBD-1-BATA):	10	n.a.
Storage Subsystem Disk Drives (36GB 15krpm HDD SAS):	160	n.a.
Total Storage:	5704.35GB	n.a.

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	Bull Novascale 3045 4 Sockets / 64 GB				TPC-H REV 2.6.0 Report Date: March 6, 2007		
Description	**Part Number**	**Brand**	**Pricing**	**Unit Price**	**Qty**	**Extended Price**	**3 yr. Maint. Price**
Server Hardware							
NovaScale 3045 Server	CPSU204-4U4S	Bull	1	8,356	1	8,356	
1x Socket Itanium 9040 1.6GHz/18MB L3 DC, FSB 533	CPKU233-1618	Bull	1	4,477	4	17,908	
2x Memory Boxes for 3005 Series	CMMU220-00MB	Bull	1	959	1	959	
16GB (8x2048MB DIMMs, DDR2 533) kit	CMMU216-0016	Bull	1	8,065	4	32,260	
DVD/CD R/W Drive IDE Slim	MSUU243-CDVD	Bull	1	301	1	301	
19" LCD Monitor - SyncMaster	LCDU002-1900	Bull	1	361	1	361	
USB standard Keyboard (105 keys) + mouse pack	CTKU208-0USB	Bull	1	167	1	167	
SAS Internal Cable	CBLU160-SA01	Bull	1	33	1	33	
73GB SAS Hot Swap Disk DRV w/ canister (3"5/15Krpm)	OPTF107-0000	Bull	1	436	5	2,180	
PCI-X SAS 4 Ports Host Connection Kit	CKTU237-004P	Bull	1	406	1	406	
Dummy disk canister	DSKH103-FDA2	Bull	1	24	3	73	
					Subtotal	**63,003**	**2,086**
Storage Hardware							
Rack 1100H 40U/19" w/o Power Distribution Unit	RCKU209-1140	Bull	1	3,682	1	3,682	
7-outlet Power Distribution Unit (7x C13)	PSSU211-00M7	Bull	1	266	4	1,065	
LSILogic SAS3442E-R HBA Card 5-Pack (**)	LSI00111	LSILogic	3	1,140	1	1,140	*spares*
LSILogic SAS3442E-R HBA (**)	LSI00110	LSILogic	3	328	1	328	*spares*
SAS disks enclosure and connection cable (2 m)	RS-1603-E3	Bull	1	3,100	10	31,000	
SAS disks enclosure and cable (**)	RS-1603-E3	Bull	1	3,100	2	6,200	*spares*
73GB/15k SAS disk	OPTF107-0000	Bull	1	420	160	67,200	
73GB/15k SAS disk (**)	OPTF107-0000	Bull	1	420	16	6,720	*spares*
					Subtotal	**117,335**	**0**
Server Software							
Novascale Master	Included	Bull	1				
Windows Server 2003 Enterp. Ed. (up to 8-CPU) & 5CAL	P72-00284	Microsoft	2	2,334	1	2,334	
SQL Server 2005 Enterprise Edition	810-04793	Microsoft	2	8,487	1	8,487	
SQL Server 2005 Client License	359-01911	Microsoft	2	156	45	7,020	
Microsoft Visual C++ Standard Edition	254-00170	Microsoft	2	109	1	109	*Included*
Microsoft Visual Basic .Net Professional	046-00856	Microsoft	2	109	1	109	*Included*
Microsoft Problem Resolution Services (1 incident)		Microsoft	2	245	1		245
					Subtotal	**18,059**	**245**
Large Volume HW, SW & Maintenance Discount (*)					**Discounts**	48,295	563
					TOTAL	**150,102**	**1,768**

Notes:

Pricing : 1-Bull, 2-Microsoft, 3-Heights Performance Supply

(*) Discount: 27% on Bull catalog and on Maintenance

(**) Spares = 10% spare disks, drawers and HBA added in place of onsite service

Used 4 HBA, 10 disk drawers, 160x73GB disks - Spares are 2 HBA, 2 drawers, 16x73GB disks

Result and methodology audited by François Raab of InfoSizing Inc. (www.sizing.com)

Three-Year Cost of Ownership :	**$151,870**
QphH @ 1000GB :	**12,087.4**
$ / QphH@1000GB :	**$12.56**

Prices used in TPC benchmarks reflect the actual prices a customer would pay for a one-time purchase of the stated components. Individually negotiated discounts are not permitted. Special prices based on assumptions about past or future purchases are not permitted. All discounts reflects standard pricing policies for the listed components. For complete details, see the pricing sections of the TPC benchmark specifications.If you find that the stated prices are not available according to these terms, please inform the TPC at pricing@tpc.org. Thank you.

Numerical Quantities

Measurement Results

Scale Factor	= 1000
Total Data Storage / Database Size	= 5.71
Start of Database Load	= 2/8/2007 18:35:40
End of Database Load	= 2/9/2007 22:33:44
Database Load Time	= 27:58:04
Query Streams for Throughput Test	= 7
TPC-H Power	= 17195.2
TPC-H Throughput	= 8496.9
Composite Query per Hour Rating (QphH@1000GB)	= 12087.4
Total System Price Over 3 Years	= $151,870
TPC-H Price Performance Metric	= $12.56

Measurement Intervals

Measurement Interval in Throughput Test (Ts)	= 65247.6 seconds

Duration of Stream Execution

Power Stream	Seed	RF1 Start Date/Time RF1 End Date/Time	Query Start Date/Time Query End Date/Time	RF2 Start Date/Time RF2 End Date/Time	Duration
	209223344	02-12-2007 16:29:29 02-12-2007 16:36:35	02-12-2007 16:36:35 02-12-2007 19:00:40	02-12-2007 19:00:41 02-12-2007 19:04:18	2:34:49

Throughput Stream	Seed	Query Start Date/Time Query End Date/Time	Duration	RF1 Start Date/Time RF1 End Date/Time	RF2 Start Date/Time RF2 End Date/Time
1	209223345	02-12-2007 19:04:19 02-13-2007 11:12:41	16:08:22	02-13-2007 11:20:05 02-13-2007 11:28:57	02-13-2007 11:28:57 02-13-2007 11:35:00
2	209223346	02-12-2007 19:04:19 02-13-2007 10:25:02	15:20:43	02-13-2007 11:35:01 02-13-2007 11:44:14	02-13-2007 11:44:14 02-13-2007 11:50:34
3	209223347	02-12-2007 19:04:19 02-13-2007 10:23:52	15:19:33	02-13-2007 11:50:35 02-13-2007 12:00:33	02-13-2007 12:00:34 02-13-2007 12:07:02
4	209223348	02-12-2007 19:04:19 02-13-2007 11:20:04	16:15:45	02-13-2007 12:07:03 02-13-2007 12:16:39	02-13-2007 12:16:39 02-13-2007 12:23:12
5	209223349	02-12-2007 19:04:19 02-13-2007 09:38:16	14:33:57	02-13-2007 12:23:13 02-13-2007 12:32:52	02-13-2007 12:32:52 02-13-2007 12:39:17
6	209223350	02-12-2007 19:04:19 02-13-2007 10:59:27	15:55:08	02-13-2007 12:39:18 02-13-2007 12:49:02	02-13-2007 12:49:02 02-13-2007 12:56:10
7	209223351	02-12-2007 19:04:19 02-13-2007 08:56:01	13:51:42	02-13-2007 12:56:11 02-13-2007 13:05:03	02-13-2007 13:05:04 02-13-2007 13:11:46

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TPC-H Timing Intervals (in seconds):

Query	Stream 0	Stream 1	Stream 2	Stream 3	Stream 4	Stream 5	Stream 6	Stream 7	Min Qi	Max Qi	Avg Qi
Q1	1623.8	9820.6	10885.0	6477.9	12151.7	6006.3	14430.3	7278.8	6006.3	14430.3	9578.7
Q2	39.4	200.7	478.2	262.5	391.0	456.3	211.5	274.5	200.7	478.2	325.0
Q3	69.0	2432.0	747.7	234.1	229.3	1001.8	4417.8	662.8	229.3	4417.8	1389.4
Q4	96.9	154.2	1800.2	745.5	3060.2	2131.5	1999.9	3512.6	154.2	3512.6	1914.9
Q5	226.6	2463.6	1374.0	4762.5	1255.6	2981.9	1749.6	1647.5	1255.6	4762.5	2319.2
Q6	53.6	200.5	434.2	295.9	277.9	305.0	323.0	267.8	200.5	434.2	300.6
Q7	259.1	2665.3	3287.4	1072.6	365.2	1867.2	1103.6	2685.0	365.2	3287.4	1863.8
Q8	165.9	5286.7	1961.6	1644.2	3103.1	805.0	900.6	1484.1	805.0	5286.7	2169.3
Q9	1602.0	8401.5	8271.8	9087.8	6672.1	7181.4	8080.5	5064.0	5064.0	9087.8	7537.0
Q10	139.0	930.0	1960.8	799.3	4634.7	2749.5	627.8	1083.7	627.8	4634.7	1826.5
Q11	104.3	2873.5	634.9	598.3	520.6	1162.3	767.3	2738.5	520.6	2873.5	1327.9
Q12	222.6	911.6	1038.9	848.4	4205.4	3206.2	1425.5	1433.6	848.4	4205.4	1867.1
Q13	596.2	2729.6	2993.9	3648.9	1424.5	3003.4	3347.9	2468.2	1424.5	3648.9	2802.3
Q14	71.2	347.3	2320.7	389.1	530.6	415.3	421.9	651.7	347.3	2320.7	725.2
Q15	53.6	448.8	203.3	266.6	249.6	479.8	559.0	252.9	203.3	559.0	351.4
Q16	274.0	2210.6	1664.0	1321.7	2668.4	1589.3	1557.1	1489.0	1321.7	2668.4	1785.7
Q17	120.1	346.3	1524.9	1456.5	1028.0	982.2	339.7	1976.5	339.7	1976.5	1093.4
Q18	1025.6	6593.6	5498.0	7246.0	7517.4	6203.9	7082.5	6769.7	5498.0	7517.4	6701.6
Q19	268.5	974.0	1590.8	1611.3	1185.2	3425.2	987.3	1298.4	974.0	3425.2	1581.7
Q20	93.2	1959.3	507.5	2208.9	145.2	417.2	1035.5	1082.8	145.2	2208.9	1050.9
Q21	1361.5	4110.6	4790.5	6503.4	6625.4	4145.3	4732.3	4908.8	4110.6	6625.4	5116.6
Q22	179.6	2041.6	1274.4	3691.1	303.4	1920.5	1207.3	870.9	303.4	3691.1	1615.6
RF1	425.6	532.9	552.5	598.9	575.6	578.8	583.6	532.6	532.6	598.9	565.0
RF2	217.8	363.0	379.6	388.6	392.7	384.8	427.5	402.6	363.0	427.5	391.3

PREFACE

Document Overview

This report documents the methodology and results of the TPC Benchmark™ H (TPC-H) test conducted on the Bull Novascale 3045 using Microsoft SQL Server 2005 Enterprise Edition 64-bit, in conformance with the requirements of the TPC Benchmark™H Standard Specification Revision 2.6.0. The tests documented in this report were sponsored by Bull. The operating system used for the benchmark was Microsoft Windows Server 2003, Enterprise Edition for 64-bit Itanium-based Systems.

The Transaction Processing Performance Council (TPC) developed the TPC-H Benchmark. The TPC Benchmark™ H Standard represents an effort by Bull and other members of the Transaction Processing Performance Council (TPC) to create an industry-wide benchmark for evaluating the performance and price/performance of decision support systems, and to disseminate objective, verifiable performance data to the data processing industry.

A certified audit of these measurements and the reported results was performed by François RAAB of Info Sizing Inc. He has verified compliance with the relevant TPC Benchmark™ H specifications; audited the benchmark configuration, environment, and methodology used to produce and validate the test results; and audited the pricing model used to calculate the price/ performance. The auditor's letter of attestation is attached to the Executive Summary and precedes this section.

TPC Benchmark™H Overview

The TPC Benchmark™H (TPC-H) is a decision support benchmark. It consists of a suite of business oriented ad-hoc queries and concurrent updates. The queries and the data populating the database have been chosen to have broad industry-wide relevance while maintaining a sufficient degree of ease of implementation. This benchmark illustrates decision support systems that:

- Examine large volumes of data;
- Execute queries with a high degree of complexity;
- Give answers to critical business questions.

TPC-H evaluates the performance of various decision support systems by the execution of sets of queries against a standard database under controlled conditions. The TPC-H queries:

- Give answers to real-world business questions;
- Simulate generated ad-hoc queries (e.g., via a point and click GUI interface);
- Are far more complex than most OLTP transactions;
- Include a rich breadth of operators and selectivity constraints;
- Generate intensive activity on the part of the database server component of the system under test;
- Are executed against a database complying to specific population and scaling requirements;
- Are implemented with constraints derived from staying closely synchronized with an on-line production database.

The TPC-H operations are modeled as follows:

- The database is continuously available 24 hours a day, 7 days a week, for ad-hoc queries from multiple end users and updates against all tables, except possibly during infrequent (e.g., once a month) maintenance sessions;
- The TPC-H database tracks, possibly with some delay, the state of the OLTP database through on-going updates which batch together a number of modifications impacting some part of the decision support database;
- Due to the world-wide nature of the business data stored in the TPC-H database, the queries and the updates may be executed against the database at any time, especially in relation to each other. In addition, this mix of queries and updates is subject to specific ACIDity requirements, since queries and updates may execute concurrently;
- To achieve the optimal compromise between performance and operational requirements the database administrator can set, once and for all, the locking levels and the concurrent scheduling rules for queries and updates.

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The minimum database required to run the benchmark holds business data from 10,000 suppliers. It contains almost ten million rows representing a raw storage capacity of about 1 gigabyte. Compliant benchmark implementations may also use one of the larger permissible database populations (e.g., 1000 gigabytes), as defined in Clause 4.1.3.

The performance metric reported by TPC-H is called the TPC-H Composite Query-per-Hour Performance Metric (QphH@Size), and reflects multiple aspects of the capability of the system to process queries. These aspects include the selected database size against which the queries are executed, the query processing power when queries are submitted by a single stream, and the query throughput when queries are submitted by multiple concurrent users. The TPC-H Price/Performance metric is expressed as $/QphH@Size. To be compliant with the TPC-H standard, all references to TPCH results for a given configuration must include all required reporting components. *The TPC believes that comparisons of TPC-H results measured against different database sizes are misleading and discourages such comparisons.*

The TPC-H database must be implemented using a commercially available database management system (DBMS) and the queries executed via an interface using dynamic SQL. The specification provides for variants of SQL, as implementers are not required to have implemented a specific SQL standard in full.

TPC-H uses terminology and metrics that are similar to other benchmarks, originated by the TPC and others. Such similarity in terminology does not in any way imply that TPC-H results are comparable to other benchmarks. The only benchmark results comparable to TPC-H are other TPC-H results compliant with the same revision.

Despite the fact that this benchmark offers a rich environment representative of many decision support systems, this benchmark does not reflect the entire range of decision support requirements. In addition, the extent to which a customer can achieve the results reported by a vendor is highly dependent on how closely TPC-H approximates the customer application. The relative performance of systems derived from this benchmark does not necessarily hold for other workloads or environments. Extrapolations to any other environment are not recommended.

Benchmark results are highly dependent upon workload, specific application requirements, and systems design and implementation. Relative system performance will vary as a result of these and other factors. Therefore, TPC-H should not be used as a substitute for a specific customer application benchmarking when critical capacity planning and/or product evaluation decisions are contemplated.

Benchmark sponsors are permitted several possible system designs, provided that they adhere to the model described in Clause 6. A full disclosure report (FDR) of the implementation details, as specified in Clause 8, must be made available along with the reported results.

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General Implementation Guidelines

The purpose of TPC benchmarks is to provide relevant, objective performance data to industry users. To achieve that purpose, TPC benchmark specifications require that benchmark tests be implemented with systems, products, technologies and pricing that:

- Are generally available to users;
- Are relevant to the market segment that the individual TPC benchmark models or represents (e.g. TPC-H models and represents complex, high data volume, decision support environments);
- Would plausibly be implemented by a significant number of users in the market segment the benchmark models or represents.

A Table of Contents follows after this page.

Related Product Information

The TPC Benchmark™ H Standard requires that test sponsors provide a Full Disclosure Report in addition to published results. You can obtain copies of the test results as well as additional copies of this full disclosure report by sending a request to the following address:

Bull S.A.S.
Rue Jean Jaurès
B.P.68
78340 Les Clayes-sous-Bois
France

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Table of contents

PREFACE *1*
Document Overview 1
TPC Benchmark™H Overview 1
General Implementation Guidelines 3
Related Product Information 3
1. GENERAL ITEMS *6*
1.1 Benchmark Sponsor 6
1.2 Parameter Settings 6
1.3 Configuration Items 6
2. CLAUSE 1: LOGICAL DATA BASE DESIGN *9*
2.1 Table Definitions 9
2.2 Database Organization 9
2.3. Horizontal Partitioning 9
2.4 Vertical Partitioning 9
2.5 Replication 9
3. CLAUSE 2: QUERIES AND UPDATE FUNCTIONS *10*
3.1 Query Language 10
3.2 Random Number Generation 10
3.3 Substitution Parameters 10
3.4 Query Text and Output Data from Qualification Database 10
3.5 Query Substitution Parameters and Seeds 10
3.6 Query Isolation Level 10
3.7 Source Code of Refresh Functions 10
4. CLAUSE 3: DATABASE SYSTEM PROPERTIES *11*
4.1 Atomicity 11
4.2 Consistency 11
4.3 Isolation 12
4.4 Durability 13
5. CLAUSE 4: SCALING AND DATABASE POPULATION *15*
5.1 Cardinality of Tables 15
5.2 Distribution of Tables and Logs Across Media 15
5.3 Partitions/Replications Mapping 17
5.4 Use of RAID 17

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5.5 DBGEN Modifications **17**
5.6 Database Load Time **17**
5.7 Data Storage Ratio **17**
5.8 Database Loading **17**
5.9 Qualification Database Configuration **19**
6. CLAUSE 5: PERFORMANCE METRICS AND EXECUTION RULES ***20***
6.1 System Activity Between Load and Performance Tests **20**
6.2 Power Test Implementation **20**
6.3 Timing Intervals and Reporting **20**
6.4 Number of Streams in the Throughput Test **20**
6.6 Start and End Date/Time for each Query **20**
6.6 Total Elapsed Time for the Measurement Interval **20**
6.7 Refresh Function Start Date/Time and Finish Date/Time **20**
6.8 Timing Intervals for Each Query and Each Refresh Function for Each Stream **21**
6.9 Performance Metrics **21**
6.10 The Performance Metric and Numerical Quantities from Both Runs **21**
6.11 System Activity Between Tests **21**
7. CLAUSE 6: SUT AND DRIVER IMPLEMENTATION RELATED ITEMS ***22***
7.1 Driver **22**
7.2 Implementation-Specific Layer (ISL) **22**
7.3 Profile-Directed Optimization **23**
8. CLAUSE 7: PRICING RELATED ITEMS ***24***
8.1 Hardware and Software Used **24**
8.2 Three-Year Cost of System Configuration **24**
8.3 Availability Dates **25**
9. CLAUSE 8: AUDIT RELATED ITEMS ***26***
APPENDIX A: SYSTEM AND DATABASE TUNABLE PARAMETERS ***29***
APPENDIX B: DATABASE, TABLES, AND INDEXES CREATION ***32***
APPENDIX C: QUERY TEXT AND OUTPUT ***40***
APPENDIX D: SEED & QUERY SUBSTITUTION ***50***
APPENDIX E: REFRESH FUNCTION AND STEPMASTER SOURCE CODE ***54***
APPENDIX F: THIRD PARTY QUOTES ***291***

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1. GENERAL ITEMS

1.1 Benchmark Sponsor

A statement identifying the benchmark sponsor(s) and other participating companies must be provided.

This TPC benchmark H was sponsored by Bull S.A.S. The benchmark test was developed by Microsoft and Bull. The benchmark was conducted at Bull in Les Clayes sous Bois, France.

1.2 Parameter Settings

Settings must be provided for all customer-tunable parameters and options which have been changed from the defaults found in actual products, including but not limited to:

- *Data Base tuning options;*
- *Optimizer/Query execution options;*
- *Query Processing tool/language configuration parameters;*
- *Recovery/commit options;*
- *Consistency/locking options;*
- *Operating system and configuration parameters;*
- *Configuration parameters and options for any other software component incorporated into the pricing structure;*
- *Compiler optimization options.*

Comment 1: In the event that some parameters and options are set multiple times, it must be easily discernible by an interested reader when the parameter or option was modified and what new value it received each time.

Comment 2: This requirement can be satisfied by providing a full list of all parameters and options, as long as all those that have been modified from their default values have been clearly identified and these parameters and options are only set once.

Details of system and database configurations and parameters are provided in Appendixes A and B.

1.3 Configuration Items

Diagrams of both measured and priced configurations must be provided, accompanied by a description of the differences. This includes, but is not limited to:

- *Total number of nodes used, total number and type of processors used/total number of cores used/total number of threads used (including sizes of L2 and L3 caches);*
- *Size of allocated memory, and any specific mapping/partitioning of memory unique to the test;*
- *Number and type of disk units (and controllers, if applicable);*
- *Number of channels or bus connections to disk units, including their protocol type;*
- *Number of LAN (e.g. Ethernet) connections, including routers, work stations, terminals, etc., that were physically used in the test or are incorporated into the pricing structure;*
- *Type and run-time execution location of software components (e.g., DBMS, query processing tools/languages, middle-ware components, software drivers, etc.).*

Measured Configuration:

- 4 Dual-Core Intel Itanium2 9040, 1.6GHz each with 9MB L3 Cache per core
- 64 GB Memory
- 5 PCI SAS HBAs
- 1 Intel Pro1000/EB network adapter
- 10 StoreWay OPTIMA RS-1063-E3-EBD-1-BATA disk enclosures
- 160 36GB SAS 15K drives
- 5 73GB SAS 15K drives

Priced Configuration:

- 4 Dual-Core Intel Itanium2 9040, 1.6GHz each with 9MB L3 Cache per core
- 64 GB Memory

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- 5 PCI SAS HBAs
- 1 Intel Pro1000/EB network adapter
- 10 StoreWay OPTIMA RS-1063-E3-EBD-1-BATA disk enclosures
- 160 73GB SAS 15K drives
- 5 73GB SAS 15K drives

The server System Under Test (SUT), a Bull Novascale3045 is shown in the following diagram :

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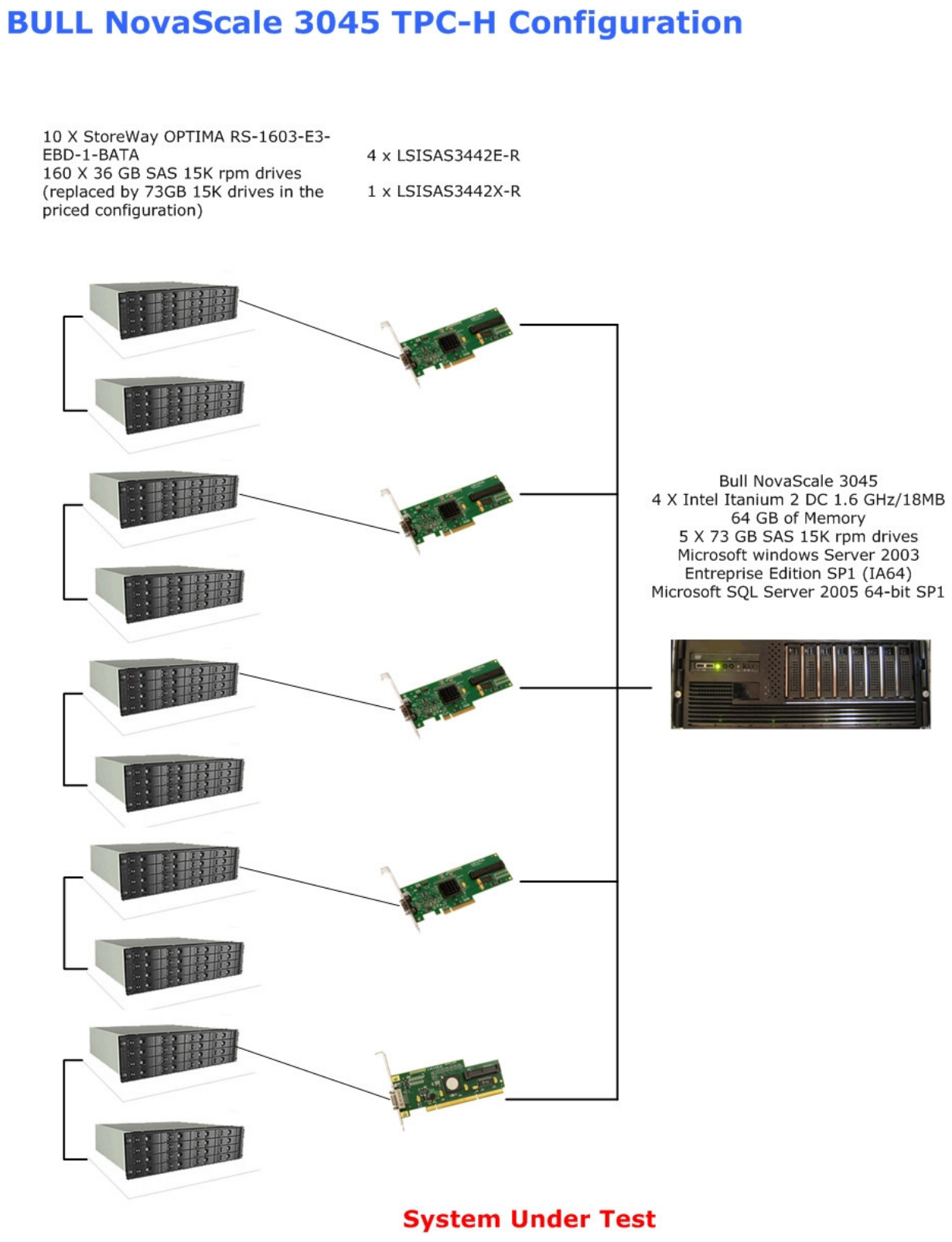

Figure 1.1 Benchmark and Priced Configuration for Novascale 3045

2. CLAUSE 1: LOGICAL DATA BASE DESIGN

2.1 Table Definitions

Listings must be provided for all table definition statements and all other statements used to setup the test and qualification databases.

Appendix B contains the scripts that define, create, and analyze the tables and indexes for the TPC-H database.

2.2 Database Organization

The physical organization of tables and indices, within the test and qualification databases, must be disclosed. If the column ordering of any table is different from that specified in Clause 1.4, it must be noted.

Clustered indexes were used. See Appendix B, which contains the database and table creation statements.

2.3. Horizontal Partitioning

Horizontal partitioning of base tables or auxiliary structures created by database directives is allowed. Groups of rows from a table or auxiliary structure may be assigned to different files, disks, or areas. If this assignment is a function of data in the table or auxiliary structure, the assignment must be based on the value of a partitioning field. A partitioning field must be one and only one of the following:

- *A primary*
- *A foreign*
- *A single date column*

Some partitioning schemes require the use of directives that specify explicit values for the partitioning field. If such directives are used they must satisfy the following conditions:

- *They may not rely on any knowledge of the data stored in the table except the minimum and maximum values of columns used for the partitioning field.*
- *Within the limitations of integer division, they must define each partition to accept an equal portion of the range between the minimum and maximum values of the partitioning column(s).*
- *The directives must allow the insertion of values of the partitioning column(s) outside the range covered by the minimum and maximum values.*

Multiple-level partitioning of base tables or auxiliary structures is allowed only if each level of partitioning satisfies the conditions stated above and each level references only one partitioning field as defined above. If implemented, the details of such partitioning must be disclosed.

Horizontal partitioning was not used. See Appendix B, which contains the database and table creation statements.

2.4 Vertical Partitioning

Vertical partitioning of tables is not allowed. For example, groups of columns of one row shall not be assigned to files, disks, or areas different from those storing the other columns of that row. The row must be processed as an atomic series of contiguous columns.

Comment: *The effect of vertical partitioning is to reduce the effective row size accessed by the system. Given the synthetic nature of this benchmark, the effect of vertical partitioning is achieved by the choice of row sizes. No further vertical partitioning of the data set is allowed. Specifically, the above Clause prohibits assigning one or more of the columns not accessed by the TPC-H query set to a vertical partition.*

Vertical partitioning was not used. See Appendix B, which contains the database and table creation statements.

2.5 Replication

Any replication of physical objects must be disclosed and must conform to the requirements of Clause1.5.6.

No replication was used. See Appendix B, which contains the database and table creation statements.

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3. CLAUSE 2: QUERIES AND UPDATE FUNCTIONS

3.1 Query Language

The query language used to implement the queries must be identified.

SQL was the query language used to implement all queries.

3.2 Random Number Generation

The method of verification for the random number generation must be described unless the supplied DBGEN and QGEN were used.

DBGEN Version 2.6.0 and QGEN version 2.6.0 were used to generate random numbers for all database populations.

3.3 Substitution Parameters

The method used to generate values for substitution parameters must be disclosed. If QGEN is not used for this purpose, then the source code of any non-commercial tool used must be disclosed. If QGEN is used, the version number, release number, modification number and patch level of QGEN must be disclosed.

The supplied QGEN version 2.6.0 was used to generate the substitution parameters.

3.4 Query Text and Output Data from Qualification Database

The executable query text used for query validation must be disclosed along with the corresponding output data generated during the execution of the query text against the qualification database. If minor modifications (see Clause 2.2.3) have been applied to any functional query definitions or approved variants in order to obtain executable query text, these modifications must be disclosed and justified. The justification for a particular minor query modification can apply collectively to all queries for which it has been used. The output data for the power and throughput tests must be made available electronically upon request.

Appendix C contains the query text and query output.

3.5 Query Substitution Parameters and Seeds

All the query substitution parameters used during the performance test must be disclosed in tabular format, along with the seeds used to generate these parameters.

Appendix D contains the seed and query substitution parameters.

3.6 Query Isolation Level

The isolation level used to run the queries must be disclosed. If the isolation level does not map closely to one of the isolation levels defined in Clause 3.4, additional descriptive detail must be provided.

The queries and transactions were run with the isolation level “Level 1”.

3.7 Source Code of Refresh Functions

The details of how the refresh functions were implemented must be disclosed (including source code of any non-commercial program used).

Appendix E contains the source code for the refresh functions.

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4. CLAUSE 3: DATABASE SYSTEM PROPERTIES

4.1 Atomicity

The results of the ACID tests must be disclosed along with a description of how the ACID requirements were met. This includes disclosing the code written to implement the Acid transaction and Query.

4.1.1 Completed Transaction

Perform the Acid transaction for a randomly selected set of input data and verify that the appropriate rows have been changed in the ORDER, LINEITEM, and HISTORY tables.

1. The total price from the ORDER table and the extended price from the LINEITEM table were retrieved for a randomly selected order key.
2. The Acid transaction was performed using the order key from Step 1.
3. The Acid transaction was committed.
4. The total price from the ORDER table and the extended price from the LINEITEM table were retrieved for the same order key used in Step 1. It was verified that the appropriate rows had been inserted.

4.1.2 Aborted Transaction

Perform the Acid transaction for a randomly selected set of input data, substituting a ROLLBACK of the transaction for the COMMIT of the transaction. Verify that the appropriate rows have not been changed in the ORDER, LINEITEM, and HISTORY tables.

1. The total price from the ORDER table and the extended price from the LINEITEM table were retrieved for a randomly selected order key.
2. The Acid transaction was performed using the order key from Step 1. The transaction was stopped prior to the commit.
3. The Acid transaction was ROLLED BACK.
4. The total price from the ORDER table and the extended price from the LINEITEM table were retrieved for the same order key used in Step 1. It was verified that the appropriate rows had not been changed.

4.2 Consistency

Consistency is the property of the application that requires any execution of transactions to take the database from one consistent state to another.

A consistent state for the TPC-H database is defined to exist when :

O_TOTALPRICE = SUM(L_EXTENDEDPRICE – L_DISCOUNT) * (1 + L_TAX)
For each ORDER and LINEITEM defined by (O_ORDERKEY = L_ORDERKEY)

4.2.1 Consistency Test

Verify that ORDER and LINEITEM tables are initially consistent, submit the required number of Acid transactions with randomly selected input parameters, and re-verify the consistency of the ORDER and LINEITEM tables.

The consistency of the ORDER and LINEITEM tables was verified based on randomly selected values of the column O_ORDERKEY.

1. Acid queries were executed to verify the initial consistent state of the ORDER and LINEITEM tables.
2. More than 100 Acid transactions were submitted from each of 8 execution streams.
3. Acid queries were re-executed to verify the consistent state of the ORDER and LINEITEM tables after the Acid transaction streams.
4. The consistency of the ORDER and LINEITEM tables was re-verified.

To guarantee arithmetic function portability and consistency of results, the following expression was executed to verify the consistency between the ORDER and LINEITEM tables:

O_TOTALPRICE = SUM(ROUND((ROUND((L_EXTENDEDPRICE * (1 - L_DISCOUNT)),2,1) * (1 + L_TAX)),2,1))

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4.3 Isolation

Operations of concurrent transactions must yield results which are indistinguishable from the results which would be obtained by forcing each transaction to be serially executed to completion in some order.

4.3.1 Read-Write Conflict with Commit

Demonstrate isolation for the read-write conflict of a read-write transaction and a read-only transaction when the read-write transaction is committed.

1. An Acid transaction was started for a randomly selected O_KEY, L_KEY, and DELTA. The Acid transaction was suspended prior to COMMIT.

2. An ACID query was started for the same O_KEY used in Step 1. The ACID query completed and did not see the uncommitted changes made by the Acid transaction.

3. The Acid transaction was COMMITTED.

4.3.2 Read-Write Conflict with Rollback

Demonstrate isolation for the read-write conflict of a read-write transaction and a read-only transaction when the read-write transaction is rolled back.

1. An ACID transaction was started for a randomly selected O_KEY, L_KEY, and DELA. The ACID transaction was suspended prior to ROLLBACK.

2. An ACID query was started for the same O_KEY used in Step 1. The ACID query did not see the uncommitted changes made by the ACID transaction.

3. The ACID transaction was ROLLED BACK.

4. The ACID query completed.

4.3.3 Write-Write Conflict with Commit

Demonstrate isolation for the write-write conflict of two update transactions when the first transaction is committed.

1. An ACID transaction, T1, was started for a randomly selected O_KEY, L_KEY, and DELTA. The ACID transaction was suspended prior to COMMIT.

2. Another ACID transaction, T2, was started using the same O_KEY and L_KEY and a randomly selected DELTA.

3. T2 waited.

4. T1 was allowed to COMMIT and T2 completed.

5. It was verified that T2.L_EXTENDEDPRICE was calculated correctly.

   T2.L_EXTENDEDPRICE = T1.L_EXTENDEDPRICE +(DELTA1*(T1.L_EXTENDEDPRICE/T1.L_QUANTITY))

4.3.4 Write-Write Conflict with Rollback

Demonstrate isolation for the write-write conflict of two update transactions when the first transaction is rolled back.

1. An Acid transaction, T1, was started for a randomly selected O_KEY, L_KEY, and DELTA. The Acid transaction was suspended prior to ROLLBACK.

2. Another Acid transaction, T2, was started using the same O_KEY and L_KEY and a different randomly selected DELA.

3. T2 waited

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4. T1 was allowed to ROLLBACK and T2 completed

5. It was verified that T2.L_EXTENDEDPRICE = T1.L_EXTENDEDPRICE.

4.3.5 Concurrent Progress of Read and Write on Different Tables

Demonstrate the ability of read and write transactions affecting different database tables to make progress concurrently.

1. An ACID Transaction, T1, was started for a randomly selected O_KEY, L_KEY, and DELTA. T1 was suspended prior to COMMIT.

2. Another ACID transaction, T2 was started using random values for PS_PARTKEY and PS_SUPPKEY.

3. ACID Transaction T2 completed.

4. ACID transaction T1 completed and the appropriate rows in the ORDER, LINEITEM, and HISTORY tables were changed.

4.3.6 Updates not Indefinitely Delayed by Reads on Same Table

Demonstrate that the continuous submission of arbitrary (read-only) queries against one or more tables of the database does not indefinitely delay update transactions affecting those tables from making progress.

1. An ACID transaction, T1, was started, executing Q1 against the qualification database. The substitution parameter was chosen from the interval [0..2159] so that the query ran for a sufficient length of time.

2. Before T1 completed, an ACID transaction, T2, was started using randomly selected values of O_KEY, L_KEY and DELTA.

3. T2 completed before T1 completed. Verified that the appropriate rows in ORDER, LINEITEM and HISTORY tables have been changed.

4.4 Durability

The tested system must guarantee durability: the ability to preserve the effects of committed transactions and insure database consistency after recovery from any one of the failures listed in Clause 3.5.2

4.4.1 Failure of a Durable Medium and System Crash

Guarantee the database and committed updates are preserved across a permanent irrecoverable failure of any single durable medium containing TPC-H database tables or recovery log tables.

The database logs were placed on raid-10 volumes.

The tables for the database were stored on raw partitions. The partitions were placed on two drives of the same characteristics as the drives used for the test database, and the two drives were on two separate controllers.

1. The database was backed up to an alternate disk media.

2. Eight streams of ACID transactions were started.

3. After at least 100 transactions had occurred on each stream and the streams were still running, one of the raid-10 set of log disks was removed.

4. After it was determined that the test would still run with the loss of a log disk, a data disk was removed.

5. A checkpoint was issued to force a failure.

6. The eight streams of ACID transactions failed and recorded their numbers of committed transactions in success files.

7. The transaction log was backed up.

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8. Two new drives were used to replace the removed log and data disks.

9. The database was restored to their state prior to the ACID transaction streams.

10. After the database restore had finished, the backed up transaction log was applied.

11. The database ran through its recovery mode.

12. The counts in the success files and the HISTORY table count were compared and were found to match.

4.4.2 System Crash

Guarantee the database and committed updates are preserved across an instantaneous interruption (system crash/system hang) in processing which requires the system to reboot to recover.

The system crash and memory failure tests were combined.

1. Eight streams of ACID transactions were started.

2. After at least 100 transactions had occurred on each stream and the streams of ACID transactions were still running, the system was powered off.

3. When power was restored the system rebooted and the database was restarted.

4. The database went through a recovery period.

5. The success file and the HISTORY table counts were compared and found to match.

4.4.3 Memory Failure

Guarantee the database and committed updates are preserved across failure of all or part of memory (loss of contents).

The system crash and memory failure tests were combined. See the previous section.

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5. CLAUSE 4: SCALING AND DATABASE POPULATION

5.1 Cardinality of Tables

The cardinality (e.g., the number of rows) of each table of the test database, as it existed at the completion of the database load (see Clause 4.2.5), must be disclosed.

TABLE	# of ROWS
Orders	1,500,000,000
Lineitem	5,999,989,709
Customer	150,000,000
Parts	200,000,000
Supplier	10,000,000
Partsupp	800,000,000
Nation	25
Region	5

5.2 Distribution of Tables and Logs Across Media

The distribution of tables and logs across all media must be explicitly described using a format similar to that shown in the following example for both the tested and priced systems.

The SUT composed of 160 external drives and 5 internal drives.

- 160 physical/logical drives for the 1000GB database.
- Data and Load file groups, consisting of 160 logical single volumes each, mounted as junction points. Tempdb group, consisting of 160 logical single volumes, mounted as junction points.
- 32 logical drives (160 physical) used for the backup devices of the 1000GB database, formatted as RAID5. The database backup files were stored on the different external drives from the database.
- The Tpch1t log was placed on 1 logical drive, 105GB total, formatted as Raid 1E with 3 internal 73GB drives.
- The operating system, Microsoft Windows Server 2003, Enterprise Edition, and Microsoft SQL Server 2005 Enterprise Edition 64-bit, were installed on the 73GB internal drive formatted as NTFS.
- 1 physical internal 73GB drive formatted as NTFS was used for the operating system page file and Tempdb log.
- The 2 physical internal drives were also used for mount/junction points.

A detailed description of distribution of database filegroups and log can be found in Table 5.2.1

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Table 5.2.1: Logical Drive Mapping

Disk Partition Description					
Cntrlr	**# Drives**	**Data_FG**	**Tempdb**	**Load_FG & backupdb***	**Update files****
1	32 (36GB)	13.57GB/drive	6.15GB/drive	13.44GB/drive	1GB/drive
2	32 (36GB)	13.57GB/drive	6.15GB/drive	13.44GB/drive	1GB/drive
3	32 (36GB)	13.57GB/drive	6.15GB/drive	13.44GB/drive	1GB/drive
(internal port)	3 (73GB)	Formatted as RAID 1E for tpchlog			
4	32 (36GB)	13.57GB/drive	6.15GB/drive	13.44GB/drive	1GB/drive
5	32 (36GB)	13.57GB/drive	6.15GB/drive	13.44GB/drive	1GB/drive
Internal Controller	1 (73GB)	Operating System, Database Manager			
	1 (73GB)	mount/junction points, Page File, Tempdb log			
Total	165	Total physical drives			

(*) 32 logical RAID5 drives (over 5 physical drives each) used for file group Load_FG and backup devices.

(**) 1 logical striped drive (over 30 physical drives) used for update files data.

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5.3 Partitions/Replications Mapping

The mapping of data base partitions/replications must be explicitly described.

Comment: *The intent is to provide sufficient detail about partitioning and replication to allow independent reconstruction of the test database.*

Database partitioning and replication were not used.

5.4 Use of RAID

Implementations may use some form of RAID. The RAID level used must be disclosed for each device.

No hardware RAID was used in the implementation, except for the log file for the qualification and test databases stored on a drive which was RAID1E.

5.5 DBGEN Modifications

The version number, release number, modification number, and patch level of DBGEN must be disclosed. Any modifications to the DBGEN source code must be disclosed. In the event that a program other than DBGEN was used to populate the database, it must be disclosed in its entirety.

The supplied DBGEN 2.6.0 was used for populating the database.

5.6 Database Load Time

The database load time for the test database (see Clause 4.3) must be disclosed.

The Numerical Quantities summary (p. 5) contains the database load time, which was 27:58:04.

5.7 Data Storage Ratio

The data storage ratio must be disclosed. It is computed by dividing the total data storage of the priced configuration (expressed in GB) by the size chosen for the test database. The ratio must be reported to the nearest 1/100th, rounded up. For example, a system configured with 96 disks of 2.1 GB capacity for a 100GB test database has a data storage ratio of 2. 02.

Comment: *For the reporting of configured disk capacity, gigabyte (GB) is defined to be 2^30 bytes. Since disk manufacturers typically report disk size using base ten (i.e., GB = 10^9), it may be necessary to convert the advertised size from base ten to base two.*

The Numerical Quantities summary (p. 5) contains the data storage ratio (5.71) for the system used.

5.8 Database Loading

The details of the database load must be disclosed, including a block diagram illustrating the overall process. Disclosure of the load procedure includes all steps, scripts, input and configuration files required to completely reproduce the test and qualification databases.

The following steps were used to load the database:

1) DBGEN version 2.6.0 was used to create flat files.
2) SQL Server 2005 was used to define the database, to define tables, and to load the tables via a “bulk insert” command.
3) Rows were inserted into the database by running 64 concurrent threads, each of which performed a “bulk insert” operation that loaded one sixty-four of each of the LINEITEM, ORDERS, PART, PARTSUPP, SUPPLIER and CUSTOMER tables. The NATION and REGION tables were loaded sequentially, each by a single thread.
4) Indexes and constraints were created using SQL Server 2005.
5) Statistics were created using SQL Server 2005.
6) Date correlation optimization was set using SQL Server 2005.
7) Refresh functions were installed using SQL Server 2005.
8) A database backup was performed to 32 logical devices.

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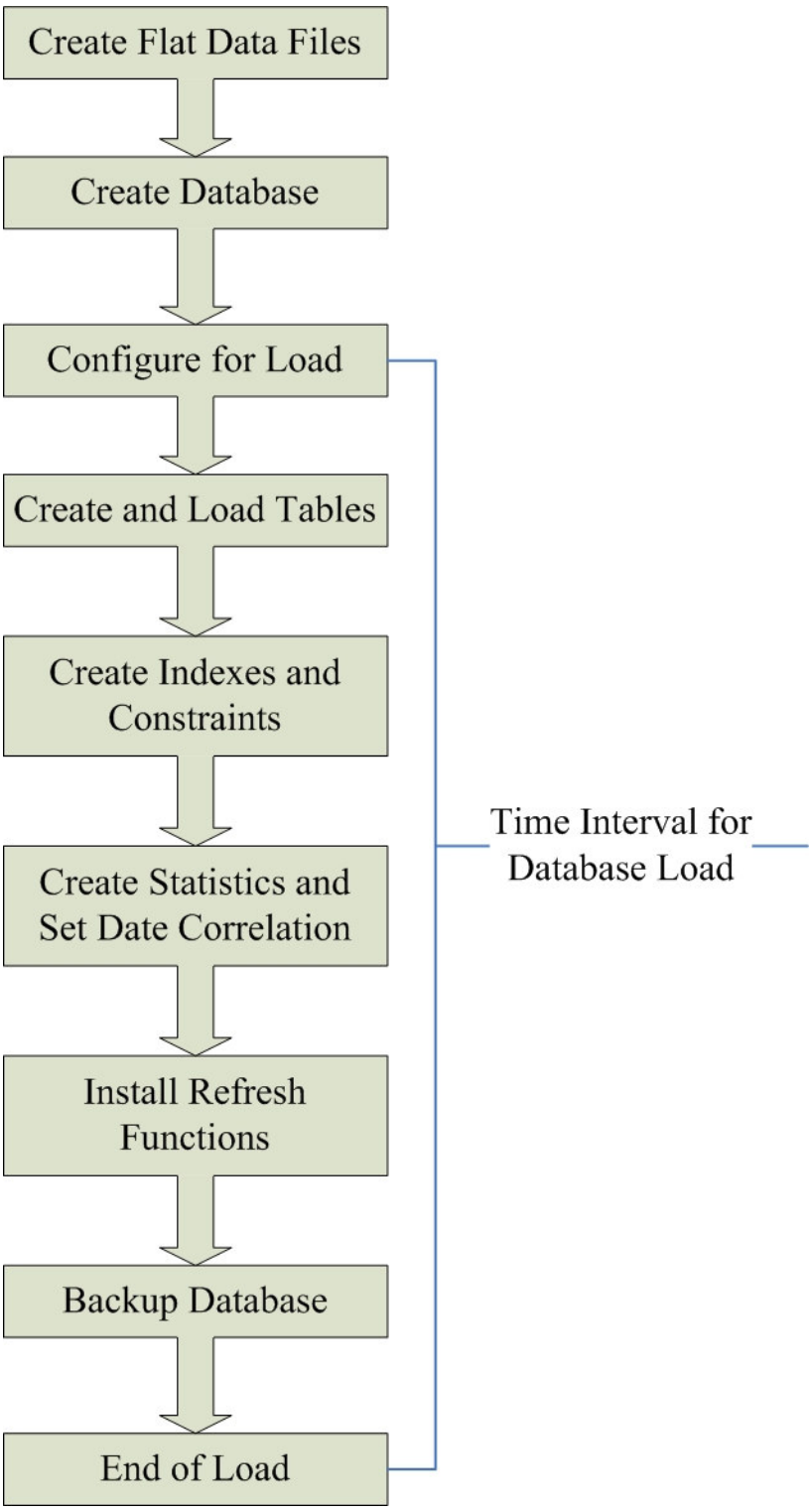

Diagram of Database Load Process

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5.9 Qualification Database Configuration

Any differences between the configuration of the qualification database and the test database must be disclosed.

The qualification database was created using scripts identical to those of the test database, except for variances due to the sizes of the two databases.

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6. CLAUSE 5: PERFORMANCE METRICS AND EXECUTION RULES

6.1 System Activity Between Load and Performance Tests

Any system activity on the SUT which takes place between the conclusion of the load test and the beginning of the performance test must be fully disclosed including listings of scripts or command logs.

Auditor requested queries were run against the database to verify the completeness and correctness of the database load.

6.2 Power Test Implementation

The details of the steps followed to implement the power test (e.g., system boot, database restart, etc.) must be disclosed.

The following steps were followed to run the power test.

1. SQL Server 2005 was started.
2. RF1 refresh transactions were run
3. Stream 00 execution was run
4. RF2 refresh transactions were run.

6.3 Timing Intervals and Reporting

The timing intervals for each query and for both refresh functions must be reported for the power test.

This information is contained in the Numerical Quantities Summary page in the Executive Summary at the beginning of this report. For convenience, it is repeated in Section 6.10.

6.4 Number of Streams in the Throughput Test

The number of query streams used for the throughput test must be disclosed.

Seven streams were run for the throughput test

6.6 Start and End Date/Time for each Query

The start time and finish time for each query stream must be reported for the throughput test.

This information is contained in the Numerical Quantities Summary page in the Executive Summary at the beginning of this report. For convenience, it is repeated in Section 6.10.

6.6 Total Elapsed Time for the Measurement Interval

The total elapsed time of the measurement interval must be reported for the throughput test.

This information is contained in the Numerical Quantities Summary page in the Executive Summary at the beginning of this report. For convenience, it is repeated in Section 6.10.

6.7 Refresh Function Start Date/Time and Finish Date/Time

The start time and finish time for each refresh function in the refresh stream must be reported for the throughput test.

This information is contained in the Numerical Quantities Summary page in the Executive Summary at the beginning of this report.

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6.8 Timing Intervals for Each Query and Each Refresh Function for Each Stream

The timing intervals for each query of each stream and for each refresh function must be reported for the throughput test.

This information is contained in the Numerical Quantities Summary page in the Executive Summary at the beginning of this report. For convenience, it is repeated in Section 6.10.

6.9 Performance Metrics

The computed performance metric, related numerical quantities and the price performance metric must be reported.

This information is contained in the Numerical Quantities Summary page in the Executive Summary at the beginning of this report.

6.10 The Performance Metric and Numerical Quantities from Both Runs

*The performance metric (QphH) and the numerical quantities (TPC-*H Power@Size and *TPC-H Throughput@Size) from both of the runs must be disclosed.*

Performance results from the first two executions of the TPC-H benchmark indicated the following difference for the metric points:

	QppH@1000GB	QthH@1000GB	QphH@1000GB
Run 1	17317.8	8606.8	12208.6
Run 2	17195.2	8496.9	12087.4
% Difference	-0.7%	-1.3%	-1.0%

(Run 2 was reported.)

6.11 System Activity Between Tests

Any activity on the SUT that takes place between the conclusion of Run1 and the beginning of Run2 must be fully disclosed including listings of scripts or command logs along with any system reboots or database restarts.

The first attempt of run two failed due to a power failure which lead to an unexpected system shutdown. The system was rebooted, SQL Server was restarted and the database recovered before the next attempt was made.

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7. CLAUSE 6: SUT AND DRIVER IMPLEMENTATION RELATED ITEMS

7.1 Driver

A detailed textual description of how the driver performs its functions, how its various components interact and any product functionalities or environmental setting on which it relies must be provided. All related source code, scripts and configuration files must be disclosed. The information provided should be sufficient for an independent reconstruction of the driver.

The TPC-H benchmark was implemented using a Microsoft internal tool called StepMaster. StepMaster is a general purpose test harness which can drive ODBC and shell commands. Within StepMaster, the user designs a workspace corresponding to the sequence of operations (or steps) to be executed. When the workspace is executed, StepMaster records information about the run into a database for post-processing.

StepMaster provides a mechanism for creating parallel streams of execution. This is used in the throughput tests to drive the query and refresh streams.

Each step is timed using a millisecond resolution timer. A timestamp T1 is taken before beginning the operation and a timestamp T2 is taken after completing the operation. These times are recorded in a database for post-processing.

Two types of ODBC connections are supported: static and dynamic. A dynamic connection is used to execute a single operation and is closed when the operation finishes. A static connection is held open until the run completes and may be used to execute more than one step. A connection (either static or dynamic) can only have one outstanding operation at any time.

In TPC-H, static connections are used for the query streams in the power and throughput tests.

StepMaster reads an Access database to determine the sequence of steps to execute. These commands are represented as the Implementation Specific Layer. StepMaster records its execution history, including all timings, in the Access database. Additionally, StepMaster writes a textual log file of execution for each run.

SQL Server operations executed from StepMaster do not gain any performance advantage compared to osql, the command prompt utility for ad hoc, interactive execution of Transact-SQL statements and scripts. Rather, StepMaster simplifies the task of benchmark execution, event timing, and reporting. This was confirmed during the audit.

7.2 Implementation-Specific Layer (ISL)

If an implementation specific layer is used, then a detailed description of how it performs its functions, how its various components interact and any product functionalities or environmental setting on which it relies must be provided. All related source code, scripts and configuration files must be disclosed. The information provided should be sufficient for an independent reconstruction of the implementation specific layer.

StepMaster program is used to control and track the execution of queries, via commands stored in an external Microsoft Access database. The source of this program is contained in Appendix E. The following steps are performed, to accomplish the Power and Throughput Runs:

1. Power Run

Execute 48 concurrent RF 1 threads, each of which will apply a segment of a refresh set generated by dbgen. Each thread submits multiple transactions, where a transaction spans a set of orders and their associated line items.

- Execute the Stream 0 queries, in the prescribed order.
- Execute 48 concurrent RF2 threads, each of which will apply a segment of a refresh set generated by dbgen. Each thread submits multiple transactions, where a transaction spans a set of orders and their associated line items.

2. Throughput Run

- Execute seven concurrent query streams. Each stream executes queries in the prescribed order for the appropriate Stream Id (01-07). Upon completion of each stream, a semaphore is set to indication completion.
- Execute seven consecutive RF1/RF2 transactions, against ascending Refresh sets produced by dbgen. The first RF1 waits on a semaphore prior to beginning its insert operations.

Each step is timed by StepMaster. The timing information, together with an activity log, is stored for later analysis. The inputs and results of steps are stored in text files for later analysis.

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7.3 Profile-Directed Optimization

If profile-directed optimization as described in Clause 5.2.9 is used, such use must be disclosed. In particular, the procedure and any scripts used to perform the optimization must be disclosed.

Profile-directed optimization was not used in the benchmark.

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8. CLAUSE 7: PRICING RELATED ITEMS

8.1 Hardware and Software Used

A detailed list of hardware and software used in the priced system must be reported. Each item must have a vendor part number, description, and release/revision level, and indicate General Availability status or committed delivery date. If package pricing is used, contents of the package must be disclosed. Pricing source(s) and effective date(s) of price(s) must also be reported.

The components (hardware and software) and the maintenances supplied by Bull are discounted by 27% from list price, only for similar quantities and configuration and in case of a prepay cash. The detailed list of all hardware and software for the priced configuration is provided in Executive Summary at the front of this report.

8.2 Three-Year Cost of System Configuration

The total 3-year price of the entire configuration must be reported, including: hardware, software, and maintenance charges. Separate component pricing is required.

The three years support pricing for Bull S.A.S. consists of one year warranty (two years for disks) included in the system package price and two years support price, defined as full care in the "GlobalCare" Bull maintenance offer.

This offer is presented in three levels of service: Bronze, Silver and Gold. The customer may opt, according to their requirements, for the level of their choice. The level of service chosen must be the same for all of the products of the configuration.

Contents of the Gold service:

The Gold service offers a high quality of service, permanent prevention and accelerated response time. It is composed of the following services:

Hardware maintenance

- The reception of 'break-down' calls 24hrs 7/7 through a number allocated by Bull or upon the automatic telephone server or being recorded on the web.
- Telephone product assistance from 8 AM to 8 PM (*) Monday to Friday except bank holidays.
- The customer is called back by an expert within 1 hour of the call being received, not included during the intervention stages.
- Remote maintenance and remote diagnostics of the system (*)
- System controlled remotely (*)
- Access to technical product data via the web.
- Breakdown intervention carried out during working days, between 8 AM and 8 PM Monday to Friday with a delay inferior to 2 hours for a subsystem stops, or inferior to 4 hours for a partly non-functioning system. This consists of the on-site repair and replacement if necessary of parts or faulty equipment broken due to ordinary usage, by new or equivalent parts or equipment. Carrying out these interventions is included in the price of the service.
- The correction of faulty products is carried out within 8 hours of receiving the initial call from the customer.
- The creation and implementation of hardware technical status applicable to Bull customers.

In choosing the Gold level of service, the equivalent level of software support is chosen automatically.

Other extended coverage options are available

(*)The 'Alarm' (Autocalls) service authorizes warning messages to be sent by the server to a Bull remote maintenance center. These alarms can be received 24h 7/7, but the reaction depends wholly upon the contractual service cover period. This means that if action is necessary following an alarm, action will only be taken during the periods stated in the maintenance contract. It is mandatory to have the material necessary to alarming and remote maintenance to benefit this functionality.

The Gold Service is chosen for the system configuration. The pricing summary sheet on page 4 in the front of this report contains all details.

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8.3 Availability Dates

The committed delivery date for general availability (availability date) of products used in the priced calculations must be reported. When the priced system includes products with different availability dates, the single availability date reported on the first page of the executive summary must be the date by which all components are committed to being available. The full disclosure report must report availability dates individually for at least each of the categories for which a pricing subtotal must be provided (see Clause 7.3.1.4). All availability dates, whether for individual components or for the SUT as a whole, must be disclosed to a precision of 1 day, but the precise format is left to the test sponsor.

Summary by category from the measured and priced configuration:

Category		**Available**
Server Hardware		Now (date of publication)
Storage Hardware		Now (date of publication)
Server Software	SQL Server 2005	Now (date of publication)
	Others	Now (date of publication)

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9. CLAUSE 8: AUDIT RELATED ITEMS

The auditor's agency name, address, phone number, and Attestation letter with a brief audit summary report indicating compliance must be included in the full disclosure report. A statement should be included specifying who to contact in order to obtain further information regarding the audit process.

The next page contains the complete independent auditor's report by François RAAB of Info Sizing Inc. for the test described in this report.

Request for this TPC Benchmark™ H Full Disclosure Report should be sent to:

Transaction Processing Performance Council
Presidio of San Francisco
Building 572B (surface)
P.O.Box 29920 (mail) San Francisco, CA 94129-0920
Voice: 415-561-6272
Fax: 415-561-6120
Email: info@tpc.org

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INFO SIZING

TPC TRANSACTION PROCESSING PERFORMANCE COUNCIL CERTIFIED AUDITOR

Benchmark Sponsors: Francy Jourdan
Bull S.A.S.
Windows Benchmark and Certif. Ctr.
Rue Jean Jaures
B.P.68
78340 Les Clayes-sous-Bois

February 27, 2007

I verified the TPC Benchmark™ H performance of the following configuration:

Platform: **Bull Novascale 3045**

Database Manager: **Microsoft SQL Server 2005 Enterprise IA64 Edition SP1**

Operating System: **Microsoft Windows Server 2003 Enterprise IA64 Edition SP1**

The results were:

CPU (Speed)	Memory	Disks	**QphH@1000GB**
Bull Novascale 3045			
4 x Intel Itanium2 Dual-Core 9040 (1.6 GHz)	64 GB Main (9 MB L3/core)	160 x 73 GB 15Krpm 5 x 73 GB 15Krpm	**12,087.4**

In my opinion, this performance result was produced in compliance with the TPC's requirements for the benchmark. The following verification items were given special attention:

- The database records were defined with the proper layout and size
- The database population was generated using DBGEN
- The database was properly scaled to 1,000GB and populated accordingly
- The compliance of the database auxiliary data structures was verified
- The database load time was correctly measured and reported

- The required ACID properties were verified and met
- The query input variables were generated by QGEN
- The query text was produced using minor modifications and no query variant
- The execution of the queries against the SF1 database produced compliant answers
- A compliant implementation specific layer was used to drive the tests
- The throughput tests involved 7 query streams
- The ratio between the longest and the shortest query was such that no query timing was adjusted
- The execution times for queries and refresh functions were correctly measured and reported
- The repeatability of the measured results was verified
- The required amount of database log was configured
- The system pricing was verified for major components and maintenance
- The major pages from the FDR were verified for accuracy

Additional Audit Notes:

None.

Respectfully Yours,

François Raab
President

APPENDIX A: SYSTEM AND DATABASE TUNABLE PARAMETERS

Software levels:

Microsoft(R) Windows(R) Server 2003, Enterprise Edition for 64-Bit Itanium-based Systems
Microsoft SQL Server 2005 Enterprise Edition 64-bit 9.00.2047.00

System Information:

OS Name Microsoft(R) Windows(R) Server 2003, Enterprise Edition for 64-Bit Itanium-based Systems
Version 5.2.3790 Service Pack 1 Build 3790
Other OS Description Not Available
OS Manufacturer Microsoft Corporation
System Name TPCH-LYNX
System Manufacturer HITACHI
System Model
System Type

System Model	Cold Fusion-3e 4S4U	
System Type	Itanium (TM) -based System	
Processor	ia64	Family 32 Model 0 Stepping 5 GenuineIntel ~1598 Mhz
Processor	ia64	Family 32 Model 0 Stepping 5 GenuineIntel ~1598 Mhz
Processor	ia64	Family 32 Model 0 Stepping 5 GenuineIntel ~1598 Mhz
Processor	ia64	Family 32 Model 0 Stepping 5 GenuineIntel ~1598 Mhz
Processor	ia64	Family 32 Model 0 Stepping 5 GenuineIntel ~1598 Mhz
Processor	ia64	Family 32 Model 0 Stepping 5 GenuineIntel ~1598 Mhz
Processor	ia64	Family 32 Model 0 Stepping 5 GenuineIntel ~1598 Mhz
Processor	ia64	Family 32 Model 0 Stepping 5 GenuineIntel ~1598 Mhz
Processor	ia64	Family 32 Model 0 Stepping 5 GenuineIntel ~1598 Mhz
Processor	ia64	Family 32 Model 0 Stepping 5 GenuineIntel ~1598 Mhz
Processor	ia64	Family 32 Model 0 Stepping 5 GenuineIntel ~1598 Mhz
Processor	ia64	Family 32 Model 0 Stepping 5 GenuineIntel ~1598 Mhz
Processor	ia64	Family 32 Model 0 Stepping 5 GenuineIntel ~1598 Mhz
Processor	ia64	Family 32 Model 0 Stepping 5 GenuineIntel ~1598 Mhz
Processor	ia64	Family 32 Model 0 Stepping 5 GenuineIntel ~1598 Mhz

BIOS Version/Date	HITACHI 03-18, 12/18/2006
SMBIOS Version	2.4
Windows Directory	C:\WINDOWS
System Directory	C:\WINDOWS\system32
Boot Device	\Device\HarddiskVolume1
Locale	United States
Hardware Abstraction Layer	Version = "5.2.3790.1830 (srv03_sp1_rtm.050324-1447)"
User Name	Not Available
Time ZoneRomance	Standard Time
Total Physical Memory	65,393.08 MB
Available Physical Memory	62.49 GB
Total Virtual Memory	67.06 GB
Available Virtual Memory	66.48 GB
Page File Space	4.00 GB
Page File	C:\pagefile.sys

Microsoft SQL Server 2005 Version

2007-02-12 13:44:17.51 Server Microsoft SQL Server 2005 - 9.00.2047.00 (Intel IA-64)
Apr 14 2006 01:23:10
Copyright (c) 1988-2005 Microsoft Corporation
Enterprise Edition (64-bit) on Windows NT 5.2 (Build 3790: Service Pack 1)

SQL Server 2005 Installation

Microsoft SQL Server 2005 was installed on the SUT. All default options were selected during the install except:

• Database Server Enterprise Edition was installed.
• “Custom installation” was selected. The SQL Server Development tools were not installed.

• Binary order, for use with the Latin1_General character set was used.
• Services Accounts > Customized > SQL Server > Use Local System Account > Authentication Mode > Mixed > Blank Password.

SQL Server 2005 Startup Parameters

SQLSERVR –c –x -E –T834 –T2301

Where:

-c	Start SQL Server independently of the Windows Service Control Manager
-x	Disable the keeping of CPU time and cache-hit ratio statistics
-E	Increase the number of consecutive extents allocated per file
-T834	On systems with 8GB or more, this trace flag causes the buffer pool to use large pages. These are allocated at startup and are kept throughout the lifetime of the process. This trace flag can only be set on 64-bit installations of SQL Server
-T2301	Trace flag to enable more accurate query run-time behavior modeling in the SQL Server query optimizer, typically only needed for large data set decision support processing

SQL Server 2005 Parameter Settings:

name	minimum	maximum	config_value	run_value
Ad Hoc Distributed Queries	0	1	0	0
affinity I/O mask	-2147483648	2147483647	0	0
affinity mask	-2147483648	2147483647	65535	65535
affinity64 I/O mask	-2147483648	2147483647	0	0
affinity64 mask	-2147483648	2147483647	0	0
Agent XPs	0	1	0	0
allow updates	0	1	1	1
awe enabled	0	1	0	0
blocked process threshold	0	86400	0	0
c2 audit mode	0	1	0	0
clr enabled	0	1	0	0
cost threshold for parallelism	0	32767	0	0
cross db ownership chaining	0	1	0	0
cursor threshold	-1	2147483647	-1	-1
Database Mail XPs	0	1	0	0
default full-text language	0	2147483647	1033	1033
default language	0	9999	0	0
default trace enabled	0	1	1	1
disallow results from triggers	0	1	0	0
fill factor (%)	0	100	0	0
ft crawl bandwidth (max)	0	32767	100	100
ft crawl bandwidth (min)	0	32767	0	0
ft notify bandwidth (max)	0	32767	100	100
ft notify bandwidth (min)	0	32767	0	0
in-doubt xact resolution	0	2	0	0
index create memory (KB)	704	2147483647	0	0
lightweight pooling	0	1	1	1
locks	5000	2147483647	0	0
max degree of parallelism	0	64	16	16
max full-text crawl range	0	256	4	4
max server memory (MB)	16	2147483647	62000	62000
max text repl size (B)	0	2147483647	65536	65536
max worker threads	128	32767	0	0
media retention	0	365	0	0
min memory per query (KB)	512	2147483647	512	512
min server memory (MB)	0	2147483647	60000	60000
nested triggers	0	1	1	1
network packet size (B)	512	32767	32767	32767
Ole Automation Procedures	0	1	0	0
open objects	0	2147483647	0	0
PH timeout (s)	1	3600	60	60
precompute rank	0	1	0	0
priority boost	0	1	0	0

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query governor cost limit	0	2147483647	0	0
query wait (s)	-1	2147483647	2147483647	2147483647
recovery interval (min)	0	32767	32767	32767
remote access	0	1	1	1
remote admin connections	0	1	0	0
remote login timeout (s)	0	2147483647	20	20
remote proc trans	0	1	0	0
remote query timeout (s)	0	2147483647	600	600
Replication XPs	0	1	0	0
scan for startup procs	0	1	0	0
server trigger recursion	0	1	1	1
set working set size	0	1	0	0
show advanced options	0	1	1	1
SMO and DMO XPs	0	1	1	1
SQL Mail XPs	0	1	0	0
transform noise words	0	1	0	0
two digit year cutoff	1753	9999	2049	2049
user connections	0	32767	0	0
user options	0	32767	0	0
Web Assistant Procedures	0	1	0	0
xp_cmdshell	0	1	0	0

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APPENDIX B: DATABASE, TABLES, AND INDEXES CREATION

Create Database

```
-- CreateDatabase
-- for use with StepMaster
-- Uses FileGroups
--
--      Drop the existing database
--

if exists (select name from sysdatabases where name = '%DBNAME%')
        drop database %DBNAME%

CREATE DATABASE %DBNAME%
ON PRIMARY
(       NAME            = %DBNAME%_root,
        FILENAME        = "C:\%DBNAME%_root.mdf",
        SIZE            = 37MB,
        FILEGROWTH      = 0)
LOG ON
(       NAME            = %DBNAME%_log,
        FILENAME        = "L:",
        SIZE            = 104000MB,
        FILEGROWTH      = 0)

ALTER DATABASE %DBNAME%
ADD FILEGROUP   DATA_FG

ALTER DATABASE %DBNAME%
ADD FILEGROUP   LOAD_FG

ALTER DATABASE %DBNAME%
ADD FILE
(       NAME            = %DBNAME%_da_0,
        FILENAME        = "C:\MSSQL\tpch1t\data0\",
        SIZE            = 13900MB,
        FILEGROWTH      = 0),
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TO FILEGROUP    DATA_FG


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        FILEGROWTH      = 0),
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```
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TO FILEGROUP    LOAD_FG
```

Create Tables

```
-- File:    CREATETABLES.SQL
--          Microsoft TPC-H Benchmark Kit Ver. 1.00
--          Copyright Microsoft, 1999
--

create table PART
        (P_PARTKEY      int             not null,
         P_NAME         varchar(55)     not null,
         P_MFGR         char(25)        not null,
         P_BRAND        char(10)        not null,
         P_TYPE         varchar(25)     not null,
         P_SIZE         int             not null,
         P_CONTAINER    char(10)        not null,
         P_RETAILPRICE  float           not null,
         P_COMMENT      varchar(23)     not null)
on LOAD_FG

create table SUPPLIER
        (S_SUPPKEY      int             not null,
         S_NAME         char(25)        not null,
         S_ADDRESS      varchar(40)     not null,
         S_NATIONKEY    int             not null,
         S_PHONE        char(15)        not null,
         S_ACCTBAL      float           not null,
         S_COMMENT      varchar(101)    not null)
on LOAD_FG

create table PARTSUPP
        (PS_PARTKEY     int             not null,
         PS_SUPPKEY     int             not null,
         PS_AVAILQTY    int             not null,
         PS_SUPPLYCOST  float           not null,
         PS_COMMENT     varchar(199)    not null)
on LOAD_FG

create table CUSTOMER
        (C_CUSTKEY      int             not null,
         C_NAME         varchar(25)     not null,
         C_ADDRESS      varchar(40)     not null,
         C_NATIONKEY    int             not null,
         C_PHONE        char(15)        not null,
         C_ACCTBAL      float           not null,
         C_MKTSEGMENT   char(10)        not null,
         C_COMMENT      varchar(117)    not null)
on LOAD_FG

create table ORDERS
        (O_ORDERKEY     bigint          not null,
         O_CUSTKEY      int             not null,
         O_ORDERSTATUS  char(1)         not null,
         O_TOTALPRICE   float           not null,
         O_ORDERDATE    datetime        not null,
         O_ORDERPRIORITY char(15)       not null,
         O_CLERK        char(15)        not null,
         O_SHIPPRIORITY int             not null,
         O_COMMENT      varchar(79)     not null)
on LOAD_FG

create table LINEITEM
        (L_ORDERKEY     bigint          not null,
         L_PARTKEY      int             not null,
         L_SUPPKEY      int             not null,
         L_LINENUMBER   int             not null,
         L_QUANTITY     float           not null,
         L_EXTENDEDPRICE float          not null,
         L_DISCOUNT     float           not null,
         L_TAX          float           not null,
         L_RETURNFLAG   char(1)         not null,
         L_LINESTATUS   char(1)         not null,
         L_SHIPDATE     datetime        not null,
         L_COMMITDATE   datetime        not null,
         L_RECEIPTDATE  datetime        not null,
         L_SHIPINSTRUCT char(25)        not null,
         L_SHIPMODE     char(10)        not null,
         L_COMMENT      varchar(44)     not null)
on LOAD_FG

create table NATION
        (N_NATIONKEY    int             not null,
         N_NAME         char(25)        not null,
         N_REGIONKEY    int             not null,
         N_COMMENT      varchar(152)    not null)
on LOAD_FG

create table REGION
        (R_REGIONKEY    int             not null,
         R_NAME         char(25)        not null,
         R_COMMENT      varchar(152)    not null)
on LOAD_FG
```

Create Indexes

```
-- File:    CREATECLUSTEREDINDEXES.SQL
--          Microsoft TPC-H Benchmark Kit Ver. 1.00
--          Copyright Microsoft, 1999
--

 alter table NATION add constraint PK_N_NATIONKEY primary key
(N_NATIONKEY)
 ON DATA_FG

 alter table REGION add constraint PK_R_REGIONKEY primary key
(R_REGIONKEY)  ON DATA_FG

 create index N_REGIONKEY_IDX
      on NATION(N_REGIONKEY)
      with fillfactor=100, SORT_IN_TEMPDB
      on DATA_FG

 alter table PART add constraint PK_P_PARTKEY primary key
(P_PARTKEY)  ON DATA_FG

 alter table SUPPLIER add constraint PK_S_SUPPKEY primary key
(S_SUPPKEY)
 ON DATA_FG

 create index S_NATIONKEY_IDX
          on SUPPLIER(S_NATIONKEY)
          with fillfactor=100, SORT_IN_TEMPDB
          on DATA_FG

 alter table CUSTOMER add constraint PK_C_CUSTKEY primary key
(C_CUSTKEY)  ON DATA_FG

 alter table PARTSUPP add constraint
PK_PS_PARTKEY_PS_SUPPKEY primary key (PS_PARTKEY,
PS_SUPPKEY)  ON DATA_FG

 create clustered index O_ORDERDATE_CLUIDX
          on ORDERS(O_ORDERDATE)
          with FILLFACTOR=95,SORT_IN_TEMPDB
          on DATA_FG

 alter table ORDERS add constraint PK_O_ORDERKEY primary key
(O_ORDERKEY)
 WITH (FILLFACTOR = 95)
 ON DATA_FG
```

```
-- File:    CREATEINDEXESSTREAM2.SQL
--          Microsoft TPC-H Benchmark Kit Ver. 1.00
--          Copyright Microsoft, 1999
--


create index PS_SUPPKEY_IDX
      on PARTSUPP(PS_SUPPKEY)
      with fillfactor=100, SORT_IN_TEMPDB
      on DATA_FG

create clustered index L_SHIPDATE_CLUIDX
            on LINEITEM(L_SHIPDATE)
            with FILLFACTOR=95,SORT_IN_TEMPDB
            on DATA_FG

create index L_ORDERKEY_IDX
            on LINEITEM(L_ORDERKEY)
            with FILLFACTOR=95,SORT_IN_TEMPDB
            on DATA_FG

create index L_PARTKEY_IDX
            on LINEITEM(L_PARTKEY)
            with FILLFACTOR=95,SORT_IN_TEMPDB
            on DATA_FG

-- File:    CREATEINDEXESSTREAM2.SQL
--          Microsoft TPC-H Benchmark Kit Ver. 1.00
--          Copyright Microsoft, 1999
--

create index PS_SUPPKEY_IDX
      on PARTSUPP(PS_SUPPKEY)
      with fillfactor=100, SORT_IN_TEMPDB
      on DATA_FG

create clustered index L_SHIPDATE_CLUIDX
            on LINEITEM(L_SHIPDATE)
            with FILLFACTOR=95,SORT_IN_TEMPDB
            on DATA_FG

create index L_ORDERKEY_IDX
            on LINEITEM(L_ORDERKEY)
            with FILLFACTOR=95,SORT_IN_TEMPDB
            on DATA_FG

create index L_PARTKEY_IDX
            on LINEITEM(L_PARTKEY)
            with FILLFACTOR=95,SORT_IN_TEMPDB
            on DATA_FG

-- File:    CREATEFK.SQL
--          Microsoft TPC-H Benchmark Kit Ver. 1.00
--          Copyright Microsoft, 1999
--

-- create FK

alter table SUPPLIER add constraint FK_S_NATIONKEY foreign key
(S_NATIONKEY) references NATION(N_NATIONKEY)

alter table PARTSUPP add constraint FK_PS_PARTKEY foreign key
(PS_PARTKEY) references PART(P_PARTKEY)

alter table PARTSUPP add constraint FK_PS_SUPPKEY foreign key
(PS_SUPPKEY) references SUPPLIER(S_SUPPKEY)

alter table CUSTOMER add constraint FK_C_NATIONKEY foreign
key (C_NATIONKEY) references NATION (N_NATIONKEY)

alter table ORDERS add constraint FK_O_CUSTKEY foreign key
(O_CUSTKEY)  references CUSTOMER (C_CUSTKEY)

alter table NATION add constraint FK_N_REGIONKEY foreign key
(N_REGIONKEY)  references REGION (R_REGIONKEY)

alter table LINEITEM add constraint FK_L_ORDERKEY foreign key
(L_ORDERKEY)  references ORDERS (O_ORDERKEY)

alter table LINEITEM add constraint FK_L_PARTKEY foreign key
(L_PARTKEY)  references PART (P_PARTKEY)

alter table LINEITEM add constraint FK_L_SUPPKEY foreign key
(L_SUPPKEY)  references SUPPLIER (S_SUPPKEY)

alter table LINEITEM add constraint FK_L_PARTKEY_SUPPKEY
foreign key (L_PARTKEY,L_SUPPKEY) references
PARTSUPP(PS_PARTKEY, PS_SUPPKEY)
```

APPENDIX C: QUERY TEXT AND OUTPUT

```
-- using default substitutions

/* TPC_H  Query 1 - Pricing Summary Report */

SELECT   L_RETURNFLAG,
         L_LINESTATUS,
         SUM(L_QUANTITY)
                  AS SUM_QTY,
         SUM(L_EXTENDEDPRICE)
         AS SUM_BASE_PRICE,
         SUM(L_EXTENDEDPRICE*(1-L_DISCOUNT))
         AS SUM_DISC_PRICE,
         SUM(L_EXTENDEDPRICE*(1-
L_DISCOUNT)*(1+L_TAX))     AS SUM_CHARGE,
         AVG(L_QUANTITY)
                  AS AVG_QTY,
         AVG(L_EXTENDEDPRICE)
         AS AVG_PRICE,
         AVG(L_DISCOUNT)
         AS AVG_DISC,
         COUNT_BIG(*)
         AS COUNT_ORDER
FROM     LINEITEM
WHERE    L_SHIPDATE          <= dateadd(dd, -90, '1998-12-01')
GROUP    BY          L_RETURNFLAG,
                     L_LINESTATUS
ORDER    BY          L_RETURNFLAG,
                     L_LINESTATUS

L_RETURNFLAG L_LINESTATUS SUM_QTY
SUM_BASE_PRICE       SUM_DISC_PRICE       SUM_CHARGE
AVG_QTY              AVG_PRICE            AVG_DISC
COUNT_ORDER
------------ ------------ --------------------- --------------------- -------------------
--- --------------------- --------------------- --------------------- -------------------
--- -----------
A            F            37734107.0000        56586554400.7300
53758257134.8700     55909065224.7041     25.5220
38273.1297           .0499                1478493
N            F            991417.0000          1487504710.3800
1413082168.0541      1469649223.2395      25.5164
38284.4677           .0500                38854
N            O            74476040.0000        111701729697.7400
106118230307.6056    110367043876.2372    25.5022
38249.1179           .0499                2920374
R            F            37719753.0000        56568041380.9000
53741292684.6040     55889619121.7027     25.5057
38250.8546           .0500                1478870

(4 row(s) affected)

-- using default substitutions

/* TPC_H  Query 2 - Minimum Cost Supplier */

SELECT   TOP 100
         S_ACCTBAL,
         S_NAME,
         N_NAME,
         P_PARTKEY,
         P_MFGR,
         S_ADDRESS,
         S_PHONE,
         S_COMMENT
FROM     PART,
         SUPPLIER,
         PARTSUPP,
         NATION,
         REGION
WHERE    P_PARTKEY           = PS_PARTKEY AND
         S_SUPPKEY           = PS_SUPPKEY AND
         P_SIZE              = 15 AND
         P_TYPE              LIKE '%%BRASS' AND
         S_NATIONKEY         = N_NATIONKEY AND
         N_REGIONKEY         = R_REGIONKEY AND
         R_NAME              = 'EUROPE' AND
         PS_SUPPLYCOST       = (          SELECT
         MIN(PS_SUPPLYCOST)
                                          FROM     PARTSUPP,
                                                   SUPPLIER,
                                                   NATION,
                                                   REGION
                                          WHERE    P_PARTKEY
         = PS_PARTKEY AND
                                                   S_SUPPKEY
         = PS_SUPPKEY AND

         S_NATIONKEY         = N_NATIONKEY AND

         N_REGIONKEY         = R_REGIONKEY AND
                                                   R_NAME
         = 'EUROPE'
                                          )
ORDER    BY          S_ACCTBAL DESC,
                     N_NAME,
                     S_NAME,
                     P_PARTKEY

S_ACCTBAL            S_NAME               N_NAME
P_PARTKEY    P_MFGR                  S_ADDRESS
S_PHONE      S_COMMENT
--------------------- ------------------------- ------------------------- ----------- --
------------------------ ---------------------------------------- --------------- -------
-----------------------------------------------------------------------------------------
-------
9938.5300            Supplier#000005359       UNITED KINGDOM
185358       Manufacturer#4          QKuHYh,vZGiwu2FWEJoLDx04
33-429-790-6131 blithely silent pinto beans are furiously. slyly final
deposits acros
9937.8400            Supplier#000005969       ROMANIA
108438       Manufacturer#1
ANDENSOSmk,miq23Xfb5RWt6dvUcvt6Qa       29-520-692-3537
carefully slow deposits use furiously. slyly ironic platelets above the
ironic
9936.2200            Supplier#000005250       UNITED KINGDOM
249          Manufacturer#4          B3rqp0xbSEim4Mpy2RH J
33-320-228-2957 blithely special packages are. stealthily express
deposits across the closely final instructi
9923.7700            Supplier#000002324       GERMANY
29821        Manufacturer#4          y3OD9UywSTOk
17-779-299-1839 quickly express packages breach quiet pinto beans.
requ
9871.2200            Supplier#000006373       GERMANY
43868        Manufacturer#5          J8fcXWsTqM                    17-
813-485-8637 never silent deposits integrate furiously blit
9870.7800            Supplier#000001286       GERMANY
81285        Manufacturer#2
YKA,E2fjiVd7eUrzp2Ef8j1QxGo2DFnosaTEH    17-516-924-4574
final theodolites cajole slyly special,
9870.7800            Supplier#000001286       GERMANY
181285       Manufacturer#4
YKA,E2fjiVd7eUrzp2Ef8j1QxGo2DFnosaTEH    17-516-924-4574
final theodolites cajole slyly special,
9852.5200            Supplier#000008973       RUSSIA                18972
Manufacturer#2          t5L67YdBYYH6o,Vz24jpDyQ9              32-
```

```
188-594-7038 quickly regular instructions wake-- carefully unusual
braids into the expres
9847.8300	Supplier#000008097	RUSSIA
130557	Manufacturer#2	xMe97bpE69NzdwLoX
32-375-640-3593 slyly regular dependencies sleep slyly furiously
express dep
9847.5700	Supplier#000006345	FRANCE
86344	Manufacturer#1
VSt3rzk3qG698u6ld8HhOByvrTcSTSvQlDQDag	16-886-766-7945
silent pinto beans should have to snooze carefully along the final reques
9847.5700	Supplier#000006345	FRANCE
173827	Manufacturer#2
VSt3rzk3qG698u6ld8HhOByvrTcSTSvQlDQDag	16-886-766-7945
silent pinto beans should have to snooze carefully along the final reques
9836.9300	Supplier#000007342	RUSSIA	4841
Manufacturer#4	JOlK7C1,7xrEZSSOw	32-399-
414-5385 final accounts haggle. bold accounts are furiously dugouts.
furiously silent asymptotes are slyly
...
...Additional rows deleted
...
7980.6500	Supplier#000001288	FRANCE
13784	Manufacturer#4	zE,7HgVPrCn	16-
646-464-8247 unusual pinto beans cajole furiously according t
7950.3700	Supplier#000008101	GERMANY
33094	Manufacturer#5	kkYvL6IuvojJgTNG
IKkaXQDYgx8ILohj	17-627-663-8014 quickly regular requests are
furiously. pending deposits wake
7937.9300	Supplier#000009012	ROMANIA
83995	Manufacturer#2	iUiTziH,Ek3i4lwSgunXMgrcTzwdb
29-250-925-9690 blithely bold ideas haggle quickly final, regular
request
7914.4500	Supplier#000001013	RUSSIA
125988	Manufacturer#2
riRcntps4KEDtYScjpMIWeYF6mNnR	32-194-698-3365 final,
ironic theodolites alongside of the ironic
7912.9100	Supplier#000004211	GERMANY
159180	Manufacturer#5
2wQRVovHrm3,v03IKzfTd,1PYsFXQFFOG	17-266-947-7315
final requests integrate slyly above the silent, even
7912.9100	Supplier#000004211	GERMANY
184210	Manufacturer#4
2wQRVovHrm3,v03IKzfTd,1PYsFXQFFOG	17-266-947-7315
final requests integrate slyly above the silent, even
7894.5600	Supplier#000007981	GERMANY
85472	Manufacturer#4	NSJ96vMROAbeXP
17-963-404-3760 regular, even theodolites integrate carefully. bold,
special theodolites are slyly fluffily iron
7887.0800	Supplier#000009792	GERMANY
164759	Manufacturer#3	Y28ITVeYriT3kIGdV2K8fSZ
V2UqT5H1Otz	17-988-938-4296 pending, ironic packages sleep
among the carefully ironic accounts. quickly final accounts
7871.5000	Supplier#000007206	RUSSIA
104695	Manufacturer#1	3w fNCnrVmvJjE95sgWZzvW
32-432-452-7731 furiously dogged pinto beans cajole. bold, express
notornis until the slyly pending
7852.4500	Supplier#000005864	RUSSIA	8363
Manufacturer#4	WCNfBPZeSXh3h,c	32-454-
883-3821 blithely regular deposits
7850.6600	Supplier#000001518	UNITED KINGDOM
86501	Manufacturer#1	ONda3YJiHKJOC
33-730-383-3892 furiously final accounts wake carefully idle requests.
even dolphins wake acc
7843.5200	Supplier#000006683	FRANCE
11680	Manufacturer#4	2Z0JGkiv01Y00oCFwUGfviIbhzCdy
16-464-517-8943 carefully bold accounts doub

(100 row(s) affected)

-- using default substitutions
```

```
/* TPC_H  Query 3 - Shipping Priority */

SELECT	TOP 10
	L_ORDERKEY,
	SUM(L_EXTENDEDPRICE*(1-L_DISCOUNT))	AS
REVENUE,
	O_ORDERDATE,
	O_SHIPPRIORITY
FROM	CUSTOMER,
	ORDERS,
	LINEITEM
WHERE	C_MKTSEGMENT	= 'BUILDING' AND
	C_CUSTKEY	= O_CUSTKEY AND
	L_ORDERKEY	= O_ORDERKEY AND
	O_ORDERDATE	< '1995-03-15' AND
	L_SHIPDATE	> '1995-03-15'
GROUP	BY	L_ORDERKEY,
		O_ORDERDATE,
		O_SHIPPRIORITY
ORDER	BY	REVENUE DESC,
		O_ORDERDATE

L_ORDERKEY  REVENUE	O_ORDERDATE
O_SHIPPRIORITY
----------- --------------------- ------------------------ --------------
2456423	406181.0111	1995-03-05 00:00:00.000 0
3459808	405838.6989	1995-03-04 00:00:00.000 0
492164	390324.0610	1995-02-19 00:00:00.000 0
1188320	384537.9359	1995-03-09 00:00:00.000 0
2435712	378673.0558	1995-02-26 00:00:00.000 0
4878020	378376.7952	1995-03-12 00:00:00.000 0
5521732	375153.9215	1995-03-13 00:00:00.000 0
2628192	373133.3094	1995-02-22 00:00:00.000 0
993600	371407.4595	1995-03-05 00:00:00.000 0
2300070	367371.1452	1995-03-13 00:00:00.000 0

(10 row(s) affected)

-- using default substitutions

/* TPC_H  Query 4 - Order Priority Checking */

SELECT	O_ORDERPRIORITY,
	COUNT(*)	AS ORDER_COUNT
FROM	ORDERS
WHERE	O_ORDERDATE	>= '1993-07-01' AND
	O_ORDERDATE	< dateadd (mm, 3, '1993-07-01') AND
	EXISTS	(	SELECT	*
		FROM	LINEITEM
		WHERE	L_ORDERKEY
	= O_ORDERKEY AND

	L_COMMITDATE	< L_RECEIPTDATE
		)
GROUP	BY	O_ORDERPRIORITY
ORDER	BY	O_ORDERPRIORITY

O_ORDERPRIORITY ORDER_COUNT
--------------- -----------
1-URGENT	10594
2-HIGH	10476
3-MEDIUM	10410
4-NOT SPECIFIED 10556
5-LOW	10487

(5 row(s) affected)

-- using default substitutions
```

```
/* TPC_H  Query 5 - Local Supplier Volume */

SELECT   N_NAME,
         SUM(L_EXTENDEDPRICE*(1-L_DISCOUNT))       AS
REVENUE
FROM     CUSTOMER,
         ORDERS,
         LINEITEM,
         SUPPLIER,
         NATION,
         REGION
WHERE    C_CUSTKEY          = O_CUSTKEY AND
         L_ORDERKEY         = O_ORDERKEY AND
         L_SUPPKEY          = S_SUPPKEY AND
         C_NATIONKEY        = S_NATIONKEY AND
         S_NATIONKEY        = N_NATIONKEY AND
         N_REGIONKEY        = R_REGIONKEY AND
         R_NAME             = 'ASIA' AND
         O_ORDERDATE        >= '1994-01-01' AND
         O_ORDERDATE        < DATEADD(YY, 1, '1994-01-01')
GROUP    BY        N_NAME
ORDER    BY        REVENUE DESC

N_NAME                   REVENUE
------------------------ --------------------
INDONESIA                55502041.1697
VIETNAM                  55295086.9967
CHINA                    53724494.2566
INDIA                    52035512.0002
JAPAN                    45410175.6954

(5 row(s) affected)

-- using default substitutions

/* TPC_H  Query 6 - Forecasting Revenue Change */

SELECT   SUM(L_EXTENDEDPRICE*L_DISCOUNT)           AS
REVENUE
FROM     LINEITEM
WHERE    L_SHIPDATE         >= '1994-01-01' AND
         L_SHIPDATE         < dateadd (yy, 1, '1994-01-01') AND
         L_DISCOUNT         BETWEEN .06 - 0.01 AND .06 + 0.01
AND
         L_QUANTITY         < 24

REVENUE
---------------------
123141078.2283

(1 row(s) affected)

-- using default substitutions

/* TPC_H  Query 7 - Volume Shipping */

SELECT   SUPP_NATION,
         CUST_NATION,
         L_YEAR,
         SUM(VOLUME)        AS REVENUE
FROM     (         SELECT   N1.N_NAME
         AS SUPP_NATION,
                            N2.N_NAME
         AS CUST_NATION,
                            datepart(yy,L_SHIPDATE)
         AS L_YEAR,
                            L_EXTENDEDPRICE*(1-
L_DISCOUNT)         AS VOLUME
                   FROM     SUPPLIER,
                            LINEITEM,
                            ORDERS,
                            CUSTOMER,
                            NATION N1,
                            NATION N2
                   WHERE    S_SUPPKEY          = L_SUPPKEY
AND
                            O_ORDERKEY         =
L_ORDERKEY AND
                            C_CUSTKEY          =
O_CUSTKEY AND
                            S_NATIONKEY        =
N1.N_NATIONKEY AND
                            C_NATIONKEY        =
N2.N_NATIONKEY AND
                            (         (N1.N_NAME         =
'FRANCE' AND N2.N_NAME      = 'GERMANY')
                                      OR
                                      (N1.N_NAME         =
'GERMANY'          AND N2.N_NAME      = 'FRANCE')
                            ) AND
                            L_SHIPDATE         BETWEEN
'1995-01-01' AND '1996-12-31'
         )         AS SHIPPING
GROUP    BY        SUPP_NATION,
                   CUST_NATION,
                   L_YEAR
ORDER    BY        SUPP_NATION,
                   CUST_NATION,
                   L_YEAR

SUPP_NATION          CUST_NATION          L_YEAR
REVENUE
------------------------ ------------------------ ----------- ---------------------
FRANCE                   GERMANY              1995      54639732.7336
FRANCE                   GERMANY              1996      54633083.3076
GERMANY                    FRANCE             1995      52531746.6697
GERMANY                    FRANCE             1996      52520549.0224

(4 row(s) affected)


-- using default substitutions

/* TPC_H  Query 8 - National Market Share */

SELECT   O_YEAR,
         SUM(CASE           WHEN     NATION  = 'BRAZIL'
                            THEN     VOLUME
                            ELSE     0
                            END) / SUM(VOLUME)         AS
MKT_SHARE
FROM     (         SELECT   datepart(yy,O_ORDERDATE)
         AS O_YEAR,
                            L_EXTENDEDPRICE * (1-
L_DISCOUNT)         AS VOLUME,
                            N2.N_NAME
                   AS NATION
                   FROM     PART,
                            SUPPLIER,
                            LINEITEM,
                            ORDERS,
                            CUSTOMER,
                            NATION N1,
                            NATION N2,
                            REGION
                   WHERE    P_PARTKEY          = L_PARTKEY
AND
                            S_SUPPKEY          = L_SUPPKEY
AND
```

```
                                L_ORDERKEY      =
O_ORDERKEY AND
                                O_CUSTKEY       = C_CUSTKEY
AND
                                C_NATIONKEY     =
N1.N_NATIONKEY AND
                                N1.N_REGIONKEY  =
R_REGIONKEY AND
                                R_NAME          = 'AMERICA'
AND
                                S_NATIONKEY     =
N2.N_NATIONKEY AND
                                O_ORDERDATE     BETWEEN
'1995-01-01' AND '1996-12-31' AND
                                P_TYPE          = 'ECONOMY
ANODIZED STEEL'
            )           AS      ALL_NATIONS
GROUP   BY          O_YEAR
ORDER   BY          O_YEAR

O_YEAR      MKT_SHARE
----------- ----------------------
1995        .0344
1996        .0414

(2 row(s) affected)

-- using default substitutions

/* TPC_H  Query 9 - Product Type Profit Measure */

SELECT  NATION,
        O_YEAR,
        SUM(AMOUNT)     AS SUM_PROFIT
FROM    (           SELECT  N_NAME
                                AS NATION,
                        datepart(yy, O_ORDERDATE)
                        AS O_YEAR,
                        L_EXTENDEDPRICE*(1-
L_DISCOUNT)-PS_SUPPLYCOST*L_QUANTITY    AS AMOUNT
                    FROM    PART,
                            SUPPLIER,
                            LINEITEM,
                            PARTSUPP,
                            ORDERS,
                            NATION
                    WHERE   S_SUPPKEY       = L_SUPPKEY
AND
                            PS_SUPPKEY      = L_SUPPKEY
AND
                            PS_PARTKEY      = L_PARTKEY
AND
                            P_PARTKEY       = L_PARTKEY
AND
                            O_ORDERKEY      =
L_ORDERKEY AND
                            S_NATIONKEY     =
N_NATIONKEY AND
                            P_NAME          LIKE
'%%green%%'
            )       AS PROFIT
GROUP   BY          NATION,
                    O_YEAR
ORDER   BY          NATION,
                    O_YEAR  DESC

NATION                  O_YEAR      SUM_PROFIT
------------------------- ----------- ----------------------
ALGERIA                 1998        31342867.2345
ALGERIA                 1997        57138193.0233
ALGERIA                 1996        56140140.1330
ALGERIA                 1995        53051469.6534
ALGERIA                 1994        53867582.1286
ALGERIA                 1993        54942718.1324
ALGERIA                 1992        54628034.7127
ARGENTINA               1998        30211185.7081
ARGENTINA               1997        50805741.7523
ARGENTINA               1996        51923746.5755
ARGENTINA               1995        49298625.7666
ARGENTINA               1994        50835610.1095
ARGENTINA               1993        51646079.1775
ARGENTINA               1992        50410314.9948
...
...Additional rows deleted
...
UNITED STATES           1998        25126238.9461
UNITED STATES           1997        50077306.4186
UNITED STATES           1996        48048649.4703
UNITED STATES           1995        48809032.4226
UNITED STATES           1994        49296747.1827
UNITED STATES           1993        48029946.8014
UNITED STATES           1992        48671944.4983
VIETNAM                 1998        30442736.0594
VIETNAM                 1997        50309179.7942
VIETNAM                 1996        50488161.4100
VIETNAM                 1995        49658284.6125
VIETNAM                 1994        50596057.2607
VIETNAM                 1993        50953919.1519
VIETNAM                 1992        49613838.3151

(175 row(s) affected)

-- using default substitutions

/* TPC_H  Query 10 - Returned Item Reporting */

SELECT  TOP 20
        C_CUSTKEY,
        C_NAME,
        SUM(L_EXTENDEDPRICE*(1-L_DISCOUNT))     AS
REVENUE,
        C_ACCTBAL,
        N_NAME,
        C_ADDRESS,
        C_PHONE,
        C_COMMENT
FROM    CUSTOMER,
        ORDERS,
        LINEITEM,
        NATION
WHERE   C_CUSTKEY       = O_CUSTKEY
        AND
        L_ORDERKEY      = O_ORDERKEY
        AND
        O_ORDERDATE     >= '1993-10-01'
        AND
        O_ORDERDATE     < dateadd(mm, 3, '1993-10-01')
        AND
        L_RETURNFLAG    = 'R'
        AND
        C_NATIONKEY     = N_NATIONKEY
GROUP   BY      C_CUSTKEY,
                C_NAME,
                C_ACCTBAL,
                C_PHONE,
                N_NAME,
                C_ADDRESS,
                C_COMMENT
ORDER   BY      REVENUE         DESC
```

```
C_CUSTKEY   C_NAME                REVENUE
C_ACCTBAL         N_NAME                C_ADDRESS
C_PHONE        C_COMMENT
----------- ------------------------- --------------------- --------------------- ------
------------------- ---------------------------------------- --------------- -----------
-----------------------------------------------------------------------------------------
------------------
57040       Customer#000057040       734235.2455          632.8700
JAPAN                Eioyzjf4pp                        22-895-641-3466
requests sleep blithely about the furiously i
143347      Customer#000143347       721002.6948          2557.4700
EGYPT                1aReFYv,Kw4                       14-742-935-3718
fluffily bold excuses haggle finally after the u
60838       Customer#000060838       679127.3077          2454.7700
BRAZIL               64EaJ5vMAHWJlBOxJklpNc2RJiWE          12-
913-494-9813 furiously even pinto beans integrate under the ruthless
foxes; ironic, even dolphins across the slyl
101998      Customer#000101998       637029.5667          3790.8900
UNITED KINGDOM       01c9CILnNtfOQYmZj                 33-
593-865-6378 accounts doze blithely! enticing, final deposits sleep
blithely special accounts. slyly express accounts pla
125341      Customer#000125341       633508.0860          4983.5100
GERMANY              S29ODD6bceU8QSuuEJznkNaK          17-
582-695-5962 quickly express requests wake quickly blithely
25501       Customer#000025501       620269.7849          7725.0400
ETHIOPIA
W556MXuoiaYCCZamJI,Rn0B4ACUGdkQ8DZ    15-874-808-6793
quickly special requests sleep evenly among the special deposits. special
deposi
115831      Customer#000115831       596423.8672          5098.1000
FRANCE               rFeBbEEyk dl
ne7zV5fDrmiq1oK09wV7pxqCgIc 16-715-386-3788 carefully bold
excuses sleep alongside of the thinly idle
84223       Customer#000084223       594998.0239          528.6500
UNITED KINGDOM       nAVZCs6BaWap rrM27N
2qBnzc5WBauxbA      33-442-824-8191 pending, final ideas haggle
final requests. unusual, regular asymptotes affix according to the even
foxes.
54289       Customer#000054289       585603.3918          5583.0200
IRAN                 vXCxoCsU0Bad5JQI ,oobkZ           20-834-
292-4707 express requests sublate blithely regular requests. regular,
even ideas solve.
39922       Customer#000039922       584878.1134          7321.1100
GERMANY              Zgy4s50l2GKN4pLDPBU8m342gIw6R
17-147-757-8036 even pinto beans haggle. slyly bold accounts inte
6226        Customer#000006226       576783.7606          2230.0900
UNITED KINGDOM
8gPu8,NPGkfyQQ0hcIYUGPIBWc,ybP5g,       33-657-701-3391
quickly final requests against the regular instructions wake blithely final
instructions. pa
922         Customer#000000922       576767.5333          3869.2500
GERMANY              Az9RFaut7NkPnc5zSD2PwHgVwr4jRzq
17-945-916-9648 boldly final requests cajole blith
147946      Customer#000147946       576455.1320          2030.1300
ALGERIA              iANyZHjqhyy7Ajah0pTrYyhJ          10-886-
956-3143 furiously even accounts are blithely above the furiousl
115640      Customer#000115640       569341.1933          6436.1000
ARGENTINA            Vtgfia9qI 7EpHgecU1X              11-411-
543-4901 final instructions are slyly according to the
73606       Customer#000073606       568656.8578          1785.6700
JAPAN                xuR0Tro5yChDfOCrjkd2ol            22-437-
653-6966 furiously bold orbits about the furiously busy requests wake
across the furiously quiet theodolites. d
110246      Customer#000110246       566842.9815          7763.3500
VIETNAM              7KzflgX MDOq7sOkI                 31-943-
426-9837 dolphins sleep blithely among the slyly final
142549      Customer#000142549       563537.2368          5085.9900
INDONESIA            ChqEoK43OysjdHbtKCp6dKqjNyvvi9
19-955-562-2398 regular, unusual dependencies boost slyly; ironic
attainments nag fluffily into the unusual packages?
146149      Customer#000146149       557254.9865          1791.5500
ROMANIA              s87fvzFQpU                        29-744-164-
6487 silent, unusual requests detect quickly slyly regul
52528       Customer#000052528       556397.3509          551.7900
ARGENTINA            NFztyTOR10UOJ                     11-208-
192-3205 unusual requests detect. slyly dogged theodolites use slyly.
deposit
23431       Customer#000023431       554269.5360          3381.8600
ROMANIA              HgiV0phqhaIa9aydNoIlb             29-915-
458-2654 instructions nag quickly. furiously bold accounts cajol

(20 row(s) affected) .

-- using default substitutions

/* TPC_H  Query 11 - Important Stock Indentification */

SELECT   PS_PARTKEY,
         SUM(PS_SUPPLYCOST*PS_AVAILQTY)              AS
VALUE
FROM     PARTSUPP,
         SUPPLIER,
         NATION
WHERE    PS_SUPPKEY        = S_SUPPKEY        AND
         S_NATIONKEY       = N_NATIONKEY      AND
         N_NAME            = 'GERMANY'
GROUP    BY        PS_PARTKEY
HAVING   SUM(PS_SUPPLYCOST*PS_AVAILQTY) >
                   (         SELECT
         SUM(PS_SUPPLYCOST*PS_AVAILQTY) *
0.0001000000
                             FROM      PARTSUPP,
                                       SUPPLIER,
                                       NATION
                             WHERE     PS_SUPPKEY        =
S_SUPPKEY         AND
                                       S_NATIONKEY       =
N_NATIONKEY       AND
                                       N_NAME            =
'GERMANY'
                   )
ORDER    BY        VALUE     DESC

PS_PARTKEY  VALUE
----------- ---------------------
129760      17538456.8600
166726      16503353.9200
191287      16474801.9700
161758      16101755.5400
34452       15983844.7200
139035      15907078.3400
9403        15451755.6200
154358      15212937.8800
38823       15064802.8600
85606       15053957.1500
33354       14408297.4000
...
...Aditional rows deleted
...
10157       7897046.2500
171154      7896814.5000
79373       7896186.0000
113808      7893353.8800
27901       7892952.0000
128820      7892882.7200
25891       7890511.2000
122819      7888881.0200
154731      7888301.3300
101674      7879324.6000
51968       7879102.2100
```

```
72073      7877736.1100
5182      7874521.7300

(1048 row(s) affected)

-- using default substitutions

/* TPC_H  Query 12 - Shipping Modes and Order Priority */

SELECT   L_SHIPMODE,
         SUM(      CASE      WHEN O_ORDERPRIORITY  = '1-
URGENT' OR
                                O_ORDERPRIORITY  = '2-HIGH'
                           THEN 1
                           ELSE 0
                   END)      AS HIGH_LINE_COUNT,
         SUM(      CASE      WHEN O_ORDERPRIORITY <> '1-
URGENT' AND
                                O_ORDERPRIORITY <> '2-
HIGH'
                           THEN 1
                           ELSE 0
                   END)      AS LOW_LINE_COUNT
FROM     ORDERS,
         LINEITEM
WHERE    O_ORDERKEY        = L_ORDERKEY
         AND
         L_SHIPMODE        IN ('MAIL','SHIP')
         AND
         L_COMMITDATE      < L_RECEIPTDATE
         AND
         L_SHIPDATE        < L_COMMITDATE
         AND
         L_RECEIPTDATE     >= '1994-01-01'
         AND
         L_RECEIPTDATE     < dateadd(yy, 1, '1994-01-01')
GROUP    BY        L_SHIPMODE
ORDER    BY        L_SHIPMODE

L_SHIPMODE HIGH_LINE_COUNT LOW_LINE_COUNT
---------- --------------- --------------
MAIL       6202            9324
SHIP       6200            9262

(2 row(s) affected)

-- using default substitutions

/* TPC_H  Query 13 - Customer Distribution */

SELECT   C_COUNT,
         COUNT(*)          AS CUSTDIST
FROM     (         SELECT  C_CUSTKEY,
                           COUNT(O_ORDERKEY)
                   FROM    CUSTOMER left outer join ORDERS
on
                           C_CUSTKEY         =
O_CUSTKEY                  AND
                           O_COMMENT         not like
'%%special%%requests%%'
                   GROUP   BY        C_CUSTKEY
         )         AS C_ORDERS (C_CUSTKEY, C_COUNT)
GROUP    BY        C_COUNT
ORDER    BY        CUSTDIST          DESC,
                   C_COUNT                     DESC

C_COUNT     CUSTDIST
----------- -----------
0           50004
9           6641
10          6566
11          6058
8           5949
12          5553
13          4989
19          4748
7           4707
18          4625
15          4552
17          4530
...
...Additional rows deleted
...
32          128
33          71
34          48
35          33
1           23
36          17
37          7
40          4
38          4
39          2
41          1

(42 row(s) affected)

-- using default substitutions

/* TPC_H  Query 14 - Promotion Effect */

SELECT   100.00 * SUM      (         CASE      WHEN
P_TYPE LIKE 'PROMO%%'
                                                THEN
L_EXTENDEDPRICE*(1-L_DISCOUNT)
                                                ELSE 0
                                     END) /
SUM(L_EXTENDEDPRICE*(1-L_DISCOUNT))      AS
PROMO_REVENUE
FROM     LINEITEM,
         PART
WHERE    L_PARTKEY         = P_PARTKEY       AND
         L_SHIPDATE        >= '1995-09-01'
         AND
         L_SHIPDATE        < dateadd(mm, 1, '1995-09-01')

PROMO_REVENUE
----------------------------------------
16.380779266357422

(1 row(s) affected)


-- using default substitutions

/* TPC_H  Query 15 - Create View for Top Supplier Query */

CREATE   VIEW REVENUE0 (SUPPLIER_NO, TOTAL_REVENUE)
AS
SELECT   L_SUPPKEY,
         SUM(L_EXTENDEDPRICE*(1-L_DISCOUNT))
FROM     LINEITEM
WHERE    L_SHIPDATE        >= '1996-01-01' AND
         L_SHIPDATE        < dateadd(mm, 3, '1996-01-01')
GROUP    BY        L_SUPPKEY
GO


/* TPC_H  Query 15 - Top Supplier */
```

```
SELECT   S_SUPPKEY,
         S_NAME,
         S_ADDRESS,
         S_PHONE,
         TOTAL_REVENUE
FROM     SUPPLIER,
         REVENUE0
WHERE    S_SUPPKEY          = SUPPLIER_NO AND
         TOTAL_REVENUE  = (          SELECT
         MAX(TOTAL_REVENUE)
                                     FROM      REVENUE0
                                )
ORDER    BY          S_SUPPKEY

DROP VIEW REVENUE0

S_SUPPKEY   S_NAME                 S_ADDRESS
S_PHONE        TOTAL_REVENUE
----------- ------------------------- ------------------------------------- ---------
------ ---------------------
8449       Supplier#000008449       Wp34zim9qYFbVctdW
20-469-856-8873 1772627.2087

(1 row(s) affected)

-- using default substitutions

/* TPC_H  Query 16 - Parts/Supplier Relationship */

SELECT   P_BRAND,
         P_TYPE,
         P_SIZE,
         COUNT(DISTINCT PS_SUPPKEY)          AS
SUPPLIER_CNT
FROM     PARTSUPP,
         PART
WHERE    P_PARTKEY          = PS_PARTKEY
                  AND
         P_BRAND                       <> 'Brand#45'
                                       AND
         P_TYPE             NOT LIKE 'MEDIUM
POLISHED%%'                                  AND
         P_SIZE             IN (49, 14, 23, 45, 19, 3, 36, 9)
         AND
         PS_SUPPKEY         NOT IN    (         SELECT
         S_SUPPKEY
                                             FROM
         SUPPLIER
                                             WHERE
         S_COMMENT          LIKE
'%%Customer%%Complaints%%'
                                       )
GROUP    BY          P_BRAND,
                     P_TYPE,
                     P_SIZE
ORDER    BY          SUPPLIER_CNT       DESC,
                     P_BRAND,
                     P_TYPE,
                     P_SIZE

P_BRAND    P_TYPE                 P_SIZE     SUPPLIER_CNT
---------- ------------------------- ----------- ------------
Brand#41   MEDIUM BRUSHED TIN       3          28
Brand#54   STANDARD BRUSHED COPPER   14         27
Brand#11   STANDARD BRUSHED TIN      23         24
Brand#11   STANDARD BURNISHED BRASS  36         24
Brand#15   MEDIUM ANODIZED NICKEL    3          24
Brand#15   SMALL ANODIZED BRASS      45         24
Brand#15   SMALL BURNISHED NICKEL    19         24
Brand#21   MEDIUM ANODIZED COPPER    3          24
Brand#22   SMALL BRUSHED NICKEL      3          24
Brand#22   SMALL BURNISHED BRASS     19         24
Brand#25   MEDIUM BURNISHED COPPER   36         24
Brand#31   PROMO POLISHED COPPER     36         24
Brand#33   LARGE POLISHED TIN        23         24
Brand#33   PROMO POLISHED STEEL      14         24
...
...Additional rows deleted
...
Brand#15   LARGE POLISHED NICKEL     9          3
Brand#21   PROMO BURNISHED STEEL     45         3
Brand#22   STANDARD PLATED STEEL     23         3
Brand#25   LARGE PLATED STEEL        19         3
Brand#32   STANDARD ANODIZED COPPER  23         3
Brand#33   SMALL ANODIZED BRASS      9          3
Brand#35   MEDIUM ANODIZED TIN       19         3
Brand#51   SMALL PLATED BRASS        23         3
Brand#52   MEDIUM BRUSHED BRASS      45         3
Brand#53   MEDIUM BRUSHED TIN        45         3
Brand#54   ECONOMY POLISHED BRASS    9          3
Brand#55   PROMO PLATED BRASS        19         3
Brand#55   STANDARD PLATED TIN       49         3

(18314 row(s) affected)

-- using default substitutions

/* TPC_H  Query 17 - Small-Quantity-Order Revenue */

SELECT   SUM(L_EXTENDEDPRICE)/7.0              AS
AVG_YEARLY
FROM     LINEITEM,
         PART
WHERE    P_PARTKEY          = L_PARTKEY        AND
         P_BRAND                       = 'Brand#23'
         AND
         P_CONTAINER        = 'MED BOX'
         AND
         L_QUANTITY         <          (          SELECT   0.2 *
AVG(L_QUANTITY)
                                                  FROM
         LINEITEM
                                                  WHERE
         L_PARTKEY          = P_PARTKEY
                                       )

AVG_YEARLY
-------------------------
348406.0625000

(1 row(s) affected)

-- using default substitutions

/* TPC_H  Query 18 - Large Volume Customer */

SELECT   TOP 100
         C_NAME,
         C_CUSTKEY,
         O_ORDERKEY,
         O_ORDERDATE,
         O_TOTALPRICE,
         SUM(L_QUANTITY)
FROM     CUSTOMER,
         ORDERS,
         LINEITEM
WHERE    O_ORDERKEY         IN         (          SELECT
         L_ORDERKEY
                                                  FROM
         LINEITEM
```

```
                                                GROUP    BY
        L_ORDERKEY HAVING SUM(L_QUANTITY) > 300
                                        )       AND
        C_CUSTKEY       = O_CUSTKEY     AND
        O_ORDERKEY      = L_ORDERKEY
GROUP   BY      C_NAME,
                C_CUSTKEY,
                O_ORDERKEY,
                O_ORDERDATE,
                O_TOTALPRICE
ORDER   BY      O_TOTALPRICE    DESC,
                O_ORDERDATE

C_NAME              C_CUSTKEY   O_ORDERKEY
O_ORDERDATE         O_TOTALPRICE
------------------------- ----------- ----------- ----------------------- --------------
------- ---------------------
Customer#000128120      128120      4722021     1994-04-07
00:00:00.000 544089.0900        323.0000
Customer#000144617      144617      3043270     1997-02-12
00:00:00.000 530604.4400        317.0000
Customer#000013940      13940       2232932     1997-04-13
00:00:00.000 522720.6100        304.0000
Customer#000066790      66790       2199712     1996-09-30
00:00:00.000 515531.8200        327.0000
Customer#000046435      46435       4745607     1997-07-03
00:00:00.000 508047.9900        309.0000
Customer#000015272      15272       3883783     1993-07-28
00:00:00.000 500241.3300        302.0000
Customer#000146608      146608      3342468     1994-06-12
00:00:00.000 499794.5800        303.0000
Customer#000096103      96103       5984582     1992-03-16
00:00:00.000 494398.7900        312.0000
Customer#000024341      24341       1474818     1992-11-15
00:00:00.000 491348.2600        302.0000
Customer#000137446      137446      5489475     1997-05-23
00:00:00.000 487763.2500        311.0000
Customer#000107590      107590      4267751     1994-11-04
00:00:00.000 485141.3800        301.0000
Customer#000050008      50008       2366755     1996-12-09
00:00:00.000 483891.2600        302.0000
Customer#000015619      15619       3767271     1996-08-07
00:00:00.000 480083.9600        318.0000
...
...Additional rows deleted
…
Customer#000015631      15631       1845057     1994-05-12
00:00:00.000 419879.5900        302.0000
Customer#000112987      112987      4439686     1996-09-17
00:00:00.000 418161.4900        305.0000
Customer#000012599      12599       4259524     1998-02-12
00:00:00.000 415200.6100        304.0000
Customer#000105410      105410      4478371     1996-03-05
00:00:00.000 412754.5100        302.0000
Customer#000149842      149842      5156581     1994-05-30
00:00:00.000 411329.3500        302.0000
Customer#000010129      10129       5849444     1994-03-21
00:00:00.000 409129.8500        309.0000
Customer#000069904      69904       1742403     1996-10-19
00:00:00.000 408513.0000        305.0000
Customer#000017746      17746       6882        1997-04-09
00:00:00.000 408446.9300        303.0000
Customer#000013072      13072       1481925     1998-03-15
00:00:00.000 399195.4700        301.0000
Customer#000082441      82441       857959      1994-02-07
00:00:00.000 382579.7400        305.0000
Customer#000088703      88703       2995076     1994-01-30
00:00:00.000 363812.1200        302.0000

(57 row(s) affected)
```

```
-- using default substitutions

/* TPC_H  Query 19 - Discounted Revenue */

SELECT   SUM(L_EXTENDEDPRICE* (1 - L_DISCOUNT))      AS
REVENUE
FROM     LINEITEM,
         PART
WHERE    (       P_PARTKEY           = L_PARTKEY
                                                     AND
                 P_BRAND                             = 'Brand#12'

         AND
                 P_CONTAINER         IN ( 'SM CASE', 'SM
BOX', 'SM PACK', 'SM PKG')           AND
                 L_QUANTITY          >= 1
                                                     AND
                 L_QUANTITY          <= 1 + 10
                                     AND
                 P_SIZE              BETWEEN 1 AND 5
                                                     AND
                 L_SHIPMODE          IN ('AIR', 'AIR REG')
                                     AND
                 L_SHIPINSTRUCT      = 'DELIVER IN PERSON'
         )
         OR
         (       P_PARTKEY           = L_PARTKEY
                                                     AND
                 P_BRAND                             = 'Brand#23'

         AND
                 P_CONTAINER         IN ( 'MED BAG', 'MED
BOX', 'MED PKG', 'MED PACK')         AND
                 L_QUANTITY          >= 10
                                                     AND
                 L_QUANTITY          <= 10 + 10
                                     AND
                 P_SIZE              BETWEEN 1 AND 10
                                                     AND
                 L_SHIPMODE          IN ('AIR', 'AIR REG')
                                     AND
                 L_SHIPINSTRUCT      = 'DELIVER IN PERSON'
         )
         OR
         (       P_PARTKEY           = L_PARTKEY
                                                     AND
                 P_BRAND                             = 'Brand#34'

         AND
                 P_CONTAINER         IN ( 'LG CASE', 'LG
BOX', 'LG PACK', 'LG PKG')           AND
                 L_QUANTITY          >= 20
                                                     AND
                 L_QUANTITY          <= 20 + 10
                                     AND
                 P_SIZE              BETWEEN 1 AND 15
                                                     AND
                 L_SHIPMODE          IN ('AIR', 'AIR REG')
                                     AND
                 L_SHIPINSTRUCT      = 'DELIVER IN PERSON'
         )

REVENUE
---------------------
3083843.0578

(1 row(s) affected)

-- using default substitutions
```

```
/* TPC_H  Query 20 - Potential Part Promotion */

SELECT  S_NAME,
        S_ADDRESS
FROM    SUPPLIER,
        NATION
WHERE   S_SUPPKEY       IN      (       SELECT
        PS_SUPPKEY
                                        FROM
        PARTSUPP
                                        WHERE
        PS_PARTKEY in   (       SELECT  P_PARTKEY

                        FROM    PART

                        WHERE   P_NAME like 'forest%%'

                )       AND

        PS_AVAILQTY     >       (       SELECT  0.5 *
sum(L_QUANTITY)

                        FROM    LINEITEM

                        WHERE   L_PARTKEY       =
PS_PARTKEY      AND

                                L_SUPPKEY       =
PS_SUPPKEY      AND

                                L_SHIPDATE      >=
'1994-01-01'                    AND

                                L_SHIPDATE      <
dateadd(yy,1,'1994-01-01')

                )
                                )       AND
        S_NATIONKEY     = N_NATIONKEY   AND
        N_NAME          = 'CANADA'
ORDER   BY      S_NAME


S_NAME                  S_ADDRESS
------------------------ ----------------------------------------
Supplier#000000020      iybAE,RmTymrZVYaFZva2SH,j
Supplier#000000091
YV45D7TkfdQanOOZ7q9QxkyGUapU1oOWU6q3
Supplier#000000197      YC2Acon6kjY3zj3Fbxs2k4Vdf7X0cd2F
Supplier#000000226      83qOdU2EYRdPQAQhEtn GRZEd
Supplier#000000285      Br7e1nnt1yxrw6ImgpJ7YdhFDjuBf
Supplier#000000378      FfbhyCxWvcPrO8ltp9
Supplier#000000402      i9Sw4DoyMhzhKXCH9By,AYSgmD
Supplier#000000530      0qwCMwobKY OcmLyfRXlagA8ukENJv,
Supplier#000000688      D fw5ocppmZpYBBIPI718hCihLDZ5KhKX
Supplier#000000710      f19YPvOyb QoYwjKC,oPycpGfieBAcwKJo
Supplier#000000736
l6i2nMwVuovfKnuVgaSGK2rDy65DlAFLegiL7
Supplier#000000761
zlSLelQUj2XrvTTFnv7WAcYZGvvMTx882d4
Supplier#000000884      bmhEShejaS
...
...Additional rows deleted
...
Supplier#000009709      rRnCbHYgDgl9PZYnyWKVYSUW0vKg
Supplier#000009753      wLhVEcRmd7PkJF4FBnGK7Z
Supplier#000009796      z,y4Idmr15DOvPUqYG
Supplier#000009799       4wNjXGa4OKWl
Supplier#000009811      E3iuyq7UnZxU7oPZIe2Gu6
Supplier#000009812      APFRMy3lCbgFga53n5t9DxzFPQPgnjrGt32
Supplier#000009862      rJzweWeN58
Supplier#000009868      ROjGgx5gvtkmnUUoeyy7v
Supplier#000009869
ucLqxzrpBTRMewGSM29t0rNTM30g1Tu3Xgg3mKag
Supplier#000009899      7XdpAHrzr1t,UQFZE
Supplier#000009974      7wJ,J5DKcxSU4Kp1cQLpbcAvB5AsvKT

(204 row(s) affected)

-- using default substitutions

/* TPC_H  Query 21 - Suppliers Who Kept Orders Waiting */

SELECT  TOP 100
        S_NAME,
        COUNT(*)        AS NUMWAIT
FROM    SUPPLIER,
        LINEITEM L1,
        ORDERS,
        NATION
WHERE   S_SUPPKEY               = L1.L_SUPPKEY
        AND
        O_ORDERKEY              = L1.L_ORDERKEY
        AND
        O_ORDERSTATUS           = 'F'
        AND
        L1.L_RECEIPTDATE        > L1.L_COMMITDATE
        AND
        EXISTS  (       SELECT  *
                        FROM    LINEITEM L2
                        WHERE   L2.L_ORDERKEY   =
L1.L_ORDERKEY   AND
                                L2.L_SUPPKEY    <>
L1.L_SUPPKEY
                )       AND
        NOT EXISTS      (       SELECT  *
                                FROM    LINEITEM L3
                                WHERE
        L3.L_ORDERKEY           = L1.L_ORDERKEY
        AND

        L3.L_SUPPKEY            <> L1.L_SUPPKEY
        AND

        L3.L_RECEIPTDATE        > L3.L_COMMITDATE
                        )       AND
        S_NATIONKEY     = N_NATIONKEY   AND
        N_NAME          = 'SAUDI ARABIA'
GROUP   BY      S_NAME
ORDER   BY      NUMWAIT         DESC,
                S_NAME

S_NAME                  NUMWAIT
------------------------ -----------
Supplier#000002829      20
Supplier#000005808      18
Supplier#000000262      17
Supplier#000000496      17
Supplier#000002160      17
Supplier#000002301      17
Supplier#000002540      17
Supplier#000003063      17
Supplier#000005178      17
Supplier#000008331      17
Supplier#000002005      16
...
...Additional rows deleted
...
Supplier#000000379      12
```

```
Supplier#000000673      12
Supplier#000000762      12
Supplier#000000811      12
Supplier#000000821      12
Supplier#000001337      12
Supplier#000001916      12
Supplier#000001925      12
Supplier#000002039      12
Supplier#000002357      12
Supplier#000002483      12

(100 row(s) affected)

-- using default substitutions

/* TPC_H  Query 22 - Global Sales Opportunity */

SELECT  CNTRYCODE,
        COUNT(*)            AS NUMCUST,
        SUM(C_ACCTBAL)      AS TOTACCTBAL
FROM    (       SELECT      SUBSTRING(C_PHONE,1,2)      AS
CNTRYCODE,
                            C_ACCTBAL
                FROM        CUSTOMER
                WHERE       SUBSTRING(C_PHONE,1,2)      IN
        ('13', '31', '23', '29', '30', '18', '17') AND
                            C_ACCTBAL                   >
        (       SELECT      AVG(C_ACCTBAL)

                FROM        CUSTOMER
                WHERE       C_ACCTBAL           > 0.00
        AND

                            SUBSTRING(C_PHONE,1,2)      IN
        ('13', '31', '23', '29', '30', '18', '17')

        )       AND
                            NOT EXISTS          (
        SELECT  *

        FROM    ORDERS

        WHERE   O_CUSTKEY           = C_CUSTKEY
                                                        )
        )       AS CUSTSALE
GROUP   BY      CNTRYCODE
ORDER   BY      CNTRYCODE

CNTRYCODE NUMCUST    TOTACCTBAL
--------- ----------- ---------------------
13        888         6737713.9900
17        861         6460573.7200
18        964         7236687.4000
23        892         6701457.9500
29        948         7158866.6300
30        909         6808436.1300
31        922         6806670.1800

(7 row(s) affected)
```

APPENDIX D: SEED & QUERY SUBSTITUTION

Substitution Parameters for Stream 00 (seed : 209223344)

Q1	114									
Q2	13	COPPER	MIDDLE EAST							
Q3	BUILDING		1995-03-31							
Q4	1997-11-01									
Q5	AFFRICA	1997-01-01								
Q6	1997-01-01									
Q7	EGYPT	KENYA								
Q8	KENYA	AFRICA	SMALL BRUSHED TIN							
Q9	floral									
Q10	1993-04-01									
Q11	GERMANY			0.0000001000						
Q12	TRUCK	MAIL	1993-01-01							
Q13	unusual	packages								
Q14	1993-01-01									
Q15	1996-01-01									
Q16	Brand#32	LARGE PLATED		29	39	1	38	41	44	20	49
Q17	Brand#23	MED BAG								
Q18	314									
Q19	Brand#34	Brand#34	Brand#53	9	20	30				
Q20	orchid	1995-01-01		CHINA						
Q21	IRAQ									
Q22	31	30	20	32	34	14	21			

Substitution Parameters for Stream 01 (seed : 209223345)

Q1	61									
Q2	1	BRASS	ASIA							
Q3	HOUSEHOLD		1995-03-17							
Q4	1994-11-01									
Q5	AMERICA		1997-01-01							
Q6	1997-01-01									
Q7	VIENAM	FRANCE								
Q8	FRANCE	EUROPE	SMALL PLATED TIN							
Q9	dark									
Q10	1994-01-01									
Q11	SAUDI ARABIA		0.0000001000							
Q12	RAIL MAIL		1993-01-01							
Q13	unusual	packages								
Q14	1993-01-01									
Q15	1994-01-01									
Q16	Brand#12	PROMO BRUSHED		27	4	10	19	31	11	22	18
Q17	Brand#25	MED PACK								
Q18	315									
Q19	Brand#31	Brand#12	Brand#42	5	10	27				
Q20	black	1993-01-01		INDIA						
Q21	CANADA									
Q22	18	25	22	20	10	19	33			

Substitution Parameters for Stream 02 (seed : 209223346)

Q1	69			
Q2	39	NICKEL	AFRICA	
Q3	BUILDING		1995-03-02	
Q4	1993-04-01			
Q5	EUROPE	1993-01-01		
Q6	1993-01-01			
Q7	JORDAN	UNITED KINGDOM		
Q8	UNITED KINGDOM	EUROPE	SMALL ANODIZED TIN	
Q9	chocolate			
Q10	1994-10-01			
Q11	INDIA	0.0000001000		

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Q12	REG AIR MAIL	1993-01-01									
Q13	unusual	packages									
Q14	1993-01-01										
Q15	1997-01-01										
Q16	Brand#52	MEDIUM ANODIZED			30	25	42	36	12	23	48	44
Q17	Brand#22	MED DRUM										
Q18	313											
Q19	Brand#33	Brand#55	Brand#41	10	11	23						
Q20	light	1997-01-01		UNITED KINGDOM								
Q21	SAUDI ARABIA											
Q22	33	11	27	14	24	28	19					

Substitution Parameters for Stream 03 (seed : 209223347)

Q1	77										
Q2	27	TIN	ASIA								
Q3	HOUSEHOLD	1995-03-19									
Q4	1995-11-01										
Q5	MIDDLE EAST	1993-01-01									
Q6	1993-01-01										
Q7	ETHIOPIA	MOROCCO									
Q8	MOROCCO	AFRICA	STANDARD POLISHED TIN								
Q9	blush										
Q10	1993-07-01										
Q11	VIETNAM	0.0000001000									
Q12	SHIP	MAIL	1994-01-01								
Q13	unusual	packages									
Q14	1994-01-01										
Q15	1994-01-01										
Q16	Brand#32	ECONOMY PLATED			5	46	11	27	30	48	24	23
Q17	Brand#24	JUMBO BAG										
Q18	314											
Q19	Brand#45	Brand#33	Brand#35	5	12	30						
Q20	spring	1995-01-01		JORDAN								
Q21	JAPAN											
Q22	23	17	33	21	16	12	31					

Substitution Parameters for Stream 04 (seed : 209223348)

Q1	85										
Q2	14	COPPER	AFRICA								
Q3	AUTOMOBILE	1995-03-04									
Q4	1993-08-01										
Q5	AFRICA	1993-01-01									
Q6	1993-01-01										
Q7	RUSSIA GERMANY										
Q8	GERMANY	EUROPE	STANDARD BURNISHED NICKEL								
Q9	azure										
Q10	1994-04-01										
Q11	INDONISIA	0.0000001000									
Q12	FOB	MAIL	1994-01-01								
Q13	unusual	requests									
Q14	1994-01-01										
Q15	1997-01-01										
Q16	Brand#12	STANDARD POLISHED			7	25	49	45	34	40	37	18
Q17	Brand#21	JUMBO PACK										
Q18	312										
Q19	Brand#42	Brand#11	Brand#34	1	13	26						
Q20	frosted	1993-01-01		BRAZIL								
Q21	EGYPT											
Q22	11	23	29	12	18	16	24					

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Substitution Parameters for Stream 05 (seed : 209223349)

Q1	93									
Q2	2	STEEL	EUROPE							
Q3	HOUSEHOLD	1995-03-21								
Q4	1996-03-01									
Q5	AMERICA	1993-01-01								
Q6	1993-01-01									
Q7	UNITED STATES	KENYA								
Q8	UNITED STATES	AMERICA	PROMO BRUSHED NICKEL							
Q9	wheat									
Q10	1993-02-01									
Q11	RUSSIA	0.0000001000								
Q12	MAIL	FOB	1994-01-01							
Q13	unusual	requests								
Q14	1994-01-01									
Q15	1995-01-01									
Q16	Brand#52	LARGE ANODIZED 40	16	17	28	19	46	35	4	
Q17	Brand#23	JUMBO DRUM								
Q18	314									
Q19	Brand#44	Brand#54	Brand#34	6	14	22				
Q20	puff	1997-01-01	PERU							
Q21	RUSSIA									
Q22	19	28	15	32	20	18	25			

Substitution Parameters for Stream 06 (seed : 209223350)

Q1	101									
Q2	40	NICKEL	AFRICA							
Q3	AUTOMOBILE	1995-03-06								
Q4	1993-12-01									
Q5	ASIA	1994-01-01								
Q6	1994-01-01									
Q7	FRANCE	MOZAMBIQUE								
Q8	MOZAMBIQUE	AFRICA	PROMO PLATED NICKEL							
Q9	steel									
Q10	1993-11-01									
Q11	IRAN	0.0000001000								
Q12	TRUCK	FOB	1994-01-01							
Q13	express	requests								
Q14	1994-01-01									
Q15	1997-01-01									
Q16	Brand#32	PROMO BURNISHED	43	10	7	14	20	25	29	11
Q17	Brand#25	WRAP BAG								
Q18	315									
Q19	Brand#51	Brand#32	Brand#23	1	15	30				
Q20	chiffon	1995-01-01	GERMANY							
Q21	KENYA									
Q22	16	13	22	10	23	18	17			

Substitution Parameters for Stream 07 (seed : 209223351)

Q1	109			
Q2	28	TIN	EUROPE	
Q3	FURNITURE	1995-03-23		
Q4	1996-07-01			
Q5	EUROPE	1994-01-01		
Q6	1994-01-01			
Q7	UNITED KINDOM	INDIA		
Q8	INDIA	ASIA	PROMO ANODIZED NICKEL	
Q9	sienna			
Q10	1994-08-01			
Q11	UNITED KINGDOM	0.0000001000		
Q12	AIR	FOB	1995-01-01	
Q13	express	requests		

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Q14	1995-01-01									
Q15	1995-01-01									
Q16	Brand#12	SMALL POLISHED		27	45	13	44	7	17	30	18
Q17	Brand#22	WRAP PACK								
Q18	313									
Q19	Brand#53	Brand#25	Brand#22	6	16	26				
Q20	mint	1994-01-01		VIETNAM						
Q21	FRANCE									
Q22	23	17	18	15	25	13	21			

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APPENDIX E: REFRESH FUNCTION AND STEPMASTER SOURCE CODE

CreateRF1Proc.sql

```
-- File:    CREATERF1PROC.SQL
--          Microsoft TPC-H Benchmark Kit Ver. 1.00
--          Copyright Microsoft, 1999
--

IF exists (SELECT name FROM sysobjects WHERE name = 'RF1')
            DROP PROCEDURE RF1
GO

--
-- Create a stored RefreshInsert procedure which will catch the
deadlock
-- victim abort and restart the insert transaction.
--
CREATE PROCEDURE RF1
      @current_execution INTEGER, @insert_sets INTEGER,
@parallel_executions INTEGER, @total_executions INTEGER
AS
BEGIN

DECLARE @startdate DATETIME
DECLARE @enddate DATETIME
DECLARE @edate DATETIME
DECLARE @rangeStart INTEGER
DECLARE @rangeSize INTEGER
DECLARE @range INTEGER

DECLARE @success INTEGER
DECLARE @index INTEGER
DECLARE @div INTEGER
DECLARE @mod INTEGER
DECLARE @skip INTEGER
DECLARE @i INTEGER
DECLARE @rangeSum INTEGER
DECLARE @totRangeSize INTEGER
DECLARE @stmt NCHAR(1000)
DECLARE @orderSql NCHAR(1000)
DECLARE @liSql NCHAR(1000)

SET @skip = @total_executions/@parallel_executions
SET @div = (@current_execution - 1)/@parallel_executions
SET @mod = (@current_execution - 1) - @div * @parallel_executions
SET @index = @mod*@skip + @div + 1


--
-- Get the range for this execution
--
SET @stmt = N'SELECT @sdate = dateadd(day,-
1,min(O_ORDERDATE)), @edate = max(O_ORDERDATE)
                        FROM NEWORDERS'
EXEC sp_executesql @stmt,N'@sdate datetime output, @edate
datetime output',@startdate output, @enddate output

IF (@total_executions > @parallel_executions)
            BEGIN
            SET @div = (@index-1)/@skip
            SET @mod = (@index-1) - @div * @skip
            SET @rangeSize = datediff(day, @startdate,
@enddate)/@parallel_executions + 1
            SET @totRangeSize = @rangeSize
            SET @rangeSum = 0
            SET @rangeStart = @div * @rangeSize
            SET @i = @mod
            while (@i > 0)
                        BEGIN
                        SET @rangeSize = (@totRangeSize -
@rangeSum)/2
                        SET @rangeSum = @rangeSum + @rangeSize
                        SET @rangeStart = @rangeStart + @rangeSize
                        SET @insert_sets = @insert_sets/2
                        SET @i = @i - 1
                        end

            IF (@mod + 1 = @skip) --  last allocation
                        SET @rangeSize = @totRangeSize - @rangeSum
            ELSE
                        SET @rangeSize = (@totRangeSize -
@rangeSum)/2
            IF (@rangeSize < 0)
                        SET @rangeSize = 0
            IF (@insert_sets <= 0)
                        SET @insert_sets = 1
            end
ELSE
            BEGIN
            SET @rangeSize = datediff(day, @startdate,
@enddate)/@total_executions
            SET @rangeStart = @rangeSize * (@index - 1)
            end

SET @startdate = dateadd(day, @rangeStart, @startdate)
IF (@index < @total_executions)
            SET @enddate = dateadd(day, @rangeSize, @startdate)

SET @range = datediff(day, @startdate, @enddate) / @insert_sets

--
-- This handles the case when the max-min/insert_sets is less that 1
--
IF @range = 0
            SET @range = 1

--
-- Generate the two insert statements
--
SET @edate = dateadd(day, @range, @startdate)
SET @orderSql = N'INSERT INTO ORDERS (O_ORDERKEY,
O_CUSTKEY, O_ORDERSTATUS, O_TOTALPRICE,

O_ORDERDATE, O_ORDERPRIORITY, O_CLERK,
O_SHIPPRIORITY, O_COMMENT)
                                    (SELECT O_ORDERKEY,
O_CUSTKEY, O_ORDERSTATUS, O_TOTALPRICE,

O_ORDERDATE, O_ORDERPRIORITY, O_CLERK,
O_SHIPPRIORITY, O_COMMENT
                                     FROM NEWORDERS
                                     WHERE O_ORDERDATE >
@startdate AND O_ORDERDATE <= @edate)
                                    option (loop join)'
SET @liSql = N'INSERT INTO LINEITEM
(L_ORDERKEY,L_PARTKEY,L_SUPPKEY,L_LINENUMBER,L_Q
UANTITY,
                                          L_EXTENDEDPRICE,
L_DISCOUNT, L_TAX, L_RETURNFLAG, L_LINESTATUS,
                                          L_SHIPDATE,
L_COMMITDATE, L_RECEIPTDATE, L_SHIPINSTRUCT,
L_SHIPMODE, L_COMMENT)
```

```
                                (SELECT
L_ORDERKEY,L_PARTKEY,L_SUPPKEY,L_LINENUMBER,L_QU
ANTITY,
                                        L_EXTENDEDPRICE,
L_DISCOUNT, L_TAX, L_RETURNFLAG, L_LINESTATUS,
                                        L_SHIPDATE,
L_COMMITDATE, L_RECEIPTDATE, L_SHIPINSTRUCT,
L_SHIPMODE, L_COMMENT
                                FROM NEWLINEITEM,
NEWORDERS
                                WHERE L_ORDERKEY =
O_ORDERKEY AND O_ORDERDATE > @startdate AND

        O_ORDERDATE <= @edate)
                                option (loop join)'

--
--  Loop through the order keys inserting sets into the
--  ORDERS and LINTEITEM tables
--
WHILE @startdate < @enddate
        BEGIN
        --
        --  Insert into ORDERS and LINEITEM tables
        --
        INSERT_TRANS:
        SET @success = 1
        BEGIN TRANSACTION

        BEGIN TRY
                EXEC sp_executesql @orderSql, N'@startdate
datetime, @edate datetime', @startdate, @edate
                EXEC sp_executesql @liSql, N'@startdate
datetime, @edate datetime', @startdate, @edate
        END TRY
        BEGIN CATCH
                SET @success = 0
                IF (error_number() = 1205)      -- deadlock
victim
                        PRINT 'Insert deadlock - restarting
RF1'
                ELSE
                        BEGIN                           --
not a deadlock
                        PRINT 'Error - Not a deadlock'
                        PRINT ERROR_NUMBER()
                        PRINT ERROR_SEVERITY()
                PRINT ERROR_MESSAGE()
                PRINT ERROR_STATE()
                PRINT XACT_STATE()
                        END
                IF (@@trancount>0)
                        ROLLBACK TRANSACTION
        END CATCH

        IF (@success = 0)                       -- deadlock -
redo the inserts
                GOTO INSERT_TRANS

        COMMIT TRANSACTION

        SET @startdate = @edate
        SET @edate = dateadd(day, @range, @edate)

        IF (@edate > @enddate)
                SET @edate = @enddate

        END
END
GO
```

CreateRF2Proc.sql

```
--  File:   CREATERF2PROC.SQL
--          Microsoft TPC-H Benchmark Kit Ver. 1.00
--          Copyright Microsoft, 1999
--

IF exists (SELECT name FROM sysobjects WHERE name = 'RF2')
        DROP PROCEDURE RF2
GO

--
--  Create a stored Refresh Delete procedure which will catch the
deadlock
--  victim abort and restart the delete transaction.
--
CREATE PROCEDURE RF2
    @current_execution INTEGER, @delete_sets INTEGER,
@parallel_executions INTEGER, @total_executions INTEGER
AS
BEGIN

DECLARE @startdate DATETIME
DECLARE @enddate DATETIME
DECLARE @edate DATETIME
DECLARE @rangeStart INTEGER
DECLARE @rangeSize INTEGER
DECLARE @range INTEGER

declare @success INTEGER
declare @index INTEGER
declare @div INTEGER
declare @mod INTEGER
declare @skip INTEGER
declare @i INTEGER
declare @rangeSum INTEGER
declare @totRangeSize INTEGER
declare @sql NCHAR(1000)
declare @orderSql NCHAR(1000)
declare @liSql NCHAR(1000)

SET @skip = @total_executions/@parallel_executions
SET @div = floor((@current_execution-1)/@parallel_executions)
SET @mod = (@current_execution - 1) - @div * @parallel_executions
SET @index = @mod*@skip + @div + 1

SET @sql = N'SELECT @sdate = dateadd(day,-
1,min(O_ORDERDATE)), @edate = max(O_ORDERDATE)
                FROM MOD_OLDORDERS'
EXEC sp_executesql @sql,N'@sdate datetime output, @edate datetime
output',@startdate output, @enddate output

IF (@total_executions > @parallel_executions)
        BEGIN
        SET @div = (@index-1)/@skip
        SET @mod = (@index-1) - @div * @skip
        SET @rangeSize = datediff(day, @startdate,
@enddate)/@parallel_executions + 1
        SET @totRangeSize = @rangeSize
        SET @rangeSum = 0
        SET @rangeStart = @div * @rangeSize
        SET @i = @mod
        WHILE (@i > 0)
                BEGIN
                SET @rangeSize = (@totRangeSize -
@rangeSum)/2
                SET @rangeSum = @rangeSum + @rangeSize
                SET @rangeStart = @rangeStart + @rangeSize
```

```
                SET @delete_sets = @delete_sets/2
                SET @i = @i - 1
                END

        IF (@mod + 1 = @skip) --  last allocation
                SET @rangeSize = @totRangeSize - @rangeSum
        ELSE
                SET @rangeSize = (@totRangeSize -
@rangeSum)/2
        IF (@rangeSize < 0)
                SET @rangeSize = 0
        IF (@delete_sets <= 0)
                SET @delete_sets = 1
        END
ELSE
        BEGIN
        SET @rangeSize = datediff(day, @startdate,
@enddate)/@total_executions
        SET @rangeStart = @rangeSize * (@index - 1)
        END

SET @startdate = dateadd(day, @rangeStart, @startdate)
IF (@index < @total_executions)
        SET @enddate = dateadd(day, @rangeSize, @startdate)

SET @range = datediff(day, @startdate, @enddate) / @delete_sets

--
--  This handles the case when the max-min/delete_sets is less that 1
--
IF @range = 0
        SET @range = 1

--
--  Loop through the order keys deleting sets from orders
--  and lineitem tables
--
SET @edate = dateadd(day, @range, @startdate)
SET @liSql = N'DELETE FROM LINEITEM WHERE
L_ORDERKEY in
                (SELECT O_ORDERKEY FROM
MOD_OLDORDERS
                        WHERE O_ORDERDATE >
@startdate AND O_ORDERDATE <= @edate)
                        option (loop join)'
SET @orderSql = N'DELETE FROM ORDERS WHERE
O_ORDERKEY in
                (SELECT O_ORDERKEY FROM
MOD_OLDORDERS
                        WHERE O_ORDERDATE >
@startdate AND O_ORDERDATE <= @edate)
                        option (loop join)'

WHILE @startdate < @enddate
        BEGIN

        DELETE_TRANS:
        SET @success = 1
        BEGIN TRANSACTION

        BEGIN TRY
                EXEC sp_executesql @liSql, N'@startdate
datetime, @edate datetime', @startdate, @edate
                EXEC sp_executesql @orderSql, N'@startdate
datetime, @edate datetime', @startdate, @edate
        END TRY
        BEGIN CATCH
                SET @success = 0
                IF (error_number() = 1205)      -- deadlock
victim
                        PRINT 'Insert deadlock - restarting
RF2'
                ELSE
                        BEGIN                           --
not a deadlock
                        PRINT 'Error - Not a deadlock'
                        PRINT ERROR_NUMBER()
                        PRINT ERROR_SEVERITY()
                PRINT ERROR_MESSAGE()
                PRINT ERROR_STATE()
                PRINT XACT_STATE()
                        END
                IF (@@trancount>0)
                        ROLLBACK TRANSACTION
        END CATCH

        IF (@success = 0)                       -- deadlock -
redo the inserts
                GOTO DELETE_TRANS

        COMMIT TRANSACTION

        SET @startdate = @edate
        SET @edate = dateadd(day, @range, @edate)

        IF (@edate > @enddate)
                SET @edate = @enddate

        END
END

GO
```

RF1_init.sql

```
--
-- Create tables to hold RF1 input data
--

if exists (select name from sysobjects where name = 'NEWORDERS')
                        drop table NEWORDERS

create table NEWORDERS (O_ORDERKEY bigint not null,
                O_CUSTKEY int not null,
                O_ORDERSTATUS char(1)  not null,
                O_TOTALPRICE  float  not null,
                O_ORDERDATE datetime not null,
                O_ORDERPRIORITY char(15)  not null,
                O_CLERK  char(15) not null,
                O_SHIPPRIORITY  int not null,
                O_COMMENT varchar(79) not null) on
DATA_FG


if exists (select name from sysobjects  where name = 'NEWLINEITEM')
                        drop table NEWLINEITEM
create table NEWLINEITEM (L_ORDERKEY  bigint  not null,
                L_PARTKEY int not null,
                L_SUPPKEY int not null,
                L_LINENUMBER int not null,
                L_QUANTITY float not null,
                L_EXTENDEDPRICE float not null,
                L_DISCOUNT float not null,
                L_TAX float not null,
                L_RETURNFLAG char(1) not null,
                L_LINESTATUS char(1) not null,
                L_SHIPDATE datetime not null,
                L_COMMITDATE datetime not null,
                L_RECEIPTDATE datetime not null,
```

```
                        L_SHIPINSTRUCT char(25)  not null,
                        L_SHIPMODE char(10 ) not null,
                        L_COMMENT varchar(44) not null) on
DATA_FG
```

RF2_init.sql

```
--
-- Create the tables to hold input data for RF2
--

declare @segment integer
declare @sql nchar(1000)


if exists (select name from sysobjects  where name =
'MOD_OLDORDERS')
                                drop table MOD_OLDORDERS
create table MOD_OLDORDERS (O_ORDERDATE datetime,
O_ORDERKEY bigint) on DATA_FG


set @segment = 1
while @segment <= %FILES_PER_UPDATE_SET%
        begin
        set @sql = 'if exists (select name from sysobjects  where
name = "OLDORDERS_'
                                                        +
RTRIM(CONVERT(varchar(30),@segment))+ '")
                                drop table OLDORDERS_' +
RTRIM(CONVERT(varchar(30),@segment))
        exec sp_executesql @sql
        set @sql = 'create table OLDORDERS_' +
RTRIM(CONVERT(varchar(30),@segment))
                                + '(O_ORDERKEY int) on
DATA_FG'
        exec sp_executesql @sql

        set @segment = @segment + 1
        end
```

RF1_load.sql

```
--
-- Load the insert data for the given segment
--

declare @sql nchar(1000)
declare @set integer

select @set = updateset from TPCH_AUX_TABLE

set @sql = 'bulk insert NEWLINEITEM
                        from "%RF_FLATFILE_DIR%\Lineitem.tbl.u' +
RTRIM(CONVERT(varchar(30),@set))
                                + '.%SEGMENT%" with
(FieldTerminator = "|", RowTerminator ="\n",tablock)'
exec sp_executesql @sql

set @sql = 'bulk insert NEWORDERS
                        from "%RF_FLATFILE_DIR%\Orders.tbl.u' +
RTRIM(CONVERT(varchar(30), @set))
                                + '.%SEGMENT%" with
(FieldTerminator = "|", RowTerminator ="\n",tablock)'
exec sp_executesql @sql
```

RF2_loda.sql

```
--
-- Load the RF2 data for the given segment
--

declare @set integer
declare @sql nchar(1000)

select @set = updateset from TPCH_AUX_TABLE

set @sql = 'bulk insert OLDORDERS_%SEGMENT%
                        from "%RF_FLATFILE_DIR%\Delete.u' +
RTRIM(CONVERT(varchar(30),@set))
                                + '.%SEGMENT%" with
(RowTerminator ="|",tablock)'
exec sp_executesql @sql

insert into MOD_OLDORDERS (O_ORDERDATE, O_ORDERKEY)
                        (select B.O_ORDERDATE, B.O_ORDERKEY
                        from OLDORDERS_%SEGMENT% A,
ORDERS B
                        where A.O_ORDERKEY = B.O_ORDERKEY)
```

RF1_index.sql

```
create clustered index NEWORDERS_CLUIDX
        on NEWORDERS (O_ORDERDATE)
        on DATA_FG

create clustered index NEWLINEITEM_CLUIDX
        on NEWLINEITEM (L_ORDERKEY)
        on DATA_FG
```

RF2_index.sql

```
create clustered index MOD_OLDORDERS_CLUIDX on
MOD_OLDORDERS (O_ORDERDATE)

create index MOD_OLDORDERS_IDX on MOD_OLDORDERS
(O_ORDERKEY)
```

StepMaster Source Code

This section lists VB code for StepMaster

cArrConstraints.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cArrConstraints"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:      cArrConstraints.cls
'            Microsoft TPC-H Kit Ver. 1.00
'            Copyright Microsoft, 1999
'            All Rights Reserved
'
'
'  PURPOSE:    Implements an array of cConstraint objects.
'            Type-safe wrapper around cNodeCollections.
'            Also contains additional functions that determine all the
'            constraints for a step, all constraints in a workspace,
'            validation functions, etc.
'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

Private mcarrConstraints As cNodeCollections

' Used to indicate the source module name when errors
' are raised by this class
Private mstrSource As String
Private Const mstrModuleName As String = "cArrConstraints."
Public Sub SaveWspConstraints(ByVal lngWorkspace As Long)
   ' Calls a procedure to commit all changes to the constraints
   ' in the passed in workspace.

   Call mcarrConstraints.Save(lngWorkspace)

End Sub
Public Property Set ConstraintDB(vdata As Database)

   Set mcarrConstraints.NodeDB = vdata

End Property
Public Property Get ConstraintDB() As Database

   Set ConstraintDB = mcarrConstraints.NodeDB

End Property

Public Sub Modify(cConsToUpdate As cConstraint)

   ' Modify the constraint record
   Call mcarrConstraints.Modify(cConsToUpdate)

End Sub
Public Sub CreateNewConstraintVersion(ByVal lngStepId As Long, _
      ByVal strNewVersion As String, _
      ByVal strOldVersion As String, _
      ByVal intStepType As Integer)

   ' Does all the processing needed to create new versions of
   ' all the constraints for a given step
   ' It inserts new constraint records in the database with
   ' the new version numbers on them
   ' It also updates the version number on all constraints
   ' for the step in the array to the new version passed in
   ' Since it handles both global and manager/worker steps,
   ' it checks for the step_id or global_step_id fields,
   ' depending on the type of step

   Dim lngIndex As Long
   Dim cUpdateConstraint As cConstraint

   On Error GoTo CreateNewConstraintVersionErr
   mstrSource = mstrModuleName & "CreateNewConstraintVersion"

   ' Update the version/global version on Constraint with the
   ' passed in step/global step id
   For lngIndex = 0 To mcarrConstraints.Count - 1
      Set cUpdateConstraint = mcarrConstraints(lngIndex)
      If intStepType = gintGlobalStep Then
         If cUpdateConstraint.GlobalStepId = lngStepId And _
               cUpdateConstraint.IndOperation <> DeleteOp Then
            cUpdateConstraint.GlobalVersionNo = strNewVersion

            ' Set the operation to indicate an insert
            cUpdateConstraint.IndOperation = InsertOp
         End If
      Else
         If cUpdateConstraint.StepId = lngStepId And _
               cUpdateConstraint.IndOperation <> DeleteOp Then
            cUpdateConstraint.VersionNo = strNewVersion

            ' Set the operation to indicate an insert
            cUpdateConstraint.IndOperation = InsertOp
         End If
      End If
   Next lngIndex

   Exit Sub

CreateNewConstraintVersionErr:
   LogErrors Errors
   gstrSource = mstrModuleName & "CreateNewConstraintVersion"
   On Error GoTo 0
   Err.Raise vbObjectError + errCreateNewConstraintVersionFailed, _
         mstrSource, _
         LoadResString(errCreateNewConstraintVersionFailed)

End Sub
Private Sub Class_Initialize()

   Set mcarrConstraints = New cNodeCollections
   BugMessage "cArrConstraints: Initialize event - setting Constraint
count to 0"

End Sub

Private Sub Class_Terminate()

   Set mcarrConstraints = Nothing
   BugMessage "cArrConstraints: Terminate event triggered"

End Sub

Public Sub Add(ByVal cConstraintToAdd As cConstraint)

   Set cConstraintToAdd.NodeDB = mcarrConstraints.NodeDB

   ' Retrieve a unique constraint identifier
   cConstraintToAdd.ConstraintId = cConstraintToAdd.NextIdentifier

   ' Call a procedure to load the constraint record in the array
```

```
    Call mcarrConstraints.Add(cConstraintToAdd)

End Sub
Public Sub Delete(ByVal cOldConstraint As cConstraint)

    Dim lngDeleteElement As Long
    Dim cConsToDelete As cConstraint

    lngDeleteElement =
QueryConstraintIndex(cOldConstraint.ConstraintId)
    Set cConsToDelete = mcarrConstraints(lngDeleteElement)

    Call mcarrConstraints.Delete(cConsToDelete.Position)

    Set cConsToDelete = Nothing

End Sub
Private Function QueryConstraintIndex(lngConstraintId As Long) _
        As Long

    Dim lngIndex As Integer

    ' Find the element in the array to be deleted
    For lngIndex = 0 To mcarrConstraints.Count - 1

        ' Note: The constraint id is not a primary key field in
        ' the database - there can be multiple records with the
        ' same constraint_id but for different versions of a step
        ' However, since we'll always load the constraint information
        ' for the latest version of a step, we'll have just one
        ' constraint record with a given constraint_id
        If mcarrConstraints(lngIndex).ConstraintId = lngConstraintId Then
            QueryConstraintIndex = lngIndex
            Exit Function
        End If

    Next lngIndex

    ' Raise error that Constraint has not been found
    ShowError errConstraintNotFound
    On Error GoTo 0
    Err.Raise vbObjectError + errConstraintNotFound, mstrSource, _
        LoadResString(errConstraintNotFound)

End Function

Public Function QueryConstraint(ByVal lngConstraintId As Long) _
    As cConstraint

    ' Returns a cConstraint object with the property values
    ' corresponding to the Constraint Identifier, lngConstraintId

    Dim lngQueryElement As Long

    lngQueryElement = QueryConstraintIndex(lngConstraintId)

    ' Set the return value to the queried Constraint
    Set QueryConstraint = mcarrConstraints(lngQueryElement)

End Function

Public Sub LoadConstraints(ByVal lngWorkspaceId As Long,
rstStepsInWsp As Recordset)

    ' Loads the constraints array with all the constraints
    ' for the workshop
    Dim recConstraints As Recordset
    Dim qyCons As DAO.QueryDef
    Dim strSql As String
    Dim dtStart As Date

    On Error GoTo LoadConstraintsErr
    mstrSource = mstrModuleName & "LoadConstraints"

    If rstStepsInWsp.RecordCount = 0 Then
        Exit Sub
    End If

    ' First check if the database object has been set
    If mcarrConstraints.NodeDB Is Nothing Then
        On Error GoTo 0
        Err.Raise vbObjectError + errSetDBBeforeLoad, _
            mstrSource, _
            LoadResString(errSetDBBeforeLoad)
    End If

    dtStart = Now

    ' Select based on the global step id since there might
    ' be constraints for a global step that run are executed
    ' for the workspace
    ' This method has the advantage that if the steps are queried right,
everything else follows
    strSql = "Select a.constraint_id, a.step_id, a.version_no, " & _
        " a.constraint_type, a.global_step_id, a.global_version_no, " & _
        " a.sequence_no, b.workspace_id " & _
        " from step_constraints a, att_steps b " & _
        " where a.global_step_id = b.step_id " & _
        " and a.global_version_no = b.version_no " & _
        " and a.global_step_id = [g_s_id] " & _
        " and a.global_version_no = [g_ver_no] " & _
        " and b.archived_flag = [archived] "

    ' Find the highest X-component of the version number
    strSql = strSql & " AND ( a.step_id = 0 or ( cint( mid( a.version_no,
1, instr( a.version_no, " & gstrDQ & gstrVerSeparator & gstrDQ & " ) -
1 ) ) = " & _
        " ( select max( cint( mid( version_no, 1, instr( version_no, " &
gstrDQ & gstrVerSeparator & gstrDQ & " ) - 1 ) ) ) " & _
        " from att_steps AS d " & _
        " WHERE a.step_id = d.step_id " & _
        " and d.archived_flag = [archived] ) "

    ' Find the highest Y-component of the version number for the highest
X-component
    strSql = strSql & " AND cint( mid( a.version_no, instr( a.version_no,
" & gstrDQ & gstrVerSeparator & gstrDQ & " ) + 1 ) ) = " & _
        " ( select max( cint( mid( version_no, instr( version_no, " &
gstrDQ & gstrVerSeparator & gstrDQ & " ) + 1 ) ) ) " & _
        " from att_steps AS y " & _
        " Where a.step_id = y.step_id " & _
        " AND cint( mid( version_no, 1, instr( version_no, " & gstrDQ &
gstrVerSeparator & gstrDQ & " ) - 1 ) ) = " & _
        " ( select max( cint( mid( version_no, 1, instr( version_no, " &
gstrDQ & gstrVerSeparator & gstrDQ & " ) - 1 ) ) ) " & _
        " from att_steps AS c " & _
        " WHERE y.step_id = c.step_id " & _
        " and c.archived_flag = [archived] ) ) ) ) "

    ' Order the constraints by sequence within a given step
    strSql = strSql & " order by a.sequence_no "

    Set qyCons =
mcarrConstraints.NodeDB.CreateQueryDef(gstrEmptyString, strSql)
    qyCons.Parameters("archived").Value = False

    rstStepsInWsp.MoveFirst

    While Not rstStepsInWsp.EOF
```

```
      If Not (rstStepsInWsp!global_flag) Then
         qyCons.Close
         BugMessage "Query constraints Read + load took: " &
CStr(DateDiff("s", dtStart, Now))
         Exit Sub
      End If

      qyCons.Parameters("g_s_id").Value = rstStepsInWsp!step_id
      qyCons.Parameters("g_ver_no").Value =
rstStepsInWsp!version_no

      Set recConstraints = qyCons.OpenRecordset(dbOpenSnapshot)

      Call LoadRecordsetInConstraintArray(recConstraints)
      recConstraints.Close

      rstStepsInWsp.MoveNext
   Wend

   qyCons.Close
   BugMessage "Query constraints Read + load took: " &
CStr(DateDiff("s", dtStart, Now))

   Exit Sub

LoadConstraintsErr:
   LogErrors Errors
   gstrSource = mstrModuleName & "LoadConstraints"
   On Error GoTo 0
   Err.Raise vbObjectError + errLoadDataFailed, _
         mstrSource, _
         LoadResString(errLoadDataFailed)

End Sub
Public Sub UnloadStepConstraints(ByVal lngStepId As Long)

   ' Unloads all the constraints for the workspace from
   ' the constraints array

   Dim lngIndex As Long

   ' Find all constraints in the array with a matching step id
   ' It is important to step in reverse order through the array,
   ' since we delete constraint records!
   For lngIndex = mcarrConstraints.Count - 1 To 0 Step -1
      If mcarrConstraints(lngIndex).GlobalStepId = lngStepId Then

         ' Unload the constraint from the array
         Call mcarrConstraints.Unload(lngIndex)

      End If
   Next lngIndex

End Sub
Public Sub UnloadConstraint(cOldConstraint As cConstraint)
   ' Unloads the constraint from the constraints array

   Dim lngDeleteElement As Long

   lngDeleteElement =
QueryConstraintIndex(cOldConstraint.ConstraintId)

   Call mcarrConstraints.Unload(lngDeleteElement)

End Sub
Private Sub LoadRecordsetInConstraintArray(ByVal recConstraints As
Recordset)
   ' Loads all the constraint records in the passed in
   ' recordset into the array

   Dim cNewConstraint As cConstraint

   On Error GoTo LoadRecordsetInConsArrayErr
   mstrSource = mstrModuleName &
"LoadRecordsetInConstraintArray"

   If recConstraints.RecordCount = 0 Then
      Exit Sub
   End If

   recConstraints.MoveFirst
   While Not recConstraints.EOF
      Set cNewConstraint = New cConstraint

      ' Initialize Constraint values
      cNewConstraint.ConstraintId =
CLng(ErrorOnNullField(recConstraints, "Constraint_id"))
      cNewConstraint.StepId = CLng(ErrorOnNullField(recConstraints,
"step_id"))
      cNewConstraint.VersionNo =
CStr(ErrorOnNullField(recConstraints, "version_no"))

      cNewConstraint.GlobalStepId =
CLng(ErrorOnNullField(recConstraints, "global_step_id"))
      cNewConstraint.GlobalVersionNo =
CStr(ErrorOnNullField(recConstraints, "global_version_no"))
      cNewConstraint.SequenceNo =
CInt(ErrorOnNullField(recConstraints, "sequence_no"))

      cNewConstraint.WorkspaceId =
CLng(ErrorOnNullField(recConstraints, FLD_ID_WORKSPACE))
      cNewConstraint.ConstraintType =
CInt(ErrorOnNullField(recConstraints, "constraint_type"))

      ' Add this record to the array of Constraints
      mcarrConstraints.Load cNewConstraint

      Set cNewConstraint = Nothing
      recConstraints.MoveNext
   Wend

   Exit Sub

LoadRecordsetInConsArrayErr:
   LogErrors Errors
   gstrSource = mstrModuleName &
"LoadRecordsetInConstraintArray"
   On Error GoTo 0
   Err.Raise vbObjectError + errLoadRsInArrayFailed, _
         mstrSource, _
         LoadResString(errLoadRsInArrayFailed)

End Sub

Public Function ConstraintsForStep( _
      ByVal lngStepId As Long, _
      ByVal strVersionNo As String, _
      Optional ByVal intConstraintType As ConstraintType = 0, _
      Optional ByVal blnSort As Boolean = True, _
      Optional ByVal blnGlobal As Boolean = False, _
      Optional ByVal blnGlobalConstraintsOnly As Boolean = False) _
      As Variant

   ' Returns a variant containing an array of cConstraint objects,
   ' containing all the constraints that have been defined for the
   ' given step. If the Global flag is set to true, the
   ' search will be made for all the constraints that have
   ' a matching global_step_id

   Dim lngIndex As Long
```

```
   Dim cStepConstraint() As cConstraint
   Dim lngConstraintCount As Long
   Dim cTempConstraint As cConstraint

   On Error GoTo ConstraintsForStepErr
   mstrSource = mstrModuleName & "ConstraintsForStep"

   lngConstraintCount = 0

   ' Find each element in the constraints array
   For lngIndex = 0 To mcarrConstraints.Count - 1
      ' If a constraint type has been specified then check
      ' if the constraint type for the record matches the
      ' passed in type
      Set cTempConstraint = mcarrConstraints(lngIndex)
      If Not blnGlobal Then
         If cTempConstraint.StepId = lngStepId And _
               cTempConstraint.VersionNo = strVersionNo And _
               cTempConstraint.IndOperation <> DeleteOp And _
               (intConstraintType = 0 Or _
               cTempConstraint.ConstraintType = intConstraintType)
Then
            ' We have a matching constraint for the given step
            AddArrayElement cStepConstraint, _
                  cTempConstraint, lngConstraintCount
         End If
      Else
         If cTempConstraint.GlobalStepId = lngStepId And _
               cTempConstraint.GlobalVersionNo = strVersionNo And _
               cTempConstraint.IndOperation <> DeleteOp Then
            If blnGlobalConstraintsOnly = False Or _
                  (blnGlobalConstraintsOnly And _
                  cTempConstraint.StepId = 0 And _
                  cTempConstraint.VersionNo = gstrMinVersion) Then

               ' We have a matching constraint for the global step
               AddArrayElement cStepConstraint, _
                     cTempConstraint, lngConstraintCount
            End If
         End If
      End If

   Next lngIndex

   ' Set the return value of the function to the array of
   ' constraints that has been built above
   If lngConstraintCount = 0 Then
      ConstraintsForStep = Empty
   Else
      ConstraintsForStep = cStepConstraint()
   End If

   ' Sort the constraints
   If blnSort Then
      Call QuickSort(ConstraintsForStep)
   End If

   Exit Function

ConstraintsForStepErr:
   LogErrors Errors
   On Error GoTo 0
   Err.Raise vbObjectError + errConstraintsForStepFailed, _
         mstrSource, _
         LoadResString(errConstraintsForStepFailed)

End Function
Private Sub AddArrayElement(ByRef arrNodes() As cConstraint, _
      ByVal objToAdd As cConstraint, _
      ByRef lngCount As Long)

   ' Adds the passed in object to the array

   ' Increase the array dimension and add the object to it
   ReDim Preserve arrNodes(lngCount)
   Set arrNodes(lngCount) = objToAdd
   lngCount = lngCount + 1

End Sub

Public Function ConstraintsForWsp( _
      ByVal lngWorkspaceId As Long, _
      Optional ByVal intConstraintType As Integer = 0, _
      Optional ByVal blnSort As Boolean = True, _
      Optional ByVal blnGlobalConstraintsOnly As Boolean = False) _
      As Variant

   ' Returns a variant containing an array of cConstraint objects,
   ' containing all the constraints that have been defined for the
   ' given workspace.

   Dim lngIndex As Long
   Dim cWspConstraint() As cConstraint
   Dim lngConstraintCount As Long
   Dim cTempConstraint As cConstraint

   On Error GoTo ConstraintsForWspErr
   mstrSource = mstrModuleName & "ConstraintsForWsp"

   lngConstraintCount = 0

   ' Find each element in the constraints array
   For lngIndex = 0 To mcarrConstraints.Count - 1
      ' If a constraint type has been specified then check
      ' if the constraint type for the record matches the
      ' passed in type
      Set cTempConstraint = mcarrConstraints(lngIndex)
      If cTempConstraint.WorkspaceId = lngWorkspaceId And _
            cTempConstraint.IndOperation <> DeleteOp And _
            (intConstraintType = 0 Or _
            cTempConstraint.ConstraintType = intConstraintType) Then

         If blnGlobalConstraintsOnly = False Or _
               (blnGlobalConstraintsOnly And _
               cTempConstraint.StepId = 0 And _
               cTempConstraint.VersionNo = gstrMinVersion) Then

            ' We have a matching constraint for the workspace
            AddArrayElement cWspConstraint, _
                  cTempConstraint, lngConstraintCount
         End If
      End If
   Next lngIndex

   ' Set the return value of the function to the array of
   ' constraints that has been built above
   If lngConstraintCount = 0 Then
      ConstraintsForWsp = Empty
   Else
      ConstraintsForWsp = cWspConstraint()
   End If

   ' Sort the constraints
   If blnSort Then
      Call QuickSort(ConstraintsForWsp)
   End If

   Exit Function

ConstraintsForWspErr:
   LogErrors Errors
```

```
    On Error GoTo 0
    Err.Raise vbObjectError + errConstraintsForWspFailed, _
          mstrSource, _
          LoadResString(errConstraintsForWspFailed)

End Function
Public Function PreConstraintsForStep( _
        ByVal lngStepId As Long, _
        ByVal strVersionNo As String, _
        Optional ByVal blnSort As Boolean) As Variant

    ' Returns a variant containing an array of cConstraint objects,
    ' containing all the pre-execution constraints that have
    ' been defined for the given step_id and version

    ' Call a function that will return a variant containing
    ' all the constraints of the passed in type
    PreConstraintsForStep = ConstraintsForStep(lngStepId, _
          strVersionNo, gintPreStep, blnSort)

End Function
Public Function PostConstraintsForStep( _
        ByVal lngStepId As Long, _
        ByVal strVersionNo As String, _
        Optional ByVal blnSort As Boolean) As Variant

    ' Returns a variant containing an array of cConstraint objects,
    ' containing all the Post-execution constraints that have
    ' been defined for the given step_id and version

    ' Call a function that will return a variant containing
    ' all the constraints of the passed in type
    PostConstraintsForStep = ConstraintsForStep(lngStepId, _
          strVersionNo, gintPostStep, blnSort)

End Function
Public Function PostConstraintsForWsp( _
        ByVal lngWorkspaceId As Long, _
        Optional ByVal blnSort As Boolean) As Variant

    ' Returns a variant containing an array of cConstraint objects,
    ' containing all the Post-execution globals that have
    ' been defined for the workspace

    ' Call a function that will return a variant containing
    ' all the constraints of the passed in type
    PostConstraintsForWsp = ConstraintsForWsp(lngWorkspaceId, _
          gintPostStep, blnSort, True)

End Function
Public Function PreConstraintsForWsp( _
        ByVal lngWorkspaceId As Long, _
        Optional ByVal blnSort As Boolean) As Variant

    ' Returns a variant containing an array of cConstraint objects,
    ' containing all the Pre-execution globals that have
    ' been defined for the workspace

    ' Call a function that will return a variant containing
    ' all the constraints of the passed in type
    PreConstraintsForWsp = ConstraintsForWsp(lngWorkspaceId, _
          gintPreStep, blnSort, True)

End Function
Public Property Get ConstraintCount() As Long

    ConstraintCount = mcarrConstraints.Count

End Property
```

cArrParameters.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cArrParameters"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:      cArrParameters.cls
'             Microsoft TPC-H Kit Ver. 1.00
'             Copyright Microsoft, 1999
'             All Rights Reserved
'
'
'  PURPOSE:    Implements an array of cParameter objects.
'             Type-safe wrapper around cNodeCollections.
'             Also contains additional functions to determine parameter
'             values, validation functions, etc.
'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

Private mcarrParameters As cNodeCollections

' Used to indicate the source module name when errors
' are raised by this class
Private mstrSource As String
Private Const mstrModuleName As String = "cArrParameters."

Public Sub InitBuiltInsForRun(lWspId As Long, lRunId As Long)

    Dim cParamRec As cParameter

    ' Initialize the values of the run_id and output_dir built-in parameters
and save them
    ' to the database
    Set cParamRec = GetParameterValue(lWspId, PARAM_RUN_ID)
    cParamRec.ParameterValue = CStr(lRunId)
    Call Modify(cParamRec)

    Set cParamRec = GetParameterValue(lWspId,
PARAM_OUTPUT_DIR)
    cParamRec.ParameterValue = GetDefaultDir(lWspId, Me)
    cParamRec.ParameterValue = cParamRec.ParameterValue &
gstrFileSeparator & CStr(lRunId)
    Call Modify(cParamRec)

    Call SaveParametersInWsp(lWspId)

End Sub


Public Property Set ParamDatabase(vdata As Database)

    Set mcarrParameters.NodeDB = vdata

End Property
Public Sub Modify(cModifiedParam As cParameter)

    ' First check if the parameter record is valid
    Call CheckDupParamName(cModifiedParam)

    Call mcarrParameters.Modify(cModifiedParam)

End Sub
Public Sub Load(ByRef cParamToAdd As cParameter)
```

```
    Call mcarrParameters.Load(cParamToAdd)

End Sub
Public Sub Add(ByRef cParamToAdd As cParameter)

    Set cParamToAdd.NodeDB = mcarrParameters.NodeDB

    ' First check if the parameter record is valid
    Call Validate(cParamToAdd)

    ' Retrieve a unique parameter identifier
    cParamToAdd.ParameterId = cParamToAdd.NextIdentifier

    Call mcarrParameters.Add(cParamToAdd)

End Sub

Public Sub Unload(lngParamToDelete As Long)

    Dim lngDeleteElement As Long

    lngDeleteElement = QueryIndex(lngParamToDelete)

    Call mcarrParameters.Unload(lngDeleteElement)

End Sub

Public Sub SaveParametersInWsp(ByVal lngWorkspace As Long)
    ' Calls a procedure to commit all changes to the parameters
    ' for the passed in workspace.

    ' Call a procedure to save all parameter records for the
    ' workspace
    Call mcarrParameters.Save(lngWorkspace)

End Sub
Public Function GetParameterValue(ByVal lngWorkspace As Long, _
        ByVal strParamName As String) As cParameter
    ' Returns the value for the passed in workspace parameter

    Dim cParamRec As cParameter
    Dim lngIndex As Long

    On Error GoTo GetParameterValueErr

    ' Find all parameters in the array with a matching workspace id
    For lngIndex = 0 To mcarrParameters.Count - 1
        Set cParamRec = mcarrParameters(lngIndex)
        If cParamRec.WorkspaceId = lngWorkspace And _
                cParamRec.ParameterName = strParamName Then

            Set GetParameterValue = cParamRec
            Exit For
        End If
    Next lngIndex

    If lngIndex > mcarrParameters.Count - 1 Then
        ' The parameter has not been defined for the workspace
        ' Raise an error
        On Error GoTo 0
        Err.Raise vbObjectError + errParamNameInvalid, _
                mstrModuleName & "GetParameterValue", _
                LoadResString(errParamNameInvalid)
    End If

    Exit Function

GetParameterValueErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    gstrSource = mstrModuleName & "GetParameterValue"
    On Error GoTo 0
    Err.Raise vbObjectError + errGetParamValueFailed, _
            gstrSource, _
            LoadResString(errGetParamValueFailed)

End Function
Public Sub Delete(lngParamToDelete As Long)
    ' Delete the passed in parameter

    Dim lngDeleteElement As Long

    lngDeleteElement = QueryIndex(lngParamToDelete)
    Call mcarrParameters.Delete(lngDeleteElement)

End Sub
Private Function QueryIndex(lngParameterId As Long) As Long

    Dim lngIndex As Long

    ' Find the matching parameter record in the array
    For lngIndex = 0 To mcarrParameters.Count - 1
        If mcarrParameters(lngIndex).ParameterId = lngParameterId And _
                mcarrParameters(lngIndex).IndOperation <> DeleteOp Then
            QueryIndex = lngIndex
            Exit Function
        End If
    Next lngIndex

    ' Raise error that parameter has not been found
    On Error GoTo 0
    Err.Raise vbObjectError + errParamNotFound,
"cArrParameters.QueryIndex", _
        LoadResString(errParamNotFound)

End Function

Public Function QueryParameter(lngParameterId As Long) _
        As cParameter

    Dim lngQueryElement As Long

    lngQueryElement = QueryIndex(lngParameterId)

    ' Return the queried parameter object
    Set QueryParameter = mcarrParameters(lngQueryElement)

End Function
Public Property Get ParameterCount() As Long

    ParameterCount = mcarrParameters.Count

End Property
Public Property Get Item(lngIndex As Long) As cParameter
Attribute Item.VB_UserMemId = 0

    Set Item = mcarrParameters(lngIndex)

End Property

Public Sub Validate(ByVal cParamToValidate As cParameter)
    ' This procedure is necessary since the class cannot validate
    ' all the parameter properties on it's own. This is 'coz we
    ' might have created new parameters in the workspace, but not
    ' saved them to the database yet - hence the duplicate check
    ' has to be repeated in the array

    Dim lngIndex As Long
    Dim cTempParam As cParameter
```

```
   On Error GoTo ValidateErr

   ' Check if the parameter name already exists in the workspace
   For lngIndex = 0 To mcarrParameters.Count - 1
      Set cTempParam = mcarrParameters(lngIndex)
      If cTempParam.WorkspaceId = cParamToValidate.WorkspaceId
And _
            cTempParam.ParameterName =
cParamToValidate.ParameterName And _
            cTempParam.IndOperation <> DeleteOp Then
         On Error GoTo 0
         Err.Raise vbObjectError + errDuplicateParameterName, _
            mstrSource, LoadResString(errDuplicateParameterName)
      End If
   Next lngIndex

   Exit Sub

ValidateErr:
   LogErrors Errors
   mstrSource = mstrModuleName & "Validate"
   On Error GoTo 0
   Err.Raise vbObjectError + errValidateFailed, _
      mstrSource, LoadResString(errValidateFailed)

End Sub
Public Sub CheckDupParamName(ByVal cParamToValidate As
cParameter)

   Dim lngIndex As Long
   Dim cTempParam As cParameter

   ' Check if the parameter name already exists in the workspace
   For lngIndex = 0 To mcarrParameters.Count - 1
      Set cTempParam = mcarrParameters(lngIndex)
      If cTempParam.WorkspaceId = cParamToValidate.WorkspaceId
And _
            cTempParam.ParameterName =
cParamToValidate.ParameterName And _
            cTempParam.ParameterId <> cParamToValidate.ParameterId
And _
            cTempParam.IndOperation <> DeleteOp Then
         ShowError errDuplicateParameterName
         On Error GoTo 0
         Err.Raise vbObjectError + errDuplicateParameterName, _
            mstrSource, LoadResString(errDuplicateParameterName)
      End If
   Next lngIndex

End Sub

Private Sub Class_Initialize()

   'bugmessage "cArrParameters: Initialize event - setting parameter
count to 0"
   Set mcarrParameters = New cNodeCollections

End Sub


Private Sub Class_Terminate()

   Set mcarrParameters = Nothing

End Sub
```

cArrSteps.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cArrSteps"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:      cArrSteps.cls
'             Microsoft TPC-H Kit Ver. 1.00
'             Copyright Microsoft, 1999
'             All Rights Reserved
'
'
'  PURPOSE:    Implements an array of cStep objects.
'             Type-safe wrapper around cNodeCollections.
'             Also contains additional functions to update parent version
'             on substeps, validation functions, etc.
'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

Private mcarrSteps As cNodeCollections

' Used to indicate the source module name when errors
' are raised by this class
Private mstrSource As String
Private Const mstrModuleName As String = "cArrSteps."

Public Sub Unload(lngStepToDelete As Long)

   Dim lngDeleteElement As Long
   Dim cUnloadStep As cStep

   lngDeleteElement = QueryStepIndex(lngStepToDelete)
   Set cUnloadStep = QueryStep(lngStepToDelete)

   ' First unload all iterators for the step
   Call cUnloadStep.UnloadIterators

   ' Unload the step from the collection
   Call mcarrSteps.Unload(lngDeleteElement)

End Sub
Public Sub Modify(cModifiedStep As cStep)

   Dim iAppend As Integer
   Dim sLabel As String

   On Error GoTo ModifyErr

   iAppend = 0
   sLabel = cModifiedStep.StepLabel

   Validate cModifiedStep

   Call mcarrSteps.Modify(cModifiedStep)

   Exit Sub

ModifyErr:
   ' If the error raised by the add function is due to a duplication
   ' of the step label, then try to generate a unique label
   If Err.Number - vbObjectError = errStepLabelUnique Then
      iAppend = iAppend + 1
      cModifiedStep.StepLabel = sLabel & CStr(iAppend)
      ' Try to insert the step record again
      Resume
   End If

   ' Log the error code raised by Visual Basic
```

```
    Call LogErrors(Errors)
    On Error GoTo 0
    Err.Raise vbObjectError + errModifyStepFailed, _
          gstrSource, _
          LoadResString(errModifyStepFailed)

End Sub
Public Sub UpdateParentVersion(ByVal lngStepId As Long, _
       ByVal strNewVersion As String, _
       ByVal strOldVersion As String, _
       ByVal intStepType As Integer)

    ' Does all the processing needed to update the parent version
    ' number on all the sub-steps for a given step
    ' It updates the parent version no in the database for all
    ' sub-steps of the passed in step id
    ' It also updates the parent version number on all sub-steps
    ' in the array to the new version passed in

    Dim lngIndex As Long
    Dim cUpdateStep As cStep

    On Error GoTo UpdateParentVersionErr

    If intStepType <> gintManagerStep Then
       ' Only a manager can have sub-steps - if the passed
       ' in step is not a manager, exit
       Exit Sub
    End If

    ' For all steps in the array
    For lngIndex = 0 To mcarrSteps.Count - 1

       Set cUpdateStep = mcarrSteps(lngIndex)

       ' If the current step is a sub-step of the passed in step
       If cUpdateStep.ParentStepId = lngStepId And _
             cUpdateStep.ParentVersionNo = strOldVersion And _
             Not cUpdateStep.ArchivedFlag Then

          ' Update the parent version number for the sub-step
          ' in the array
          cUpdateStep.ParentVersionNo = strNewVersion

          ' Update the parent version number for the sub-step
          ' in the array
          Call Modify(cUpdateStep)

       End If
    Next lngIndex

    Exit Sub

UpdateParentVersionErr:
    LogErrors Errors
    mstrSource = mstrModuleName & "UpdateParentVersion"
    On Error GoTo 0
    Err.Raise vbObjectError + errUpdateParentVersionFailed, _
          mstrSource, _
          LoadResString(errUpdateParentVersionFailed)

End Sub
Private Sub Validate(cCheckStep As cStep)

    ' Step validations that depend on other steps in the collection

    Dim lngIndex As Long

    ' Ensure that the step label is unique in the workspace
    For lngIndex = 0 To mcarrSteps.Count - 1

       ' If the current step is a sub-step of the passed in step
       If mcarrSteps(lngIndex).WorkspaceId = cCheckStep.WorkspaceId
And _
             mcarrSteps(lngIndex).StepLabel = cCheckStep.StepLabel
And _
             mcarrSteps(lngIndex).StepId <> cCheckStep.StepId And _
             mcarrSteps(lngIndex).IndOperation <> DeleteOp Then
          On Error GoTo 0
          Err.Raise vbObjectError + errStepLabelUnique, _
                mstrModuleName & "Validate", _
                LoadResString(errStepLabelUnique)
       End If
    Next lngIndex

End Sub

Public Sub ValidateStep(cCheckStep As cStep)

    On Error GoTo ValidateStepErr

    'Public wrapper for Validate function (2 many Validates)
    Call Validate(cCheckStep)

    Exit Sub

ValidateStepErr:
    ShowError errStepLabelUnique
    On Error GoTo 0
    Err.Raise vbObjectError + errValidateFailed, _
          gstrSource, _
          LoadResString(errValidateFailed)
End Sub

Private Sub Class_Initialize()

    BugMessage "cArrSteps: Initialize event - setting step count to 0"
    Set mcarrSteps = New cNodeCollections

End Sub

Private Sub Class_Terminate()

    BugMessage "cArrSteps: Terminate event triggered"
    Set mcarrSteps = Nothing

End Sub

Public Sub Add(ByVal cStepToAdd As cStep)

    Dim iAppend As Integer
    Dim sLabel As String

    On Error GoTo AddErr

    iAppend = 0
    sLabel = cStepToAdd.StepLabel

    Set cStepToAdd.NodeDB = mcarrSteps.NodeDB

    ' Retrieve a unique step identifier
    cStepToAdd.StepId = cStepToAdd.NextStepId

    Validate cStepToAdd

    ' Call a procedure to add the step record
    Call mcarrSteps.Add(cStepToAdd)

    ' Call a procedure to add all iterators for the step
    cStepToAdd.AddAllIterators
```

```
    Exit Sub

AddErr:
    ' If the error raised by the add function is due to a duplication
    ' of the step label, then try to generate a unique label
    If Err.Number - vbObjectError = errStepLabelUnique Then
        iAppend = iAppend + 1
        cStepToAdd.StepLabel = sLabel & CStr(iAppend)
        ' Try to insert the step record again
        Resume
    End If

    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    On Error GoTo 0
    Err.Raise vbObjectError + errInsertStepFailed, _
            gstrSource, _
            LoadResString(errInsertStepFailed)

End Sub
Public Sub Load(cStepToLoad As cStep)

    Call mcarrSteps.Load(cStepToLoad)

End Sub
Public Sub SaveStepsInWsp(ByVal lngWorkspace As Long)
    ' Calls a procedure to commit all changes to the steps
    ' in the passed in workspace.

    Dim lngIndex As Integer

    ' Find all steps in the array with a matching workspace id
    ' It is important to step in reverse order through the array,
    ' since we delete step records sometimes!
    For lngIndex = mcarrSteps.Count - 1 To 0 Step -1
        If mcarrSteps(lngIndex).WorkspaceId = lngWorkspace Then

            ' Call a procedure to commit all changes to the
            ' Step record, if any
            Call CommitStep(mcarrSteps(lngIndex), lngIndex)

        End If
    Next lngIndex

End Sub
Private Sub CommitStep(ByVal cCommitStep As cStep, _
        ByVal intIndex As Integer)
    ' This procedure checks if any changes have been made to the
    ' passed in Step. If so, it calls the step methods to commit
    ' the changes.

    ' First commit all changes to the iterator records for
    ' the step
    cCommitStep.SaveIterators

    Call mcarrSteps.Commit(cCommitStep, intIndex)

End Sub
Public Sub Delete(lngStepToDelete As Long)

    Dim lngDeleteElement As Long

    lngDeleteElement = QueryStepIndex(lngStepToDelete)
    Call mcarrSteps.Delete(lngDeleteElement)

End Sub
Public Function QueryStepIndex(lngStepId As Long) As Long

    Dim lngIndex As Long

    ' Find the element in the array that corresponds to the
    ' passed in step id - note that while there will be multiple
    ' versions of a step in the database, only one version will
    ' be currently loaded in the array - meaning that the stepid
    ' is enough to uniquely identify a step
    For lngIndex = 0 To mcarrSteps.Count - 1
        If mcarrSteps(lngIndex).StepId = lngStepId Then
            QueryStepIndex = lngIndex
            Exit Function
        End If
    Next lngIndex

    ' Raise error that step has not been found
    On Error GoTo 0
    Err.Raise vbObjectError + errStepNotFound, mstrSource, _
        LoadResString(errStepNotFound)

End Function

Public Function QueryStep(ByVal lngStepId As Long) As cStep

    ' Populates the passed in cStep object with the property
    ' values corresponding to the Step Identifier, lngStepId

    Dim lngQueryElement As Integer

    lngQueryElement = QueryStepIndex(lngStepId)

    ' Initialize the passed in step object to the queried step
    Set QueryStep = mcarrSteps(lngQueryElement)

End Function
Public Property Get Item(ByVal Position As Long) As cStep
Attribute Item.VB_UserMemId = 0

    ' Returns the element at the passed in position in the array
    If Position >= 0 And Position < mcarrSteps.Count Then
        Set Item = mcarrSteps(Position)
    Else
        On Error GoTo 0
        Err.Raise vbObjectError + errItemDoesNotExist, mstrSource, _
            LoadResString(errItemDoesNotExist)
    End If

End Property
Public Property Set Item(ByVal Position As Long, _
        ByVal cStepRec As cStep)

    ' Returns the element at the passed in position in the array
    If Position >= 0 And Position < mcarrSteps.Count Then
        Set mcarrSteps(Position) = cStepRec
    Else
        On Error GoTo 0
        Err.Raise vbObjectError + errItemDoesNotExist, mstrSource, _
            LoadResString(errItemDoesNotExist)
    End If

End Property
Public Property Set StepDB(vdata As Database)

    Set mcarrSteps.NodeDB = vdata

End Property
Public Function SubSteps(ByVal lngStepId As Long, _
        ByVal strVersionNo As String) As Variant

    ' Returns a variant containing an array of all the substeps
    ' for the passed in step
```

```
   Dim intIndex As Integer
   Dim cSubSteps() As cStep
   Dim lngStepCount As Long
   Dim cQueryStep As cStep

   On Error GoTo SubStepsErr

   lngStepCount = 0

   Set cQueryStep = QueryStep(lngStepId)

   ' Only a manager can have sub-steps
   If cQueryStep.StepType = gintManagerStep Then

      ' For each element in the Steps array
      For intIndex = 0 To mcarrSteps.Count - 1
         ' Check if the parent step id and parent version number
         ' match the passed in step
         If mcarrSteps(intIndex).ParentStepId = lngStepId And _
               mcarrSteps(intIndex).ParentVersionNo = strVersionNo
And _
               mcarrSteps(intIndex).IndOperation <> DeleteOp Then

            ' Increase the array dimension and add the step
            ' to it
            ReDim Preserve cSubSteps(lngStepCount)
            Set cSubSteps(lngStepCount) = mcarrSteps(intIndex)
            lngStepCount = lngStepCount + 1

         End If
      Next intIndex

   End If

   ' Set the return value of the function to the array of
   ' Steps that has been built above
   If lngStepCount = 0 Then
      SubSteps = Empty
   Else
      SubSteps = cSubSteps()
   End If

   Exit Function

SubStepsErr:
   LogErrors Errors
   mstrSource = mstrModuleName & "SubSteps"
   On Error GoTo 0
   Err.Raise vbObjectError + errSubStepsFailed, _
         mstrSource, _
         LoadResString(errSubStepsFailed)

End Function

Public Property Get StepCount() As Integer

   StepCount = mcarrSteps.Count

End Property
```

cAsyncShell.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cAsyncShell"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'-----------------------------------------------------------------------------
' Copyright © 1997 Microsoft Corporation. All rights reserved.
'
' You have a royalty-free right to use, modify, reproduce and distribute
the
' Sample Application Files (and/or any modified version) in any way
you find
' useful, provided that you agree that Microsoft has no warranty,
obligations or
' liability for any Sample Application Files.
'-----------------------------------------------------------------------------

Option Explicit

' Used to indicate the source module name when errors
' are raised by this class
Private mstrSource As String
Private Const mstrModuleName As String = "cAsyncShell."

Public Event Terminated()

Private WithEvents moTimer As cTimerSM
Attribute moTimer.VB_VarHelpID = -1
Private proc As PROCESS_INFORMATION
Private mfShelling As Boolean


'-----------------------------------------------------------------------------
'Initialization and cleanup:

Private Sub Class_Initialize()
   Set moTimer = New cTimerSM
End Sub

Private Sub Class_Terminate()
   If mfShelling Then CloseHandle proc.hProcess
End Sub

'-----------------------------------------------------------------------------
'Shelling:

Public Sub Shell(CommandLine As String, Optional PollingInterval As
Long = 1000)
   Dim Start As STARTUPINFO

   If mfShelling Then
      On Error GoTo 0
      Err.Raise vbObjectError + errInstanceInUse, _
            mstrSource, _
            LoadResString(errInstanceInUse)
   End If
   mfShelling = True

   ' Initialize the STARTUPINFO structure:
   Start.cb = Len(Start)
   Start.dwFlags = STARTF_USESHOWWINDOW
   Start.wShowWindow = SW_SHOWMINNOACTIVE

   ' Start the shelled application:
   CreateProcessA 0&, CommandLine, 0&, 0&, 1&, _
      NORMAL_PRIORITY_CLASS, 0&, 0&, Start, proc

   With moTimer
      If PollingInterval > 0 Then
         .Interval = PollingInterval
      Else
         .Interval = 1000
      End If
      .Enabled = True
```

```
   End With
End Sub
'-----------------------------------------------------------------------------
'Aborting:
Public Sub Abort()
   Dim nCode As Long
'    Dim X As Integer
'    Dim ReturnVal As Integer

   On Error GoTo AbortErr

   If Not mfShelling Then
      Call WriteError(errProgramError, mstrSource)
   Else
'       If IsWindow(proc.hProcess) = False Then Exit Sub
'
'       If (GetWindowLong(proc.hProcess, GWL_STYLE) And
WS_DISABLED) Then Exit Sub
'
'       If IsWindow(proc.hProcess) Then
'          If Not (GetWindowLong(proc.hProcess, GWL_STYLE) And
WS_DISABLED) Then
'             X = PostMessage(proc.hProcess, WM_CANCELMODE, 0,
0&)
'             X = PostMessage(proc.hProcess, WM_CLOSE, 0, 0&)
'          End If
'       End If

      If TerminateProcess(proc.hProcess, 0&) = 0 Then
         Debug.Print "Unable to terminate process: " & proc.hProcess
         Call WriteError(errTerminateProcessFailed, mstrSource, _
               ApiError(GetLastError()))
      Else
         ' Should always come here!
         GetExitCodeProcess proc.hProcess, nCode
         If nCode = STILL_ACTIVE Then
            ' Write an error and close the handles to the
            ' process anyway
            Call WriteError(errTerminateProcessFailed, mstrSource)
         End If
      End If

      ' Close all open handles to the shelled process, even
      ' if any of the above calls error out
      CloseHandle proc.hProcess
      moTimer.Enabled = False
      mfShelling = False
      RaiseEvent Terminated

   End If

   Exit Sub

AbortErr:
   Call LogErrors(Errors)
   mstrSource = mstrModuleName & "Abort"
   On Error GoTo 0
   Err.Raise vbObjectError + errProgramError, _
      mstrSource, _
      LoadResString(errProgramError)

End Sub
Private Sub moTimer_Timer()
   Dim nCode As Long

   GetExitCodeProcess proc.hProcess, nCode
   If nCode <> STILL_ACTIVE Then
      CloseHandle proc.hProcess
      moTimer.Enabled = False
      mfShelling = False
      RaiseEvent Terminated
   End If
End Sub
```

cConnDtl.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cConnDtl"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:       cConnDtl.cls
'              Microsoft TPC-H Kit Ver. 1.00
'              Copyright Microsoft, 1999
'              All Rights Reserved
'
'
'  PURPOSE:    Encapsulates the properties and methods of a
connection.
'              Contains functions to insert, update and delete
'              connection_dtls records from the database.
'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit
Option Base 0

' Local variable(s) to hold property value(s)
Public WorkspaceId As Long
Public ConnNameId As Long
Public ConnName As String
Public ConnectionString As String
Public ConnType As ConnectionType
Public Position As Long
Public NodeDB As Database

Private mintOperation As Operation

' Used to indicate the source module name when errors
' are raised by this class
Private mstrSource As String
Private Const mstrModuleName As String = "cConnDtl."

' The cSequence class is used to generate unique Connection identifiers
Private mConnectionSeq As cSequence

' The StringSM class is used to carry out string operations
Private mFieldValue As cStringSM

Private Sub AssignParameters(qyExec As DAO.QueryDef)
   ' Assigns values to the parameters in the querydef object
   ' The parameter names are cryptic to differentiate them from the field
names.
   ' When the parameter names are the same as the field names,
parameters in the where
   ' clause do not get created.

   Dim prmParam As DAO.Parameter

   On Error GoTo AssignParametersErr

   For Each prmParam In qyExec.Parameters
      Select Case prmParam.Name
         Case "[w_id]"
            prmParam.Value = WorkspaceId

         Case "[c_id]"
```

```
            prmParam.Value = ConnNameId

        Case "[c_name]"
            prmParam.Value = ConnName

        Case "[c_str]"
            prmParam.Value = ConnectionString

        Case "[c_type]"
            prmParam.Value = ConnType

        Case Else
            ' Write the parameter name that is faulty
            WriteError errInvalidParameter, mstrSource, prmParam.Name
            On Error GoTo 0
            Err.Raise errInvalidParameter, mstrModuleName &
"AssignParameters", _
                LoadResString(errInvalidParameter)
    End Select
  Next prmParam

  Exit Sub

AssignParametersErr:

  Call LogErrors(Errors)
  On Error GoTo 0
  Err.Raise vbObjectError + errAssignParametersFailed, _
    mstrModuleName & "AssignParameters",
LoadResString(errAssignParametersFailed)

End Sub

Public Function Clone() As cConnDtl

  ' Creates a copy of a given Connection

  Dim cCloneConn As cConnDtl

  On Error GoTo CloneErr

  Set cCloneConn = New cConnDtl

  ' Copy all the Connection properties to the newly created Connection
  cCloneConn.WorkspaceId = WorkspaceId
  cCloneConn.ConnNameId = ConnNameId
  cCloneConn.ConnName = ConnName
  cCloneConn.ConnectionString = ConnectionString
  cCloneConn.ConnType = ConnType
  cCloneConn.IndOperation = mintOperation
  cCloneConn.Position = Position

  ' And set the return value to the newly created Connection
  Set Clone = cCloneConn
  Set cCloneConn = Nothing

  Exit Function

CloneErr:
  LogErrors Errors
  mstrSource = mstrModuleName & "Clone"
  On Error GoTo 0
  Err.Raise vbObjectError + errCloneFailed, mstrSource,
LoadResString(errCloneFailed)

End Function
Private Sub CheckDupConnectionName()
  ' Check if the Connection name already exists in the workspace

  Dim rstConnection As Recordset
  Dim strSql As String
  Dim qy As DAO.QueryDef

  On Error GoTo CheckDupConnectionNameErr
  mstrSource = mstrModuleName & "CheckDupConnectionName"

  ' Create a recordset object to retrieve the count of all Connections
  ' for the workspace with the same name
  strSql = "Select count(*) as Connection_count " & _
    " from " & TBL_CONNECTION_DTLS & _
    " where " & FLD_ID_WORKSPACE & " = [w_id]" & _
    " and " & FLD_CONN_DTL_CONNECTION_NAME & " =
[c_name]" & _
    " and " & FLD_ID_CONN_NAME & " <> [c_id]"

  Set qy = dbsAttTool.CreateQueryDef(gstrEmptyString, strSql)
  Call AssignParameters(qy)

  Set rstConnection = qy.OpenRecordset(dbOpenForwardOnly)

  If rstConnection![Connection_count] > 0 Then
    rstConnection.Close
    qy.Close
    ShowError errDupConnDtlName
    On Error GoTo 0
    Err.Raise vbObjectError + errDupConnDtlName, _
      mstrSource, LoadResString(errDupConnDtlName)
  End If

  rstConnection.Close
  qy.Close

  Exit Sub

CheckDupConnectionNameErr:
  LogErrors Errors
  mstrSource = mstrModuleName & "CheckDupConnectionName"
  On Error GoTo 0
  Err.Raise vbObjectError + errProgramError, _
    mstrSource, LoadResString(errProgramError)

End Sub
Public Property Let IndOperation(ByVal vdata As Operation)

  ' The valid operations are define in the cOperations
  ' class. Check if the operation is valid
  Select Case vdata
    Case QueryOp, InsertOp, UpdateOp, DeleteOp
      mintOperation = vdata

    Case Else
      BugAssert True
  End Select

End Property
Public Sub Validate()
  ' Each distinct object will have a Validate method which
  ' will check if the class properties are valid. This method
  ' will be used to check interdependant properties that
  ' cannot be validated by the let procedures.
  ' It should be called by the add and modify methods of the class

  If ConnName = gstrEmptyString Then

    ShowError errConnectionNameMandatory
    On Error GoTo 0
    ' Propogate this error back to the caller
    Err.Raise vbObjectError + errConnectionNameMandatory, _
      mstrSource, LoadResString(errConnectionNameMandatory)
  End If
```

```
    ' Raise an error if the Connection name already exists in the
workspace
    Call CheckDupConnectionName

End Sub
Public Sub Add()

    Dim strInsert As String
    Dim qy As DAO.QueryDef

    On Error GoTo AddErr

    ' Validate the record before trying to insert the record
    Call Validate

    ' Create a temporary querydef object
    strInsert = "insert into " & TBL_CONNECTION_DTLS & _
            "( " & FLD_ID_WORKSPACE & _
            ", " & FLD_ID_CONN_NAME & _
            ", " & FLD_CONN_DTL_CONNECTION_NAME & _
            ", " & FLD_CONN_DTL_CONNECTION_STRING & _
            ", " & FLD_CONN_DTL_CONNECTION_TYPE & " ) " & _
           " values ( [w_id], [c_id], " & _
           " [c_name], [c_str], [c_type] ) "

    Set qy = dbsAttTool.CreateQueryDef(gstrEmptyString, strInsert)

    ' Call a procedure to assign the Connection values
    Call AssignParameters(qy)

    qy.Execute dbFailOnError
    qy.Close

    Exit Sub

AddErr:

    Call LogErrors(Errors)
    On Error GoTo 0
    Err.Raise vbObjectError + errInsertFailed, _
       mstrModuleName & "Add", LoadResString(errInsertFailed)

End Sub
Public Sub Delete()

    Dim strDelete As String
    Dim qy As DAO.QueryDef

    On Error GoTo DeleteErr

    strDelete = "delete from " & TBL_CONNECTION_DTLS & _
           " where " & FLD_ID_CONN_NAME & " = [c_id]"
    Set qy = dbsAttTool.CreateQueryDef(gstrEmptyString, strDelete)

    Call AssignParameters(qy)
    qy.Execute dbFailOnError

    qy.Close

    Exit Sub

DeleteErr:
    LogErrors Errors
    On Error GoTo 0
    Err.Raise vbObjectError + errDeleteFailed, _
           mstrModuleName & "Delete", LoadResString(errDeleteFailed)

End Sub
Public Sub Modify()

    Dim strUpdate As String
    Dim qy As QueryDef

    On Error GoTo ModifyErr

    ' Validate the updated values before trying to modify the db
    Call Validate

    ' Create a temporary querydef object with the modify string
    strUpdate = "update " & TBL_CONNECTION_DTLS & _
           " set " & FLD_ID_WORKSPACE & " = [w_id], " & _
           FLD_CONN_DTL_CONNECTION_NAME & " = [c_name], "
& _
           FLD_CONN_DTL_CONNECTION_STRING & " = [c_str], " &
_
           FLD_CONN_DTL_CONNECTION_TYPE & " = [c_type] " &
_
           " where " & FLD_ID_CONN_NAME & " = [c_id]"
    Set qy = dbsAttTool.CreateQueryDef(gstrEmptyString, strUpdate)

    ' Call a procedure to assign the Connection values to the
    ' querydef object
    Call AssignParameters(qy)
    qy.Execute dbFailOnError

    qy.Close

    Exit Sub

ModifyErr:

    Call LogErrors(Errors)
    On Error GoTo 0
    Err.Raise vbObjectError + errModifyFailed, _
       mstrModuleName & "Modify", LoadResString(errModifyFailed)

End Sub
Public Property Get NextIdentifier() As Long

    Dim lngNextId As Long

    On Error GoTo NextIdentifierErr

    ' Retrieve the next identifier using the sequence class
    Set mConnectionSeq = New cSequence
    Set mConnectionSeq.IdDatabase = dbsAttTool
    mConnectionSeq.IdentifierColumn = FLD_ID_CONN_NAME
    lngNextId = mConnectionSeq.Identifier
    Set mConnectionSeq = Nothing

    NextIdentifier = lngNextId
    Exit Property

NextIdentifierErr:
    LogErrors Errors
    On Error GoTo 0
    Err.Raise vbObjectError + errIdGetFailed, _
       mstrModuleName & "NextIdentifier",
LoadResString(errIdGetFailed)

End Property
Public Property Get IndOperation() As Operation

    IndOperation = mintOperation

End Property

Private Sub Class_Initialize()
```

```
    Set mFieldValue = New cStringSM

    ' Initialize the operation indicator variable to Query
    ' It will be modified later by the collection class when
    ' inserts, updates or deletes are performed
    mintOperation = QueryOp

    ConnType = giDefaultConnType

End Sub

Private Sub Class_Terminate()

    Set mFieldValue = Nothing

End Sub
```

cConnDtls.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cConnDtls"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:      cConnDtls.cls
'             Microsoft TPC-H Kit Ver. 1.00
'             Copyright Microsoft, 1999
'             All Rights Reserved
'
'
'  PURPOSE:    Implements an array of cConnDtl objects.
'             Type-safe wrapper around cNodeCollections.
'             Also contains additional functions to determine the connection
'             string value, validation functions, etc.
'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

Private mcarrConnDtls As cNodeCollections

' Used to indicate the source module name when errors
' are raised by this class
Private mstrSource As String
Private Const mstrModuleName As String = "cConnDtls."

Public Property Set ConnDb(vdata As Database)

    Set mcarrConnDtls.NodeDB = vdata

End Property
Public Sub Modify(cModifiedConn As cConnDtl)

    ' First check if the parameter record is valid
    Call CheckDupConnName(cModifiedConn)

    Call mcarrConnDtls.Modify(cModifiedConn)

End Sub
Public Sub Load(ByRef cConnToAdd As cConnDtl)

    Call mcarrConnDtls.Load(cConnToAdd)

End Sub
Public Sub Add(ByRef cConnToAdd As cConnDtl)

    ' First check if the record is valid
    Call Validate(cConnToAdd)

    ' Retrieve a unique identifier
    cConnToAdd.ConnNameId = cConnToAdd.NextIdentifier

    Call mcarrConnDtls.Add(cConnToAdd)

End Sub

Public Sub Unload(lConnNameId As Long)

    Dim lngDeleteElement As Long

    lngDeleteElement = QueryIndex(lConnNameId)

    Call mcarrConnDtls.Unload(lngDeleteElement)

End Sub

Public Sub SaveConnDtlsInWsp(ByVal lngWorkspace As Long)
    ' Call a procedure to save all connection details records for the
workspace
    Call mcarrConnDtls.Save(lngWorkspace)

End Sub
Public Function GetConnectionDtl(ByVal lngWorkspace As Long, _
        ByVal strConnectionName As String) As cConnDtl
    ' Returns the connection dtl for the passed in connection name

    Dim lngIndex As Long

    ' Find all parameters in the array with a matching workspace id
    For lngIndex = 0 To mcarrConnDtls.Count - 1
        If mcarrConnDtls(lngIndex).WorkspaceId = lngWorkspace And _
                mcarrConnDtls(lngIndex).ConnName = strConnectionName
Then

            Set GetConnectionDtl = mcarrConnDtls(lngIndex)
            Exit For
        End If
    Next lngIndex

    If lngIndex > mcarrConnDtls.Count - 1 Then
        ' The parameter has not been defined for the workspace
        ' Raise an error
        On Error GoTo 0
        Err.Raise vbObjectError + errConnNameInvalid,
mstrModuleName & "GetConnection", _
                LoadResString(errConnNameInvalid)
    End If

End Function
Public Sub Delete(lConnNameId As Long)
    ' Delete the passed in parameter

    Dim lngDeleteElement As Long

    lngDeleteElement = QueryIndex(lConnNameId)
    Call mcarrConnDtls.Delete(lngDeleteElement)

End Sub
Private Function QueryIndex(lConnNameId As Long) As Long

    Dim lngIndex As Long

    ' Find the matching parameter record in the array
    For lngIndex = 0 To mcarrConnDtls.Count - 1
        If mcarrConnDtls(lngIndex).ConnNameId = lConnNameId And _
                mcarrConnDtls(lngIndex).IndOperation <> DeleteOp Then
```

```
        QueryIndex = lngIndex
        Exit Function
      End If
    Next lngIndex

    ' Raise error that parameter has not been found
    On Error GoTo 0
    Err.Raise vbObjectError + errQueryIndexFailed,
"cArrParameters.QueryIndex", _
      LoadResString(errQueryIndexFailed)

End Function

Public Function QueryConnDtl(lConnNameId As Long) As cConnDtl

    Dim lngQueryElement As Long

    lngQueryElement = QueryIndex(lConnNameId)

    ' Return the queried connection object
    Set QueryConnDtl = mcarrConnDtls(lngQueryElement)

End Function
Public Property Get Count() As Long

    Count = mcarrConnDtls.Count

End Property
Public Property Get Item(lngIndex As Long) As cConnDtl
Attribute Item.VB_UserMemId = 0

    Set Item = mcarrConnDtls(lngIndex)

End Property

Private Sub Validate(ByVal cConnToValidate As cConnDtl)
    ' This procedure is necessary since the class cannot validate
    ' all the connection_dtl properties on it's own. This is 'coz we
    ' might have created new connections in the workspace, but not
    ' saved them to the database yet - hence the duplicate check
    ' has to be repeated in the array

    Dim lngIndex As Long
    Dim cTempParam As cConnDtl

    ' Check if the parameter name already exists in the workspace
    For lngIndex = 0 To mcarrConnDtls.Count - 1
      Set cTempParam = mcarrConnDtls(lngIndex)
      If cTempParam.WorkspaceId = cConnToValidate.WorkspaceId
And _
          cTempParam.ConnName = cConnToValidate.ConnName And
_
          cTempParam.IndOperation <> DeleteOp Then
        On Error GoTo 0
        Err.Raise vbObjectError + errDupConnDtlName, _
          mstrSource, LoadResString(errDupConnDtlName)
      End If
    Next lngIndex

End Sub
Private Sub CheckDupConnName(ByVal cConnToValidate As
cConnDtl)

    Dim lngIndex As Long
    Dim cTempParam As cConnDtl

    ' Check if the parameter name already exists in the workspace
    For lngIndex = 0 To mcarrConnDtls.Count - 1
      Set cTempParam = mcarrConnDtls(lngIndex)
      If cTempParam.WorkspaceId = cConnToValidate.WorkspaceId
And _
          cTempParam.ConnName = cConnToValidate.ConnName And
_
          cTempParam.ConnNameId <>
cConnToValidate.ConnNameId And _
          cTempParam.IndOperation <> DeleteOp Then
        ShowError errDupConnDtlName
        On Error GoTo 0
        Err.Raise vbObjectError + errDupConnDtlName, _
          mstrSource, LoadResString(errDupConnDtlName)
      End If
    Next lngIndex

End Sub

Private Sub Class_Initialize()

    Set mcarrConnDtls = New cNodeCollections

End Sub

Private Sub Class_Terminate()

    Set mcarrConnDtls = Nothing

End Sub
```

cConnection.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cConnection"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:       cConnection.cls
'              Microsoft TPC-H Kit Ver. 1.00
'              Copyright Microsoft, 1999
'              All Rights Reserved
'
'
'  PURPOSE:    Encapsulates the properties and methods of a
connection string.
'              Contains functions to insert, update and delete
'              workspace_connections records from the database.
'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit
Option Base 0

' Local variable(s) to hold property value(s)
Public WorkspaceId As Long
Public ConnectionId As Long
Public ConnectionValue As String
Public Description As String
Public NodeDB As Database
Public Position As Long
Public NoCountDisplay As Boolean
Public NoExecute As Boolean
Public ParseQueryOnly As Boolean
Public QuotedIdentifiers As Boolean
Public AnsiNulls As Boolean
Public ShowQueryPlan As Boolean
Public ShowStatsTime As Boolean
Public ShowStatsIO As Boolean
Public ParseOdbcMsg As Boolean
```

```
Public RowCount As Long
Public TsqlBatchSeparator As String
Public QueryTimeOut As Long
Public ServerLanguage As String
Public CharacterTranslation As Boolean
Public RegionalSettings As Boolean

Private mstrConnectionName As String
Private mintOperation As Operation

' Used to indicate the source module name when errors
' are raised by this class
Private mstrSource As String
Private Const mstrModuleName As String = "cConnection."

' The cSequence class is used to generate unique Connection identifiers
Private mConnectionSeq As cSequence

' The StringSM class is used to carry out string operations
Private mFieldValue As cStringSM

Private Sub AssignParameters(qyExec As DAO.QueryDef)
   ' Assigns values to the parameters in the querydef object
   ' The parameter names are cryptic to differentiate them from the field
names.
   ' When the parameter names are the same as the field names,
parameters in the where
   ' clause do not get created.

   Dim prmParam As DAO.Parameter

   On Error GoTo AssignParametersErr

   For Each prmParam In qyExec.Parameters
      Select Case prmParam.Name
         Case "[w_id]"
            prmParam.Value = WorkspaceId

         Case "[c_id]"
            prmParam.Value = ConnectionId

         Case "[c_name]"
            prmParam.Value = mstrConnectionName

         Case "[c_value]"
            prmParam.Value = ConnectionValue

         Case "[desc]"
            prmParam.Value = Description

         Case "[no_count]"
            prmParam.Value = NoCountDisplay

         Case "[no_exec]"
            prmParam.Value = NoExecute

         Case "[parse_only]"
            prmParam.Value = ParseQueryOnly

         Case "[quoted_id]"
            prmParam.Value = QuotedIdentifiers

         Case "[a_nulls]"
            prmParam.Value = AnsiNulls

         Case "[show_qp]"
            prmParam.Value = ShowQueryPlan

         Case "[stats_tm]"
            prmParam.Value = ShowStatsTime

         Case "[stats_io]"
            prmParam.Value = ShowStatsIO

         Case "[parse_odbc]"
            prmParam.Value = ParseOdbcMsg

         Case "[row_cnt]"
            prmParam.Value = RowCount

         Case "[batch_sep]"
            prmParam.Value = TsqlBatchSeparator

         Case "[qry_tmout]"
            prmParam.Value = QueryTimeOut

         Case "[lang]"
            prmParam.Value = ServerLanguage

         Case "[char_trans]"
            prmParam.Value = CharacterTranslation

         Case "[reg_settings]"
            prmParam.Value = RegionalSettings

         Case Else
            ' Write the parameter name that is faulty
            WriteError errInvalidParameter, mstrSource, prmParam.Name
            On Error GoTo 0
            Err.Raise errInvalidParameter, mstrModuleName &
"AssignParameters", _
                  LoadResString(errInvalidParameter)
      End Select
   Next prmParam

   Exit Sub

AssignParametersErr:

   Call LogErrors(Errors)
   On Error GoTo 0
   Err.Raise vbObjectError + errAssignParametersFailed, _
      mstrModuleName & "AssignParameters",
LoadResString(errAssignParametersFailed)

End Sub

Public Function Clone() As cConnection

   ' Creates a copy of a given Connection

   Dim cCloneConn As cConnection

   On Error GoTo CloneErr

   Set cCloneConn = New cConnection

   ' Copy all the Connection properties to the newly
   ' created Connection
   Set cCloneConn.NodeDB = NodeDB
   cCloneConn.WorkspaceId = WorkspaceId
   cCloneConn.ConnectionId = ConnectionId
   cCloneConn.ConnectionName = mstrConnectionName
   cCloneConn.ConnectionValue = ConnectionValue
   cCloneConn.Description = Description
   cCloneConn.IndOperation = mintOperation
   cCloneConn.Position = Position
   cCloneConn.NoCountDisplay = NoCountDisplay
   cCloneConn.NoExecute = NoExecute
   cCloneConn.ParseQueryOnly = ParseQueryOnly
```

```
    cCloneConn.QuotedIdentifiers = QuotedIdentifiers
    cCloneConn.AnsiNulls = AnsiNulls
    cCloneConn.ShowQueryPlan = ShowQueryPlan
    cCloneConn.ShowStatsTime = ShowStatsTime
    cCloneConn.ShowStatsIO = ShowStatsIO
    cCloneConn.ParseOdbcMsg = ParseOdbcMsg
    cCloneConn.RowCount = RowCount
    cCloneConn.TsqlBatchSeparator = TsqlBatchSeparator
    cCloneConn.QueryTimeOut = QueryTimeOut
    cCloneConn.ServerLanguage = ServerLanguage
    cCloneConn.CharacterTranslation = CharacterTranslation
    cCloneConn.RegionalSettings = RegionalSettings

    ' And set the return value to the newly created Connection
    Set Clone = cCloneConn
    Set cCloneConn = Nothing

    Exit Function

CloneErr:
    LogErrors Errors
    mstrSource = mstrModuleName & "Clone"
    On Error GoTo 0
    Err.Raise vbObjectError + errCloneFailed, mstrSource,
LoadResString(errCloneFailed)

End Function
Private Sub CheckDupConnectionName()
    ' Check if the Connection name already exists in the workspace

    Dim rstConnection As Recordset
    Dim strSql As String
    Dim qy As DAO.QueryDef

    On Error GoTo CheckDupConnectionNameErr
    mstrSource = mstrModuleName & "CheckDupConnectionName"

    ' Create a recordset object to retrieve the count of all Connections
    ' for the workspace with the same name
    strSql = "Select count(*) as Connection_count " & _
        " from workspace_connections " & _
        " where workspace_id = [w_id]" & _
        " and connection_name = [c_name]" & _
        " and connection_id <> [c_id]"

    Set qy = NodeDB.CreateQueryDef(gstrEmptyString, strSql)
    Call AssignParameters(qy)

    Set rstConnection = qy.OpenRecordset(dbOpenForwardOnly)

    If rstConnection![Connection_count] > 0 Then
        rstConnection.Close
        qy.Close
        ShowError errDuplicateConnectionName
        On Error GoTo 0
        Err.Raise vbObjectError + errDuplicateConnectionName, _
            mstrSource, LoadResString(errDuplicateConnectionName)
    End If

    rstConnection.Close
    qy.Close

    Exit Sub

CheckDupConnectionNameErr:
    LogErrors Errors
    mstrSource = mstrModuleName & "CheckDupConnectionName"
    On Error GoTo 0
    Err.Raise vbObjectError + errProgramError, _
        mstrSource, LoadResString(errProgramError)

End Sub
Private Sub CheckDB()
    ' Check if the database object has been initialized

    If NodeDB Is Nothing Then
        On Error GoTo 0
        Err.Raise vbObjectError + errInvalidDB, _
            mstrModuleName & "CheckDB", LoadResString(errInvalidDB)
    End If

End Sub
Public Property Let ConnectionName(vdata As String)

    If vdata = gstrEmptyString Then

        ShowError errConnectionNameMandatory
        On Error GoTo 0
        ' Propogate this error back to the caller
        Err.Raise vbObjectError + errConnectionNameMandatory, _
            mstrSource, LoadResString(errConnectionNameMandatory)
    Else
        mstrConnectionName = vdata
    End If

End Property

Public Property Let IndOperation(ByVal vdata As Operation)

    ' The valid operations are define in the cOperations
    ' class. Check if the operation is valid
    Select Case vdata
        Case QueryOp, InsertOp, UpdateOp, DeleteOp
            mintOperation = vdata

        Case Else
            BugAssert True
    End Select

End Property
Public Sub Validate()
    ' Each distinct object will have a Validate method which
    ' will check if the class properties are valid. This method
    ' will be used to check interdependant properties that
    ' cannot be validated by the let procedures.
    ' It should be called by the add and modify methods of the class

    ' Check if the db object is valid
    Call CheckDB

    ' Raise an error if the Connection name already exists in the
workspace
    Call CheckDupConnectionName

End Sub
Public Sub Add()

    Dim strInsert As String
    Dim qy As DAO.QueryDef

    On Error GoTo AddErr

    ' Validate the record before trying to insert the record
    Call Validate

    ' Create a temporary querydef object
    strInsert = "insert into workspace_connections " & _
            "( workspace_id, connection_id, " & _
            "connection_name, connection_value, " & _
            "description, no_count_display, " & _
```

```
        "no_execute, parse_query_only, " & _
        "ANSI_quoted_identifiers, ANSI_nulls, " & _
        "show_query_plan, show_stats_time, " & _
        "show_stats_io, parse_odbc_msg_prefixes, " & _
        "row_count, tsql_batch_separator, " & _
        "query_time_out, server_language, " & _
        "character_translation, regional_settings ) " & _
       " values ( [w_id], [c_id], [c_name], [c_value], " & _
       " [desc], [no_count], [no_exec], [parse_only], " & _
       " [quoted_id], [a_nulls], [show_qp], [stats_tm], " & _
       " [stats_io], [parse_odbc], [row_cnt], [batch_sep], " & _
       " [qry_tmout], [lang], [char_trans], [reg_settings] ) "

   Set qy = NodeDB.CreateQueryDef(gstrEmptyString, strInsert)

   ' Call a procedure to assign the Connection values
   Call AssignParameters(qy)

   qy.Execute dbFailOnError
   qy.Close

   Exit Sub

AddErr:

   Call LogErrors(Errors)
   On Error GoTo 0
   Err.Raise vbObjectError + errInsertFailed, _
      mstrModuleName & "Add", LoadResString(errInsertFailed)

End Sub
Public Sub Delete()

   Dim strDelete As String
   Dim qy As DAO.QueryDef

   On Error GoTo DeleteErr

   ' Check if the db object is valid
   Call CheckDB

   strDelete = "delete from workspace_connections " & _
         " where connection_id = [c_id]"
   Set qy = NodeDB.CreateQueryDef(gstrEmptyString, strDelete)

   Call AssignParameters(qy)
   qy.Execute dbFailOnError

   qy.Close

   Exit Sub

DeleteErr:
   LogErrors Errors
   On Error GoTo 0
   Err.Raise vbObjectError + errDeleteFailed, _
         mstrModuleName & "Delete", LoadResString(errDeleteFailed)

End Sub

Public Sub Modify()

   Dim strUpdate As String
   Dim qy As QueryDef

   On Error GoTo ModifyErr

   ' Validate the updated values before trying to modify the db
   Call Validate

   ' Create a temporary querydef object with the modify string
   strUpdate = "update workspace_connections " & _
         " set workspace_id = [w_id], " & _
         "connection_name = [c_name], " & _
         "connection_value = [c_value], " & _
         "description = [desc], " & _
         "no_count_display = [no_count], " & _
         "no_execute = [no_exec], " & _
         "parse_query_only = [parse_only], " & _
         "ANSI_quoted_identifiers = [quoted_id], " & _
         "ANSI_nulls = [a_nulls], " & _
         "show_query_plan = [show_qp], " & _
         "show_stats_time = [stats_tm], " & _
         "show_stats_io = [stats_io], " & _
         "parse_odbc_msg_prefixes = [parse_odbc], " & _
         "row_count = [row_cnt], " & _
         "tsql_batch_separator = [batch_sep], " & _
         "query_time_out = [qry_tmout], " & _
         "server_language = [lang], " & _
         "character_translation = [char_trans], " & _
         "regional_settings = [reg_settings] " & _
         " where connection_id = [c_id]"
   Set qy = NodeDB.CreateQueryDef(gstrEmptyString, strUpdate)

   ' Call a procedure to assign the Connection values to the
   ' querydef object
   Call AssignParameters(qy)
   qy.Execute dbFailOnError

   qy.Close

   Exit Sub

ModifyErr:

   Call LogErrors(Errors)
   On Error GoTo 0
   Err.Raise vbObjectError + errModifyFailed, _
      mstrModuleName & "Modify", LoadResString(errModifyFailed)

End Sub
Public Property Get ConnectionName() As String

   ConnectionName = mstrConnectionName

End Property

Public Property Get NextIdentifier() As Long

   Dim lngNextId As Long

   On Error GoTo NextIdentifierErr

   ' First check if the database object is valid
   Call CheckDB

   ' Retrieve the next identifier using the sequence class
   Set mConnectionSeq = New cSequence
   Set mConnectionSeq.IdDatabase = NodeDB
   mConnectionSeq.IdentifierColumn = "connection_id"
   lngNextId = mConnectionSeq.Identifier
   Set mConnectionSeq = Nothing

   NextIdentifier = lngNextId
   Exit Property

NextIdentifierErr:
   LogErrors Errors
   On Error GoTo 0
   Err.Raise vbObjectError + errIdGetFailed, _
```

```
        mstrModuleName & "NextIdentifier",
LoadResString(errIdGetFailed)

End Property
Public Property Get IndOperation() As Operation

    IndOperation = mintOperation

End Property

Private Sub Class_Initialize()

    Set mFieldValue = New cStringSM

    ' Initialize the operation indicator variable to Query
    ' It will be modified later by the collection class when
    ' inserts, updates or deletes are performed
    mintOperation = QueryOp

    ' Initialize connection properties to their default values
    NoCountDisplay = DEF_NO_COUNT_DISPLAY
    NoExecute = DEF_NO_EXECUTE
    ParseQueryOnly = DEF_PARSE_QUERY_ONLY
    QuotedIdentifiers = DEF_ANSI_QUOTED_IDENTIFIERS
    AnsiNulls = DEF_ANSI_NULLS
    ShowQueryPlan = DEF_SHOW_QUERY_PLAN
    ShowStatsTime = DEF_SHOW_STATS_TIME
    ShowStatsIO = DEF_SHOW_STATS_IO
    ParseOdbcMsg = DEF_PARSE_ODBC_MSG_PREFIXES
    RowCount = DEF_ROW_COUNT
    TsqlBatchSeparator = DEF_TSQL_BATCH_SEPARATOR
    QueryTimeOut = DEF_QUERY_TIME_OUT
    ServerLanguage = DEF_SERVER_LANGUAGE
    CharacterTranslation = DEF_CHARACTER_TRANSLATION
    RegionalSettings = DEF_REGIONAL_SETTINGS

End Sub

Private Sub Class_Terminate()

    Set NodeDB = Nothing
    Set mFieldValue = Nothing

End Sub
```

cConnections.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cConnections"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:       cConnections.cls
'            Microsoft TPC-H Kit Ver. 1.00
'            Copyright Microsoft, 1999
'            All Rights Reserved
'
'
'  PURPOSE:    Implements an array of cConnection objects.
'            Type-safe wrapper around cNodeCollections.
'            Also contains validation functions, etc.
'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

Private mcarrConnections As cNodeCollections

' Used to indicate the source module name when errors
' are raised by this class
Private mstrSource As String
Private Const mstrModuleName As String = "cConnections."

Public Property Set ConnDb(vdata As Database)

    Set mcarrConnections.NodeDB = vdata

End Property
Public Sub Modify(cModifiedConn As cConnection)

    ' First check if the parameter record is valid
    Call CheckDupConnName(cModifiedConn)

    Call mcarrConnections.Modify(cModifiedConn)

End Sub
Public Sub Load(ByRef cConnToAdd As cConnection)

    Call mcarrConnections.Load(cConnToAdd)

End Sub
Public Sub Add(ByRef cConnToAdd As cConnection)

    Set cConnToAdd.NodeDB = mcarrConnections.NodeDB

    ' First check if the record is valid
    Call Validate(cConnToAdd)

    ' Retrieve a unique identifier
    cConnToAdd.ConnectionId = cConnToAdd.NextIdentifier

    Call mcarrConnections.Add(cConnToAdd)

End Sub

Public Sub Unload(lngConnId As Long)

    Dim lngDeleteElement As Long

    lngDeleteElement = QueryIndex(lngConnId)

    Call mcarrConnections.Unload(lngDeleteElement)

End Sub

Public Sub SaveConnectionsInWsp(ByVal lngWorkspace As Long)
    ' Call a procedure to save all connection records for the workspace
    Call mcarrConnections.Save(lngWorkspace)

End Sub
Public Function GetConnection(ByVal lngWorkspace As Long, _
        ByVal strConnectionName As String) As cConnection
    ' Returns the connection string for the passed in connection name

    Dim lngIndex As Long

    ' Find all parameters in the array with a matching workspace id
    For lngIndex = 0 To mcarrConnections.Count - 1
        If mcarrConnections(lngIndex).WorkspaceId = lngWorkspace And
_
            mcarrConnections(lngIndex).ConnectionName =
strConnectionName Then

            Set GetConnection = mcarrConnections(lngIndex)
            Exit For
        End If
    Next lngIndex
```

```
    If lngIndex > mcarrConnections.Count - 1 Then
        ' The parameter has not been defined for the workspace
        ' Raise an error
        On Error GoTo 0
        Err.Raise vbObjectError + errConnNameInvalid,
mstrModuleName & "GetConnection", _
            LoadResString(errConnNameInvalid)
    End If

End Function
Public Sub Delete(lngConnId As Long)
    ' Delete the passed in parameter

    Dim lngDeleteElement As Long

    lngDeleteElement = QueryIndex(lngConnId)
    Call mcarrConnections.Delete(lngDeleteElement)

End Sub
Private Function QueryIndex(lngConnId As Long) As Long

    Dim lngIndex As Long

    ' Find the matching parameter record in the array
    For lngIndex = 0 To mcarrConnections.Count - 1
        If mcarrConnections(lngIndex).ConnectionId = lngConnId And _
            mcarrConnections(lngIndex).IndOperation <> DeleteOp Then
            QueryIndex = lngIndex
            Exit Function
        End If
    Next lngIndex

    ' Raise error that parameter has not been found
    On Error GoTo 0
    Err.Raise vbObjectError + errQueryIndexFailed,
"cArrParameters.QueryIndex", _
        LoadResString(errQueryIndexFailed)

End Function

Public Function QueryConnection(lngConnId As Long) As cConnection

    Dim lngQueryElement As Long

    lngQueryElement = QueryIndex(lngConnId)

    ' Return the queried connection object
    Set QueryConnection = mcarrConnections(lngQueryElement)

End Function
Public Property Get Count() As Long

    Count = mcarrConnections.Count

End Property
Public Property Get Item(lngIndex As Long) As cConnection
Attribute Item.VB_UserMemId = 0

    Set Item = mcarrConnections(lngIndex)

End Property

Public Sub Validate(ByVal cConnToValidate As cConnection)
    ' This procedure is necessary since the class cannot validate
    ' all the parameter properties on it's own. This is 'coz we
    ' might have created new parameters in the workspace, but not
    ' saved them to the database yet - hence the duplicate check
    ' has to be repeated in the array
    Dim lngIndex As Long
    Dim cTempParam As cConnection

    ' Check if the parameter name already exists in the workspace
    For lngIndex = 0 To mcarrConnections.Count - 1
        Set cTempParam = mcarrConnections(lngIndex)
        If cTempParam.WorkspaceId = cConnToValidate.WorkspaceId
And _
            cTempParam.ConnectionName =
cConnToValidate.ConnectionName And _
            cTempParam.IndOperation <> DeleteOp Then
            On Error GoTo 0
            Err.Raise vbObjectError + errDuplicateConnectionName, _
                mstrSource, LoadResString(errDuplicateConnectionName)
        End If
    Next lngIndex

End Sub
Public Sub CheckDupConnName(ByVal cConnToValidate As
cConnection)

    Dim lngIndex As Long
    Dim cTempParam As cConnection

    ' Check if the parameter name already exists in the workspace
    For lngIndex = 0 To mcarrConnections.Count - 1
        Set cTempParam = mcarrConnections(lngIndex)
        If cTempParam.WorkspaceId = cConnToValidate.WorkspaceId
And _
            cTempParam.ConnectionName =
cConnToValidate.ConnectionName And _
            cTempParam.ConnectionId <>
cConnToValidate.ConnectionId And _
            cTempParam.IndOperation <> DeleteOp Then
            ShowError errDuplicateConnectionName
            On Error GoTo 0
            Err.Raise vbObjectError + errDuplicateConnectionName, _
                mstrSource, LoadResString(errDuplicateConnectionName)
        End If
    Next lngIndex

End Sub

Private Sub Class_Initialize()

    Set mcarrConnections = New cNodeCollections

End Sub

Private Sub Class_Terminate()

    Set mcarrConnections = Nothing

End Sub
```

cConstraint.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cConstraint"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:        cConstraint.cls
'               Microsoft TPC-H Kit Ver. 1.00
'               Copyright Microsoft, 1999
'               All Rights Reserved
```

```
'
'
'  PURPOSE:     Encapsulates the properties and methods of a constraint.
'               Contains functions to insert, update and delete
'               step_constraints records from the database.
'  Contact:     Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

' Module level variables to store the property values
Private mlngConstraintId As Long
Private mlngStepId As Long
Private mstrVersionNo As String
Private mintConstraintType As Integer
Private mlngGlobalStepId As Long
Private mstrGlobalVersionNo As String
Private mintSequenceNo As Integer
Private mdbsConstraintDB As Database
Private mlngWorkspaceId As Integer
Private mintOperation As Operation
Private mlngPosition As Long

' The cSequence class is used to generate unique step identifiers
Private mConstraintSeq As cSequence

Private Const mstrModuleName As String = ".cConstraint."
Private mstrSource As String

Public Enum ConstraintType
   gintPreStep = 1
   gintPostStep = 2
End Enum

Private Const mstrSQ As String = """
Public Property Get WorkspaceId() As Long
   WorkspaceId = mlngWorkspaceId
End Property
Public Property Let WorkspaceId(ByVal vdata As Long)
   mlngWorkspaceId = vdata
End Property

Public Property Get IndOperation() As Operation

   IndOperation = mintOperation

End Property
Public Property Let IndOperation(ByVal vdata As Operation)

   On Error GoTo IndOperationErr
   mstrSource = mstrModuleName & "IndOperation"

   ' The valid operations are define in the cOperations
   ' class. Check if the operation is valid
   Select Case vdata
      Case QueryOp, InsertOp, UpdateOp, DeleteOp
         mintOperation = vdata

      Case Else
         On Error GoTo 0
         Err.Raise vbObjectError + errInvalidOperation, _
               mstrSource, LoadResString(errInvalidOperation)
   End Select

   Exit Property

IndOperationErr:
   LogErrors Errors
   mstrSource = mstrModuleName & "IndOperation"
   On Error GoTo 0
   Err.Raise vbObjectError + errLetOperationFailed, _
         mstrSource, LoadResString(errLetOperationFailed)

End Property

Public Function Clone() As cConstraint

   ' Creates a copy of a given constraint

   Dim cConsClone As cConstraint

   On Error GoTo CloneErr
   mstrSource = mstrModuleName & "Clone"

   Set cConsClone = New cConstraint

   ' Copy all the workspace properties to the newly
   ' created workspace
   cConsClone.ConstraintId = mlngConstraintId
   cConsClone.StepId = mlngStepId
   cConsClone.VersionNo = mstrVersionNo
   cConsClone.ConstraintType = mintConstraintType
   cConsClone.GlobalStepId = mlngGlobalStepId
   cConsClone.GlobalVersionNo = mstrGlobalVersionNo
   cConsClone.SequenceNo = mintSequenceNo
   cConsClone.WorkspaceId = mlngWorkspaceId
   cConsClone.IndOperation = mintOperation

   ' And set the return value to the newly created constraint
   Set Clone = cConsClone

   Exit Function

CloneErr:
   LogErrors Errors
   mstrSource = mstrModuleName & "Clone"
   On Error GoTo 0
   Err.Raise vbObjectError + errCloneFailed, _
         mstrSource, LoadResString(errCloneFailed)

End Function

Public Property Get SequenceNo() As Integer

   SequenceNo = mintSequenceNo

End Property

Public Property Let SequenceNo(ByVal vdata As Integer)
   mintSequenceNo = vdata
End Property

Public Sub Add()
   ' Inserts a new step constraint into the database

   Dim strInsert As String
   Dim qy As DAO.QueryDef

   On Error GoTo AddErr

   ' First check if the database object is valid
   Call CheckDB

   ' Any record validations
   Call Validate

   ' Create a temporary querydef object
   strInsert = "insert into step_constraints " & _
         "( constraint_id, step_id, version_no, " & _
         " constraint_type, global_step_id, global_version_no,
sequence_no ) " & _
```

```
        " values ( [cons_id], [s_id], [ver_no], " & _
        " [cons_type], [g_step_id], [g_ver_no], " & _
        " [seq_no] )"
   Set qy = mdbsConstraintDB.CreateQueryDef(gstrEmptyString,
strInsert)

   ' Call a procedure to execute the Querydef object
   Call AssignParameters(qy)

   qy.Execute dbFailOnError
   qy.Close

'    strInsert = "insert into step_constraints " & _
'       "( constraint_id, step_id, version_no, " & _
'       " constraint_type, global_step_id, global_version_no, sequence_no
) " & _
'       " values ( " & _
'       Str(mlngConstraintId) & ", " & Str(mlngStepId) & ", " & _
'       mstrSQ & mstrVersionNo & mstrSQ & ", " &
Str(mintConstraintType) & ", " & _
'       Str(mlngGlobalStepId) & ", " & mstrSQ & mstrGlobalVersionNo
& mstrSQ & ", " & _
'       Str(mintSequenceNo) & " ) "
'
'    BugMessage strInsert
'    mdbsConstraintDB.Execute strInsert, dbFailOnError
   Exit Sub

AddErr:
   LogErrors Errors
   mstrSource = mstrModuleName & "Add"
   On Error GoTo 0
   Err.Raise vbObjectError + errAddConstraintFailed, _
         mstrSource, _
         LoadResString(errAddConstraintFailed)
End Sub
Private Sub AssignParameters(qyExec As DAO.QueryDef)
   ' Assigns values to the parameters in the querydef object
   ' The parameter names are cryptic to make them different
   ' from the field names. When the parameter names are
   ' the same as the field names, parameters in the where
   ' clause do not get created.

   Dim prmParam As DAO.Parameter

   On Error GoTo AssignParametersErr
   mstrSource = mstrModuleName & "AssignParameters"

   For Each prmParam In qyExec.Parameters
      Select Case prmParam.Name
         Case "[cons_id]"
            prmParam.Value = mlngConstraintId

         Case "[s_id]"
            prmParam.Value = mlngStepId

         Case "[ver_no]"
            prmParam.Value = mstrVersionNo

         Case "[cons_type]"
            prmParam.Value = mintConstraintType

         Case "[g_step_id]"
            prmParam.Value = mlngGlobalStepId

         Case "[g_ver_no]"
            prmParam.Value = mstrGlobalVersionNo

         Case "[seq_no]"
            prmParam.Value = mintSequenceNo

         Case Else
            ' Write the parameter name that is faulty
            WriteError errInvalidParameter, mstrSource, _
                  prmParam.Name
            On Error GoTo 0
            Err.Raise errInvalidParameter, mstrSource, _
                  LoadResString(errInvalidParameter)
      End Select
   Next prmParam

   Exit Sub

AssignParametersErr:

   mstrSource = mstrModuleName & "AssignParameters"
   Call LogErrors(Errors)
   On Error GoTo 0
   Err.Raise vbObjectError + errAssignParametersFailed, _
      mstrSource, LoadResString(errAssignParametersFailed)

End Sub
Public Property Get NextIdentifier() As Long

   Dim lngNextId As Long

   On Error GoTo NextIdentifierErr

   ' First check if the database object is valid
   Call CheckDB

   ' Retrieve the next constraint identifier using the
   ' sequence class
   Set mConstraintSeq = New cSequence
   Set mConstraintSeq.IdDatabase = mdbsConstraintDB
   mConstraintSeq.IdentifierColumn = "constraint_id"
   lngNextId = mConstraintSeq.Identifier
   Set mConstraintSeq = Nothing

   NextIdentifier = lngNextId
   Exit Property

NextIdentifierErr:
   LogErrors Errors
   mstrSource = mstrModuleName & "NextIdentifier"
   On Error GoTo 0
   Err.Raise vbObjectError + errStepIdGetFailed, _
      mstrSource, LoadResString(errStepIdGetFailed)

End Property

Private Sub CheckDB()
   ' Check if the database object has been initialized

   If mdbsConstraintDB Is Nothing Then
      ShowError errInvalidDB
      On Error GoTo 0
      Err.Raise vbObjectError + errInvalidDB, _
         mstrModuleName, LoadResString(errInvalidDB)
   End If

End Sub

Public Sub Delete()
   ' Deletes the step constraint record from the database

   Dim strDelete As String
   Dim qy As DAO.QueryDef

   On Error GoTo DeleteErr
```

```
    mstrSource = mstrModuleName & "Delete"

    ' There can be multiple constraints for a step,
    ' meaning that there can be multiple constraint records
    ' with the same constraint_id. Only a combination
    ' of the step_id, version and constraint_id will be
    ' unique
    strDelete = "delete from step_constraints " & _
            " where constraint_id = [cons_id]" & _
            " and step_id = [s_id] " & _
            " and version_no = [ver_no] "
    Set qy = mdbsConstraintDB.CreateQueryDef(gstrEmptyString,
strDelete)

    Call AssignParameters(qy)
    qy.Execute dbFailOnError

    qy.Close

'    strDelete = "Delete from step_constraints " & _
'            " where constraint_id = " & Str(mlngConstraintId) & _
'            " and step_id = " & Str(mlngStepId) & _
'            " and version_no = " & mstrSQ & mstrVersionNo & mstrSQ
'
'    'BugMessage strDelete
'    mdbsConstraintDB.Execute strDelete, dbFailOnError

    Exit Sub

DeleteErr:
    LogErrors Errors
    mstrSource = mstrModuleName & "Delete"
    On Error GoTo 0
    Err.Raise vbObjectError + errDeleteConstraintFailed, _
            mstrSource, _
            LoadResString(errDeleteConstraintFailed)
End Sub
Public Sub Modify()
    ' Updates the sequence no of the step constraint record
    ' in the database

    Dim strUpdate As String
    Dim qy As QueryDef

    On Error GoTo Modify

    ' First check if the database object is valid
    Call CheckDB

    ' Any record validations
    Call Validate

    ' There can be multiple constraints for a step,
    ' meaning that there can be multiple constraint records
    ' with the same constraint_id. Only a combination
    ' of the step_id, version and constraint_id will be
    ' unique
    ' Create a temporary querydef object with the modify string
    strUpdate = "Update step_constraints " & _
            " set sequence_no = [seq_no] " & _
            " where constraint_id = [cons_id] " & _
            " and step_id = [s_id] " & _
            " and version_no = [ver_no] "
    Set qy = mdbsConstraintDB.CreateQueryDef(gstrEmptyString,
strUpdate)

    ' Call a procedure to assign the parameter values to the
    ' querydef object
    Call AssignParameters(qy)
    qy.Execute dbFailOnError

    qy.Close

'    strUpdate = "Update step_constraints " & _
'            " set sequence_no = " & Str(mintSequenceNo) & _
'            " where constraint_id = " & Str(mlngConstraintId) & _
'            " and step_id = " & Str(mlngStepId) & _
'            " and version_no = " & mstrSQ & mstrVersionNo & mstrSQ
'
'    'BugMessage strUpdate
'    mdbsConstraintDB.Execute strUpdate, dbFailOnError
    Exit Sub

Modify:
    LogErrors Errors
    mstrSource = mstrModuleName & "Modify"
    On Error GoTo 0
    Err.Raise vbObjectError + errUpdateConstraintFailed, _
            mstrSource, _
            LoadResString(errUpdateConstraintFailed)
End Sub
Public Property Get Position() As Long

    Position = mlngPosition

End Property
Public Property Let Position(ByVal RHS As Long)

    mlngPosition = RHS

End Property

Public Sub Validate()
    ' Each distinct object will have a Validate method which
    ' will check if the class properties are valid. This method
    ' will be used to check interdependant properties that
    ' cannot be validated by the let procedures.
    ' It should be called by the add and modify methods of the class

    ' No validations are necessary for the constraint object

End Sub

Public Property Set NodeDB(vdata As Database)

    Set mdbsConstraintDB = vdata

End Property

Public Property Get NodeDB() As Database

    Set NodeDB = mdbsConstraintDB

End Property

Public Property Get GlobalVersionNo() As String

    GlobalVersionNo = mstrGlobalVersionNo

End Property

Public Property Let GlobalVersionNo(ByVal vdata As String)

    mstrGlobalVersionNo = vdata

End Property

Public Property Get GlobalStepId() As Long

    GlobalStepId = mlngGlobalStepId
```

```
End Property

Public Property Get ConstraintId() As Long

   ConstraintId = mlngConstraintId

End Property

Public Property Get VersionNo() As String

   VersionNo = mstrVersionNo

End Property

Public Property Get StepId() As Long

   StepId = mlngStepId

End Property

Public Property Let VersionNo(ByVal vdata As String)

   mstrVersionNo = vdata

End Property

Public Property Let StepId(ByVal vdata As Long)

   mlngStepId = vdata

End Property

Public Property Let ConstraintId(ByVal vdata As Long)
   On Error GoTo ConstraintIdErr
   mstrSource = mstrModuleName & "ConstraintId"

   If (vdata > 0) Then
      mlngConstraintId = vdata
   Else
      ' Propogate this error back to the caller
      On Error GoTo 0
      Err.Raise vbObjectError + errConstraintIdInvalid, _
         mstrSource, LoadResString(errConstraintIdInvalid)
   End If

   Exit Property

ConstraintIdErr:
   LogErrors Errors
   mstrSource = mstrModuleName & "ConstraintId"
   On Error GoTo 0
   Err.Raise vbObjectError + errConstraintIdSetFailed, _
      mstrSource, LoadResString(errConstraintIdSetFailed)

End Property

Public Property Let GlobalStepId(ByVal vdata As Long)

   On Error GoTo GlobalStepIdErr
   mstrSource = mstrModuleName & "GlobalStepId"

   If (vdata > 0) Then
      mlngGlobalStepId = vdata
   Else
      ' Propogate this error back to the caller
      On Error GoTo 0
      Err.Raise vbObjectError + errGlobalStepIdInvalid, _
         mstrSource, LoadResString(errGlobalStepIdInvalid)
   End If

   Exit Property

GlobalStepIdErr:
   LogErrors Errors
   mstrSource = mstrModuleName & "GlobalStepId"
   On Error GoTo 0
   Err.Raise vbObjectError + errGlobalStepIdSetFailed, _
      mstrSource, LoadResString(errGlobalStepIdSetFailed)

End Property

Public Property Let ConstraintType(ByVal vdata As ConstraintType)

   On Error GoTo ConstraintTypeErr

   ' A global step can be either a pre- or a post-execution step.
   ' These constants have been defined in the enumeration,
   ' ConstraintType, which is exposed
   Select Case vdata
      Case gintPreStep, gintPostStep
         mintConstraintType = vdata

      Case Else
         On Error GoTo 0
         Err.Raise vbObjectError + errConstraintTypeInvalid, _
            mstrSource, LoadResString(errConstraintTypeInvalid)
   End Select

   Exit Property

ConstraintTypeErr:
   LogErrors Errors
   mstrSource = mstrModuleName & "ConstraintType"
   On Error GoTo 0
   Err.Raise vbObjectError + errConstraintTypeLetFailed, _
      mstrSource, LoadResString(errConstraintTypeLetFailed)

End Property

Public Property Get ConstraintType() As ConstraintType

   ConstraintType = mintConstraintType

End Property

Private Sub Class_Initialize()

   ' Initialize the operation indicator variable to Query
   ' It will be modified later by the collection class when
   ' inserts, updates or deletes are performed
   mintOperation = QueryOp

End Sub
```

cFailedStep.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cFailedStep"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:       cFailedStep.cls
'              Microsoft TPC-H Kit Ver. 1.00
'              Copyright Microsoft, 1999
'              All Rights Reserved
```

```
'
'
'  PURPOSE:     Properties of a step execution failure.
'  Contact:     Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

Public InstanceId As Long
Public StepId As Long
Public ParentStepId As Long
Public ContCriteria As ContinuationCriteria
Public EndTime As Currency
Public AskResponse As Long
```

cFailedSteps.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cFailedSteps"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:        cFailedSteps.cls
'               Microsoft TPC-H Kit Ver. 1.00
'               Copyright Microsoft, 1999
'               All Rights Reserved
'
'
'  PURPOSE:     This module encapsulates a collection of failed steps. It
'               also determines whether sub-steps of a passed in step need
'               to be skipped due to a failure.
'  Contact:     Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

Private mcFailedSteps As cVector
Public Function ExecuteSubStep(lParentStepId As Long) As Boolean
    ' Returns False if there is any condition that prevents sub-steps of the
passed
    ' in instance from being executed
    Dim lIndex As Long

    ExecuteSubStep = True

    For lIndex = 0 To Count() - 1
        If mcFailedSteps(lIndex).ContCriteria =
gintOnFailureCompleteSiblings And _
                lParentStepId <> mcFailedSteps(lIndex).ParentStepId Then
            ExecuteSubStep = False
            Exit For
        End If

        If mcFailedSteps(lIndex).ContCriteria =
gintOnFailureAbortSiblings And _
                lParentStepId = mcFailedSteps(lIndex).ParentStepId Then
            ExecuteSubStep = False
            Exit For
        End If

        If mcFailedSteps(lIndex).ContCriteria = gintOnFailureSkipSiblings
And _
                lParentStepId = mcFailedSteps(lIndex).ParentStepId Then
            ExecuteSubStep = False
            Exit For
        End If

        If mcFailedSteps(lIndex).ContCriteria = gintOnFailureAbort Then
            ExecuteSubStep = False
            Exit For
        End If

    Next lIndex

End Function
Public Sub Add(ByVal objItem As cFailedStep)

    mcFailedSteps.Add objItem

End Sub
Public Function Delete(ByVal lPosition As Long) As cFailedStep

    Set Delete = mcFailedSteps.Delete(lPosition)

End Function

Public Sub Clear()

    mcFailedSteps.Clear

End Sub
Public Function Count() As Long

    Count = mcFailedSteps.Count

End Function
Public Property Get Item(ByVal Position As Long) As cFailedStep
Attribute Item.VB_UserMemId = 0

    Set Item = mcFailedSteps.Item(Position)

End Property

Public Function StepFailed(lStepId As Long) As Boolean

    ' Returns True if a failure record already exists for the passed in step
    Dim lIndex As Long

    StepFailed = False

    For lIndex = 0 To Count() - 1
        If mcFailedSteps(lIndex).StepId = lStepId Then
            StepFailed = True
            Exit For
        End If
    Next lIndex

End Function

Private Sub Class_Initialize()

    Set mcFailedSteps = New cVector

End Sub

Private Sub Class_Terminate()

    Set mcFailedSteps = Nothing

End Sub
```

cFileInfo.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cFileInfo"
```

```
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:       cFileInfo.cls
'            Microsoft TPC-H Kit Ver. 1.00
'            Copyright Microsoft, 1999
'            All Rights Reserved
'
'
'  PURPOSE:     File Properties viz. name, handle, etc.
'  Contact:     Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

Private mstrFileName As String
Private mintFileHandle As Integer
Private mdbsNodeDb As Database ' Since it is used to form a
cNodeCollection
Private mlngPosition As Long ' Since it is used to form a
cNodeCollection
Public Property Get FileName() As String

   FileName = mstrFileName

End Property
Public Property Let FileName(ByVal vdata As String)

   mstrFileName = vdata

End Property
Public Property Let FileHandle(ByVal vdata As Integer)

   mintFileHandle = vdata

End Property
Public Property Set NodeDB(vdata As Database)

   Set mdbsNodeDb = vdata

End Property

Public Property Get NodeDB() As Database

   Set NodeDB = mdbsNodeDb

End Property
Public Property Get Position() As Long

   Position = mlngPosition

End Property
Public Property Let Position(ByVal vdata As Long)

   mlngPosition = vdata

End Property

Public Property Get FileHandle() As Integer

   FileHandle = mintFileHandle

End Property
```

cFileSM.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cFileSM"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
Attribute VB_Ext_KEY = "SavedWithClassBuilder" ,"Yes"
Attribute VB_Ext_KEY = "Top_Level" ,"Yes"
'  FILE:       cFileSM.cls
'            Microsoft TPC-H Kit Ver. 1.00
'            Copyright Microsoft, 1999
'            All Rights Reserved
'
'
'  PURPOSE:     Encapsulates functions to open a file and write to it.
'  Contact:     Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

' Used to indicate the source module name when errors
' are raised by this class
Private Const mstrModuleName As String = "cFileSM."
Private mstrSource As String

Private mstrFileName As String
Private mintHFile As Integer
Private mstrFileHeader As String
Private mstrProjectName As String

Public Sub CloseFile()

   ' Close the file
   If mintHFile > 0 Then
      Call CloseFileSM(mstrFileName)
      mintHFile = 0
   End If

End Sub

Public Property Let ProjectName(ByVal vdata As String)
   ' An optional field - will be appended to the file
   ' header string if specified

   Const strProjectHdr As String = "Project Name:"

   mstrProjectName = vdata
   mstrFileHeader = mstrFileHeader & _
         Space$(1) & strProjectHdr & Space$(1) & _
         gstrSQ & vdata & gstrSQ

End Property
Public Property Get ProjectName() As String

   ProjectName = mstrProjectName

End Property
Public Property Get FileName() As String

   FileName = mstrFileName

End Property
Public Property Let FileName(ByVal vdata As String)

   mstrFileName = vdata

End Property
Public Sub WriteLine(strMsg As String)

   ' Writes the passed in string to the file
   Call WriteToFile(strMsg, False)
```

```
End Sub

Public Sub WriteField(strMsg As String)

   ' Writes the passed in string to the file
   Call WriteToFile(strMsg, True)

End Sub

Private Sub WriteToFile(strMsg As String, _
      blnContinue As Boolean)
   ' Writes the passed in string to the file - the
   ' Continue flag indicates whether the next line will
   ' be continued on the same line or printed on a new one

   On Error GoTo WriteToFileErr

   ' Open the file if it hasn't been already
   If mintHFile = 0 Then

      ' If the filename has not been initialized, do not
      ' attempt to open it
      If mstrFileName <> gstrEmptyString Then

         mintHFile = OpenFileSM(mstrFileName)

         If mintHFile = 0 Then
            ' The Open File command failed for some reason
            ' No point in trying to write the file header
         Else
            ' Print a file header, if a header string has been
            ' initialized
            If mstrFileHeader <> gstrEmptyString Then
               Print #mintHFile,
               Print #mintHFile, mstrFileHeader
               Print #mintHFile,
            End If
         End If
      End If
   End If

   If mintHFile <> 0 Then
      If strMsg = gstrEmptyString Then
         Print #mintHFile,
      Else
         If blnContinue Then
            ' Write the message to the file - continue
            ' all subsequent characters on the same line
            Print #mintHFile, strMsg;
         Else
            ' Write the message to the file
            Print #mintHFile, strMsg
         End If
      End If
   Else
      ' Display the string to the user instead of
      ' trying to write it to the file
      ' This could be the project error log that we were
      ' trying to open! Play it safe and display errors - do
      ' not try to log them.
      MsgBox strMsg, vbOKOnly
   End If

   Exit Sub

WriteToFileErr:
   ' Log the error code raised by Visual Basic
   Call DisplayErrors(Errors)

   ' Display the string to the user instead of
   ' trying to write it to the file
   MsgBox strMsg, vbOKOnly

End Sub
Public Property Let FileHeader(ByVal vdata As String)

   mstrFileHeader = vdata

End Property
Public Property Get FileHeader() As String

   FileHeader = mstrFileHeader

End Property

Private Sub Class_Terminate()

   ' Close the file opened by this instance
   Call CloseFile

End Sub
```

cGlobalStep.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cGlobalStep"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:       cGlobalStep.cls
'              Microsoft TPC-H Kit Ver. 1.00
'              Copyright Microsoft, 1999
'              All Rights Reserved
'
'
'  PURPOSE:    Encapsulates the properties and methods of a global
step.
'              Implements the cStep class - carries out initializations
'              and validations that are specific to global steps.
'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

Implements cStep

' Object variable to keep the reference in
Private mcStep As cStep

' Used to indicate the source module name when errors
' are raised by this class
Private mstrSource As String
Private Const mstrModuleName As String = "cGlobalStep."

Private Sub cStep_AddAllIterators()

   Call mcStep.AddAllIterators

End Sub

Private Sub cStep_AddIterator(cItRecord As cIterator)

   Call mcStep.AddIterator(cItRecord)

End Sub

Private Property Let cStep_ArchivedFlag(ByVal RHS As Boolean)
```

```
    mcStep.ArchivedFlag = RHS

End Property

Private Property Get cStep_ArchivedFlag() As Boolean

    cStep_ArchivedFlag = mcStep.ArchivedFlag

End Property

Private Sub Class_Initialize()

    ' Create the object
    Set mcStep = New cStep

    ' Initialize the object with valid values for a global step
    ' The global flag should be the first field to be initialized
    ' since subsequent validations might try to check if the
    ' step being created is global
    mcStep.GlobalFlag = True
    mcStep.StepType = gintGlobalStep

    ' A global step cannot have any sub-steps associated with it
    ' Hence, it will always be at Step Level 0
    mcStep.ParentStepId = 0
    mcStep.ParentVersionNo = gstrMinVersion
    mcStep.StepLevel = 0

    ' The enabled flag must be False for all global steps
    ' Global steps can be of two types
    ' a. Those that are run globally within a workspace either
    '    before every step, after every step or during the entire
    '    run, depending on the global run method
    ' b. Those that are not run globally, but qualify to be either
    '    pre or post-execution steps for other steps in the workspace.
    '    Whether or not such a step will be executed depends on
    '    whether the step for which it is defined as a pre/post
    '    step will be executed
    mcStep.EnabledFlag = False

    mcStep.ContinuationCriteria = gintNoOption
    mcStep.DegreeParallelism = gstrGlobalParallelism

End Sub
Private Sub Class_Terminate()

    ' Remove the step object
    Set mcStep = Nothing

End Sub

Private Sub cStep_Add()

    ' Call a private procedure to see if the step text has been
    ' entered - since a global step actually executes a step, entry
    ' of the text is mandatory
    Call StepTextOrFileEntered

    ' Call the Add method of the step class to carry out the insert
    mcStep.Add

End Sub

Private Function cStep_Clone(Optional cCloneStep As cStep) As cStep

    Dim cNewGlobal As cGlobalStep

    Set cNewGlobal = New cGlobalStep
    Set cStep_Clone = mcStep.Clone(cNewGlobal)

End Function


Private Property Get cStep_ContinuationCriteria() As
ContinuationCriteria

    cStep_ContinuationCriteria = mcStep.ContinuationCriteria

End Property

Private Property Let cStep_ContinuationCriteria(ByVal RHS As
ContinuationCriteria)

    ' The continuation criteria field will always be empty for a
    ' global step
    mcStep.ContinuationCriteria = 0

End Property

Private Property Let cStep_DegreeParallelism(ByVal RHS As String)

    ' Will always be zero for a global step
    mcStep.DegreeParallelism = gstrGlobalParallelism

End Property

Private Property Get cStep_DegreeParallelism() As String

    cStep_DegreeParallelism = mcStep.DegreeParallelism

End Property

Private Sub cStep_DeleteIterator(cItRecord As cIterator)

    Call mcStep.DeleteIterator(cItRecord)

End Sub

Private Sub cStep_Delete()

    mcStep.Delete

End Sub

Private Property Get cStep_EnabledFlag() As Boolean

    cStep_EnabledFlag = mcStep.EnabledFlag

End Property

Private Property Let cStep_EnabledFlag(ByVal RHS As Boolean)

    ' The enabled flag must be False for all global steps
    ' Global steps can be of two types
    ' a. Those that are run globally within a workspace either
    '    before every step, after every step or during the entire
    '    run, depending on the global run method
    ' b. Those that are not run globally, but qualify to be either
    '    pre or post-execution steps for other steps in the workspace.
    '    Whether or not such a step will be executed depends on
    '    whether the step for which it is defined as a pre/post
    '    step will be executed
    mcStep.EnabledFlag = False

End Property

Private Property Let cStep_ErrorFile(ByVal RHS As String)

    mcStep.ErrorFile = RHS
```

```
End Property

Private Property Get cStep_ErrorFile() As String

   cStep_ErrorFile = mcStep.ErrorFile

End Property

Private Property Let cStep_ExecutionMechanism(ByVal RHS As
ExecutionMethod)

   ' Whether or not the Execution Mechanism is valid will be
   ' checked by the Step class
   mcStep.ExecutionMechanism = RHS

End Property

Private Property Get cStep_ExecutionMechanism() As
ExecutionMethod

   cStep_ExecutionMechanism = mcStep.ExecutionMechanism

End Property

Private Property Let cStep_FailureDetails(ByVal RHS As String)

   ' Whether or not the Failure Details are valid for the
   ' selected failure criteria will be checked by the Step class
   mcStep.FailureDetails = RHS

End Property

Private Property Get cStep_FailureDetails() As String

   cStep_FailureDetails = mcStep.FailureDetails

End Property

Private Property Get cStep_GlobalFlag() As Boolean

   cStep_GlobalFlag = mcStep.GlobalFlag

End Property

Private Property Let cStep_GlobalFlag(ByVal RHS As Boolean)

   ' Set the global flag to true
   mcStep.GlobalFlag = True

End Property

Private Function cStep_IncVersionX() As String

   cStep_IncVersionX = mcStep.IncVersionX

End Function

Private Function cStep_IncVersionY() As String

   cStep_IncVersionY = mcStep.IncVersionY

End Function


'Private Property Let cStep_GlobalRunMethod(ByVal RHS As Integer)
'
'    ' Whether or not the Global Run Method is valid for the step
'    ' will be checked by the Step class
'    mcStep.GlobalRunMethod = RHS
'
'End Property
'
'Private Property Get cStep_GlobalRunMethod() As Integer
'
'    cStep_GlobalRunMethod = mcStep.GlobalRunMethod
'
'End Property
'
Private Property Get cStep_IndOperation() As Operation

   cStep_IndOperation = mcStep.IndOperation

End Property

Private Property Let cStep_IndOperation(ByVal RHS As Operation)

   mcStep.IndOperation = RHS

End Property

Private Sub cStep_InsertIterator(cItRecord As cIterator)

   Call mcStep.InsertIterator(cItRecord)

End Sub

Private Function cStep_IsNewVersion() As Boolean
   cStep_IsNewVersion = mcStep.IsNewVersion
End Function

Private Function cStep_IteratorCount() As Long

   cStep_IteratorCount = mcStep.IteratorCount

End Function

Private Property Let cStep_IteratorName(ByVal RHS As String)

   mcStep.IteratorName = RHS

End Property

Private Property Get cStep_IteratorName() As String

   cStep_IteratorName = mcStep.IteratorName

End Property

Private Function cStep_Iterators() As Variant

   cStep_Iterators = mcStep.Iterators

End Function

Private Sub cStep_LoadIterator(cItRecord As cIterator)

   Call mcStep.LoadIterator(cItRecord)

End Sub

'Private Property Let cStep_LogFile(ByVal RHS As String)
'
'    mcStep.LogFile = RHS
'
'End Property
'
'Private Property Get cStep_LogFile() As String
'
'    cStep_LogFile = mcStep.LogFile
```

```
'
'End Property

Private Sub cStep_ModifyIterator(cItRecord As cIterator)

   Call mcStep.ModifyIterator(cItRecord)

End Sub

Private Sub cStep_Modify()

   ' Call a private procedure to see if the step text has been
   ' entered - since a global step actually executes a step,
   ' entry of the text is mandatory
   Call StepTextOrFileEntered

   ' Call the Modify method of the step class to carry out the update
   mcStep.Modify

End Sub

Private Property Get cStep_NextStepId() As Long

   cStep_NextStepId = mcStep.NextStepId

End Property

Private Property Set cStep_NodeDB(RHS As DAO.Database)

   Set mcStep.NodeDB = RHS

End Property

Private Property Get cStep_NodeDB() As DAO.Database

   Set cStep_NodeDB = mcStep.NodeDB

End Property

Private Function cStep_OldVersionNo() As String
   cStep_OldVersionNo = mcStep.OldVersionNo
End Function

Private Property Let cStep_OutputFile(ByVal RHS As String)

   mcStep.OutputFile = RHS

End Property

Private Property Get cStep_OutputFile() As String

   cStep_OutputFile = mcStep.OutputFile

End Property

Private Property Let cStep_ParentStepId(ByVal RHS As Long)

   ' A global step cannot have any sub-steps associated with it
   ' Hence, the parent step id and parent version number will be zero
   mcStep.ParentStepId = 0

End Property

Private Property Get cStep_ParentStepId() As Long

   cStep_ParentStepId = mcStep.ParentStepId

End Property

Private Property Let cStep_ParentVersionNo(ByVal RHS As String)

   ' A global step cannot have any sub-steps associated with it
   ' Hence, the parent step id and parent version number will be zero
   mcStep.ParentVersionNo = gstrMinVersion

End Property

Private Property Get cStep_ParentVersionNo() As String

   cStep_ParentVersionNo = mcStep.ParentVersionNo

End Property

Private Property Let cStep_Position(ByVal RHS As Long)

   mcStep.Position = RHS

End Property

Private Property Get cStep_Position() As Long

   cStep_Position = mcStep.Position

End Property

Private Sub cStep_RemoveIterator(cItRecord As cIterator)

   Call mcStep.RemoveIterator(cItRecord)

End Sub

Private Sub cStep_SaveIterators()

   Call mcStep.SaveIterators

End Sub

Private Property Let cStep_SequenceNo(ByVal RHS As Integer)

   mcStep.SequenceNo = RHS

End Property

Private Property Get cStep_SequenceNo() As Integer

   cStep_SequenceNo = mcStep.SequenceNo

End Property

Private Property Let cStep_StepId(ByVal RHS As Long)

   mcStep.StepId = RHS

End Property
Private Property Get cStep_StepId() As Long

   cStep_StepId = mcStep.StepId

End Property


Private Property Let cStep_StepLabel(ByVal RHS As String)

   mcStep.StepLabel = RHS

End Property

Private Property Get cStep_StepLabel() As String

   cStep_StepLabel = mcStep.StepLabel
```

```
End Property

Private Property Let cStep_StartDir(ByVal RHS As String)

   mcStep.StartDir = RHS

End Property

Private Property Get cStep_StartDir() As String

   cStep_StartDir = mcStep.StartDir

End Property

Private Property Let cStep_StepLevel(ByVal RHS As Integer)

   ' A global step cannot have any sub-steps associated with it
   ' Hence, it will always be at step level 0
   mcStep.StepLevel = 0

End Property

Private Property Get cStep_StepLevel() As Integer

   cStep_StepLevel = mcStep.StepLevel

End Property

Private Property Let cStep_StepText(ByVal RHS As String)

   mcStep.StepText = RHS

End Property

Private Property Get cStep_StepText() As String

   cStep_StepText = mcStep.StepText

End Property

Private Property Let cStep_StepTextFile(ByVal RHS As String)

   mcStep.StepTextFile = RHS

End Property

Private Property Get cStep_StepTextFile() As String

   cStep_StepTextFile = mcStep.StepTextFile

End Property

Private Property Let cStep_StepType(RHS As gintStepType)

   mcStep.StepType = gintGlobalStep

End Property

Private Property Get cStep_StepType() As gintStepType

   cStep_StepType = mcStep.StepType

End Property

Private Sub cStep_UnloadIterators()

   Call mcStep.UnloadIterators

End Sub

Private Sub cStep_UpdateIterator(cItRecord As cIterator)

   Call mcStep.UpdateIterator(cItRecord)

End Sub

Private Sub cStep_UpdateIteratorVersion()

   Call mcStep.UpdateIteratorVersion

End Sub

Private Sub cStep_Validate()
   ' The validate routines for each of the steps will
   ' carry out the specific validations for the type and
   ' call the generic validation routine

   On Error GoTo cStep_ValidateErr
   mstrSource = mstrModuleName & "cStep_Validate"

   ' Validations specific to global steps

   ' Check if the step text or a file name has been
   ' specified
   Call StepTextOrFileEntered

   ' The step level must be zero for all globals
   If mcStep.StepLevel <> 0 Then
      ShowError errStepLevelZeroForGlobal
      On Error GoTo 0
      Err.Raise vbObjectError + errValidateFailed, _
            gstrSource, _
            LoadResString(errValidateFailed)
   End If

   If mcStep.EnabledFlag Then
      ShowError errEnabledFlagFalseForGlobal
      On Error GoTo 0
      Err.Raise vbObjectError + errValidateFailed, _
            gstrSource, _
            LoadResString(errValidateFailed)
   End If

   If mcStep.DegreeParallelism > 0 Then
      ShowError errDegParallelismNullForGlobal
      On Error GoTo 0
      Err.Raise vbObjectError + errValidateFailed, _
            gstrSource, _
            LoadResString(errValidateFailed)
   End If

   If mcStep.ContinuationCriteria > 0 Then
      ShowError errContCriteriaNullForGlobal
      On Error GoTo 0
      Err.Raise vbObjectError + errValidateFailed, _
            gstrSource, _
            LoadResString(errValidateFailed)
   End If

   mcStep.Validate

   Exit Sub

cStep_ValidateErr:
   LogErrors Errors
   mstrSource = mstrModuleName & "cStep_Validate"
   On Error GoTo 0
   Err.Raise vbObjectError + errValidateFailed, _
         mstrSource, _
```

```
        LoadResString(errValidateFailed)
End Sub
Private Sub StepTextOrFileEntered()
   ' Checks if either the step text or the name of the file containing
   ' the text has been entered
   ' If both of them are null or both of them are not null,
   ' the global step is invalid and an error is raised

   If StringEmpty(mcStep.StepText) And
StringEmpty(mcStep.StepTextFile) Then
      ShowError errStepTextAndFileNull
      On Error GoTo 0
      Err.Raise vbObjectError + errStepTextAndFileNull, _
         mstrSource, LoadResString(errStepTextAndFileNull)
   ElseIf Not StringEmpty(mcStep.StepText) And Not
StringEmpty(mcStep.StepTextFile) Then
      ShowError errStepTextOrFile
      On Error GoTo 0
      Err.Raise vbObjectError + errStepTextOrFile, _
         mstrSource, LoadResString(errStepTextOrFile)
   End If

End Sub

Private Property Let cStep_VersionNo(ByVal RHS As String)

   mcStep.VersionNo = RHS

End Property

Private Property Get cStep_VersionNo() As String

   cStep_VersionNo = mcStep.VersionNo

End Property

Private Property Let cStep_WorkspaceId(ByVal RHS As Long)

   mcStep.WorkspaceId = RHS

End Property

Private Property Get cStep_WorkspaceId() As Long

   cStep_WorkspaceId = mcStep.WorkspaceId

End Property
```

cInstance.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cInstance"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:       cInstance.cls
'              Microsoft TPC-H Kit Ver. 1.00
'              Copyright Microsoft, 1999
'              All Rights Reserved
'
'
'  PURPOSE:    Encapsulates the properties and methods of an instance.
'              An instance is created when a step is executed for a
'              particular iterator value (if applicable) at 'run' time.
'              Contains functions to determine if an instance is running,
'              complete, and so on.
'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

' Used to indicate the source module name when errors
' are raised by this class
Private Const mstrModuleName As String = "cInstance."
Private mstrSource As String

Private mcStep As cStep
Public Key As String ' Node key for the step being executed
Public InstanceId As Long
Public ParentInstanceId As Long ' The parent instance
Private mblnNoMoreToStart As Boolean
Private mblnComplete As Boolean
Public StartTime As Currency
Public EndTime As Currency
Public ElapsedTime As Currency
Private mintStatus As InstanceStatus
Public DegreeParallelism As Integer
Private mcIterators As cRunColIt

' A collection of all the sub-steps for this step
Private mcSubSteps As cSubSteps
Public Sub UpdateStartTime(lStepId As Long, Optional ByVal StartTm
As Currency = gdtmEmpty, _
      Optional ByVal EndTm As Currency = gdtmEmpty, _
      Optional ByVal Elapsed As Currency = 0)
   ' We do not maintain start and end timestamps for the constraint
   ' of a step. Hence we check if the process that just started/
   ' terminated is the worker step that is being executed. If so,
   ' we update the start/end time and status on the instance record.

   BugAssert (StartTm <> gdtmEmpty) Or (EndTm <> gdtmEmpty),
"Mandatory parameter missing."

   ' Make sure that we are executing the actual step and not
   ' a pre or post-execution constraint
   If mcStep.StepId = lStepId Then
      If StartTm <> 0 Then
         StartTime = StartTm
         mintStatus = gintRunning
      Else
         EndTime = EndTm
         ElapsedTime = Elapsed
         mintStatus = gintComplete
      End If
   End If

End Sub
Public Function ValidForIteration(cParentInstance As cInstance, _
      ByVal intConsType As ConstraintType) As Boolean
   ' Returns true if the instance passed in is the first or
   ' last iteration for the step, depending on the constraint type

   Dim cSubStepRec As cSubStep
   Dim vntIterators As Variant

   On Error GoTo ValidForIterationErr

   If cParentInstance Is Nothing Then
      ' This will only be true for the dummy instance, which
      ' cannot have any iterators defined for it
      ValidForIteration = True
      Exit Function
   End If

   vntIterators = mcStep.Iterators
```

```
    If Not StringEmpty(mcStep.IteratorName) And Not
IsEmpty(vntIterators) Then

        Set cSubStepRec = cParentInstance.QuerySubStep(mcStep.StepId)

        If intConsType = gintPreStep Then
            ' Pre-execution constraints will only be executed
            ' before the first iteration
            If cSubStepRec.LastIterator.IteratorType = gintValue Then
                ValidForIteration = (cSubStepRec.LastIterator.Sequence = _
                        gintMinIteratorSequence)
            Else
                ValidForIteration = (cSubStepRec.LastIterator.Value = _
                        cSubStepRec.LastIterator.RangeFrom)
            End If
        Else
            ' Post-execution constraints will only be executed
            ' after the last iteration - check if there are any
            ' pending iterations
            ValidForIteration = cSubStepRec.NextIteration(mcStep) Is
Nothing
        End If
    Else
        ValidForIteration = True
    End If

    Exit Function

ValidForIterationErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    On Error GoTo 0
    mstrSource = mstrModuleName & "ValidForIteration"
    Err.Raise vbObjectError + errExecInstanceFailed, _
            mstrSource, LoadResString(errExecInstanceFailed)

End Function

Public Sub CreateSubStep(cSubStepDtls As cStep, RunParams As
cArrParameters)

    Dim cNewSubStep As cSubStep

    On Error GoTo CreateSubStepErr

    Set cNewSubStep = New cSubStep

    cNewSubStep.StepId = cSubStepDtls.StepId
    cNewSubStep.TasksComplete = 0
    cNewSubStep.TasksRunning = 0

    ' Initialize the iterator for the instance
    Set cNewSubStep.LastIterator = New cRunItDetails
    Call cNewSubStep.InitializeIt(cSubStepDtls, RunParams)

    ' Add add the substep to the collection
    mcSubSteps.Add cNewSubStep

    Set cNewSubStep = Nothing

    Exit Sub

CreateSubStepErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    On Error GoTo 0
    mstrSource = mstrModuleName & "CreateSubStep"
    Err.Raise vbObjectError + errProgramError, mstrSource, _
        LoadResString(errProgramError)

End Sub

Public Function QuerySubStep(ByVal SubStepId As Long) As
cSubStep
    ' Retrieves the sub-step record for the passed in sub-step id

    Dim lngIndex As Long

    On Error GoTo QuerySubStepErr

    ' Find the sub-step node with the matching step id
    For lngIndex = 0 To mcSubSteps.Count - 1
        If mcSubSteps(lngIndex).StepId = SubStepId Then
            Set QuerySubStep = mcSubSteps(lngIndex)
            Exit For
        End If
    Next lngIndex

    Exit Function

QuerySubStepErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    On Error GoTo 0
    mstrSource = mstrModuleName & "QuerySubStep"
    Err.Raise vbObjectError + errNavInstancesFailed, _
            mstrSource, LoadResString(errNavInstancesFailed)

End Function
Public Property Let AllStarted(ByVal vdata As Boolean)

    'bugmessage "Set All Started to " & vData & " for : " & _
        mstrKey

    mblnNoMoreToStart = vdata

End Property
Public Property Get AllStarted() As Boolean

    AllStarted = mblnNoMoreToStart

End Property
Public Property Let AllComplete(ByVal vdata As Boolean)

    'bugmessage "Set All Complete to " & vData & " for : " & _
        mstrKey

    mblnComplete = vdata

End Property

Public Property Get AllComplete() As Boolean

    AllComplete = mblnComplete

End Property

Public Sub ChildExecuted(mlngStepId As Long)
    ' This procedure is called when a sub-step executes.

    Dim lngIndex As Long

    On Error GoTo ChildExecutedErr

    BugAssert mcStep.StepType = gintManagerStep

    For lngIndex = 0 To mcSubSteps.Count - 1
        If mcSubSteps(lngIndex).StepId = mlngStepId Then
            mcSubSteps(lngIndex).TasksRunning = _
                    mcSubSteps(lngIndex).TasksRunning + 1
```

```
'          BugMessage "Tasks Running for Step Id : " & _
'                CStr(mcSubSteps(lngIndex).StepId) & _
'                " Instance Id: " & InstanceId & _
'                " = " & mcSubSteps(lngIndex).TasksRunning
          Exit For
       End If
    Next lngIndex

    If lngIndex > mcSubSteps.Count - 1 Then
       ' The child step wasn't found - raise an error
       On Error GoTo 0
       Err.Raise vbObjectError + errInvalidChild, mstrModuleName, _
             LoadResString(errInvalidChild)
    End If

    Exit Sub

ChildExecutedErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    On Error GoTo 0
    Err.Raise vbObjectError + errInstanceOpFailed, mstrModuleName &
"ChildExecuted", _
          LoadResString(errInstanceOpFailed)

End Sub
Public Sub ChildTerminated(mlngStepId As Long)
    ' This procedure is called when any sub-step process
    ' terminates. Note: The TasksComplete field will be
    ' updated only when all the instances for a sub-step
    ' complete execution.
    Dim lngIndex As Long

    On Error GoTo ChildTerminatedErr

    BugAssert mcStep.StepType = gintManagerStep

    For lngIndex = 0 To mcSubSteps.Count - 1

       If mcSubSteps(lngIndex).StepId = mlngStepId Then
          mcSubSteps(lngIndex).TasksRunning = _
                mcSubSteps(lngIndex).TasksRunning - 1
'          BugMessage "Tasks Running for Step Id : " & _
'                CStr(mcSubSteps(lngIndex).StepId) & _
'                " Instance Id: " & InstanceId & _
'                " = " & mcSubSteps(lngIndex).TasksRunning

          BugAssert mcSubSteps(lngIndex).TasksRunning >= 0, _
                "Tasks running for " & CStr(mlngStepId) & _
                " Instance Id " & InstanceId & " is less than 0."
          Exit For
       End If
    Next lngIndex

    If lngIndex > mcSubSteps.Count - 1 Then
       ' The child step wasn't found - raise an error
       On Error GoTo 0
       Err.Raise errInvalidChild, mstrModuleName &
"ChildTerminated", _
             LoadResString(errInvalidChild)
    End If

    Exit Sub

ChildTerminatedErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    On Error GoTo 0
    mstrSource = mstrModuleName & "ChildTerminated"
    Err.Raise vbObjectError + errInstanceOpFailed, mstrSource, _
          LoadResString(errInstanceOpFailed)

End Sub
Public Sub ChildCompleted(mlngStepId As Long)
    ' This procedure is called when any a sub-step completes
    ' execution. Note: The TasksComplete field will be
    ' incremented.
    Dim lngIndex As Long

    On Error GoTo ChildCompletedErr

    BugAssert mcStep.StepType = gintManagerStep

    For lngIndex = 0 To mcSubSteps.Count - 1
       BugAssert mcSubSteps(lngIndex).TasksComplete >= 0, _
             "Tasks complete for " & CStr(mcSubSteps(lngIndex).StepId)
& _
             " Instance Id " & InstanceId & " is less than 0."

       If mcSubSteps(lngIndex).StepId = mlngStepId Then
          mcSubSteps(lngIndex).TasksComplete = _
                mcSubSteps(lngIndex).TasksComplete + 1
'          BugMessage "Tasks Complete for Step Id : " & _
'                CStr(mcSubSteps(lngIndex).StepId) & _
'                " Instance Id: " & InstanceId & _
'                " = " & mcSubSteps(lngIndex).TasksComplete
          Exit For
       End If
    Next lngIndex

    If lngIndex > mcSubSteps.Count - 1 Then
       ' The child step wasn't found - raise an error
       On Error GoTo 0
       Err.Raise errInvalidChild, mstrModuleName, _
             LoadResString(errInvalidChild)
    End If

    Exit Sub

ChildCompletedErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    On Error GoTo 0
    Err.Raise vbObjectError + errInstanceOpFailed, mstrModuleName &
"ChildCompleted", _
          LoadResString(errInstanceOpFailed)

End Sub
Public Sub ChildDeleted(mlngStepId As Long)
    ' This procedure is called when a sub-step needs to be re-executed
    ' Note: The TasksComplete field is decremented. We needn't worry
about
    ' the TasksRunning field since no steps are currently running.
    Dim lngIndex As Long

    On Error GoTo ChildDeletedErr

    BugAssert mcStep.StepType = gintManagerStep

    For lngIndex = 0 To mcSubSteps.Count - 1

       If mcSubSteps(lngIndex).StepId = mlngStepId Then
          mcSubSteps(lngIndex).TasksRunning = _
                mcSubSteps(lngIndex).TasksRunning - 1

          BugAssert mcSubSteps(lngIndex).TasksRunning >= 0, _
                "Tasks running for " & CStr(mcSubSteps(lngIndex).StepId)
& _
                " Instance Id " & InstanceId & " is less than 0."
          Exit For
```

```
        End If
    Next lngIndex

    If lngIndex > mcSubSteps.Count - 1 Then
        ' The child step wasn't found - raise an error
        On Error GoTo 0
        Err.Raise errInvalidChild, mstrModuleName, _
                LoadResString(errInvalidChild)
    End If

    Exit Sub

ChildDeletedErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    On Error GoTo 0
    Err.Raise vbObjectError + errInstanceOpFailed, mstrModuleName &
"ChildDeleted", _
            LoadResString(errInstanceOpFailed)

End Sub
Private Sub RaiseErrForWorker()

    If mcStep.StepType <> gintManagerStep Then
        On Error GoTo 0
        mstrSource = mstrModuleName & "RaiseErrForWorker"
        Err.Raise vbObjectError + errInvalidForWorker, _
                mstrSource, _
                LoadResString(errInvalidForWorker)
    End If

End Sub

Public Property Get Step() As cStep

    Set Step = mcStep

End Property
Public Property Get Iterators() As cRunColIt

    Set Iterators = mcIterators

End Property
Public Property Get SubSteps() As cSubSteps

    Call RaiseErrForWorker

    Set SubSteps = mcSubSteps

End Property
Public Property Set Step(cRunStep As cStep)

    Set mcStep = cRunStep

End Property

Public Property Set Iterators(cIts As cRunColIt)

    Set mcIterators = cIts

End Property
Public Property Get IsPending() As Boolean
    ' Returns true if the step has any substeps that need
    ' execution
    Dim lngIndex As Long
    Dim lngRunning As Long

    Call RaiseErrForWorker

    If Not mblnComplete And Not mblnNoMoreToStart Then
        ' Get a count of all the substeps that are already being
        ' executed
        lngRunning = 0
        For lngIndex = 0 To mcSubSteps.Count - 1
            lngRunning = lngRunning +
mcSubSteps(lngIndex).TasksRunning
        Next lngIndex

        IsPending = (lngRunning < DegreeParallelism)
    Else
        ' This should be sufficient to prove that there r no
        ' more sub-steps to be executed.
        ' mblnComplete: Handles the case where all steps have
        ' been executed
        ' mblnNoMoreToStart: Handles the case where the step
        ' has a degree of parallelism greater than the total
        ' number of sub-steps available to execute
        IsPending = False
    End If

End Property
Public Property Get IsRunning() As Boolean
    ' Returns true if the any one of the substeps is still
    ' executing
    Dim lngIndex As Long

    Call RaiseErrForWorker

    IsRunning = False

    ' If a substep has no currently executing tasks and
    ' the tasks completed is greater than zero, then we can
    ' assume that it has completed execution (otherwise we
    ' would've run a new task the moment one completed!)
    For lngIndex = 0 To mcSubSteps.Count - 1
        If mcSubSteps(lngIndex).TasksRunning > 0 Then
            IsRunning = True
            Exit For
        End If
    Next lngIndex

End Property
Public Property Get TotalRunning() As Long
    ' Returns the total number of substeps that are executing
    Dim lngTotalProcesses As Long
    Dim lngIndex As Long

    Call RaiseErrForWorker

    lngTotalProcesses = 0
    For lngIndex = 0 To mcSubSteps.Count - 1
        BugAssert mcSubSteps(lngIndex).TasksRunning >= 0, _
                "Tasks running for " & CStr(mcSubSteps(lngIndex).StepId) &
_
                " is less than 0."
        lngTotalProcesses = lngTotalProcesses +
mcSubSteps(lngIndex).TasksRunning
    Next lngIndex

    TotalRunning = lngTotalProcesses
End Property
Public Property Get RunningForStep(lngSubStepId As Long) As Long
    ' Returns the total number of instances of the substep
    ' that are executing
    Dim lngIndex As Long

    Call RaiseErrForWorker

    For lngIndex = 0 To mcSubSteps.Count - 1
        BugAssert mcSubSteps(lngIndex).TasksRunning >= 0, _
```

```
            "Tasks running for " & CStr(mcSubSteps(lngIndex).StepId) &
_
            " is less than 0."

      If mcSubSteps(lngIndex).StepId = lngSubStepId Then
         RunningForStep = mcSubSteps(lngIndex).TasksRunning
         Exit For
      End If
   Next lngIndex

   If lngIndex > mcSubSteps.Count - 1 Then
      ' The child step wasn't found - raise an error
      On Error GoTo 0
      Err.Raise errInvalidChild, mstrSource, _
            LoadResString(errInvalidChild)
   End If

End Property

Public Property Let Status(ByVal vdata As InstanceStatus)

   mintStatus = vdata

End Property

Public Property Get Status() As InstanceStatus

   Status = mintStatus

End Property
Private Sub Class_Initialize()

   Set mcSubSteps = New cSubSteps

   mblnNoMoreToStart = False
   mblnComplete = False
   StartTime = gdtmEmpty
   EndTime = gdtmEmpty

End Sub

Private Sub Class_Terminate()

   mcSubSteps.Clear
   Set mcSubSteps = Nothing

End Sub
```

cInstances.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cInstances"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:      cInstances.cls
'             Microsoft TPC-H Kit Ver. 1.00
'             Copyright Microsoft, 1999
'             All Rights Reserved
'
'
'  PURPOSE:   Implements a collection of cInstance objects.
'             Type-safe wrapper around cVector.
'             Also contains additional functions to query an instance, etc.
'  Contact:   Reshma Tharamal (reshmat@microsoft.com)
'

Option Explicit

' Used to indicate the source module name when errors
' are raised by this class
Private Const mstrModuleName As String = "cInstance."
Private mstrSource As String

Private mcInstances As cVector

Public Function QueryInstance(ByVal InstanceId As Long) As
cInstance
   ' Retrieves the record for the passed in instance from
   ' the collection

   Dim lngIndex As Long

   On Error GoTo QueryInstanceErr

   ' Check for valid values of the instance id
   If InstanceId > 0 Then
      ' Find the run node with the matching step id
      For lngIndex = 0 To Count() - 1
         If mcInstances(lngIndex).InstanceId = InstanceId Then
            Set QueryInstance = mcInstances(lngIndex)
            Exit For
         End If
      Next lngIndex

      If lngIndex > mcInstances.Count - 1 Then
         On Error GoTo 0
         Err.Raise vbObjectError + errQueryFailed, mstrSource, _
               LoadResString(errQueryFailed)
      End If
   Else
      On Error GoTo 0
      Err.Raise vbObjectError + errQueryFailed, mstrSource, _
            LoadResString(errQueryFailed)
   End If

   Exit Function

QueryInstanceErr:
   ' Log the error code raised by Visual Basic
   Call LogErrors(Errors)
   On Error GoTo 0
   mstrSource = mstrModuleName & "QueryInstance"
   Err.Raise vbObjectError + errQueryFailed, _
         mstrSource, LoadResString(errQueryFailed)

End Function

Public Function QueryPendingInstance(ByVal ParentInstanceId As
Long, _
      ByVal lngSubStepId As Long) As cInstance
   ' Retrieves a pending instance for the passed in substep
   ' and the given parent instance id.

   Dim lngIndex As Long

   On Error GoTo QueryPendingInstanceErr

   ' Find the run node with the matching step id
   For lngIndex = 0 To Count() - 1
      If mcInstances(lngIndex).ParentInstanceId = ParentInstanceId And
_
            mcInstances(lngIndex).Step.StepId = lngSubStepId Then
         ' Put in a separate if condition since the IsPending
         ' property is valid only for manager steps. If the
         ' calling procedure does not pass a manager step
         ' identifier, the procedure will error out.
```

```
        If mcInstances(lngIndex).IsPending Then
            Set QueryPendingInstance = mcInstances(lngIndex)
            Exit For
        End If
    End If
  Next lngIndex

  Exit Function

QueryPendingInstanceErr:
  ' Log the error code raised by Visual Basic
  Call LogErrors(Errors)
  On Error GoTo 0
  mstrSource = mstrModuleName & "QueryPendingInstance"
  Err.Raise vbObjectError + errQueryFailed, _
        mstrSource, LoadResString(errQueryFailed)

End Function
Public Function InstanceAborted(cSubStepRec As cSubStep) As
Boolean

  Dim lIndex As Long

  InstanceAborted = False

  For lIndex = 0 To Count() - 1
    If mcInstances(lIndex).Step.StepId = cSubStepRec.StepId And _
          mcInstances(lIndex).Status = gintAborted Then
        InstanceAborted = True
        Exit For
    End If
  Next lIndex

End Function
Public Function CompletedInstanceExists(lParentInstance As Long, _
      cSubStepDtls As cStep) As Boolean
  ' Checks if there is a completed instance of the passed in step

  Dim lngIndex As Long

  CompletedInstanceExists = False

  If cSubStepDtls.StepType = gintManagerStep Then
    ' Find the run node with the matching step id
    For lngIndex = 0 To Count() - 1
        If mcInstances(lngIndex).ParentInstanceId = lParentInstance
And _
              mcInstances(lngIndex).Step.StepId = cSubStepDtls.StepId
Then
            ' Put in a separate if condition since the IsPending
            ' property is valid only for manager steps.
            BugAssert (Not mcInstances(lngIndex).IsPending), "Pending
instance exists!"

            CompletedInstanceExists = True
            Exit Function
        End If
    Next lngIndex
  End If

End Function
Public Sub Add(ByVal objItem As cInstance)

  mcInstances.Add objItem

End Sub


Public Sub Clear()

  mcInstances.Clear

End Sub


Public Function Count() As Long

  Count = mcInstances.Count

End Function


Public Function Delete(ByVal lngDelete As Long) As cInstance

  Set Delete = mcInstances.Delete(lngDelete)

End Function


Public Property Set Item(Optional ByVal Position As Long, _
      RHS As cInstance)

  If Position = -1 Then
    Position = 0
  End If
  Set mcInstances(Position) = RHS

End Property

Public Property Get Item(Optional ByVal Position As Long = -1) _
      As cInstance
Attribute Item.VB_UserMemId = 0

  If Position = -1 Then
    Position = 0
  End If
  Set Item = mcInstances.Item(Position)

End Property

Private Sub Class_Initialize()

  Set mcInstances = New cVector

End Sub


Private Sub Class_Terminate()

  Set mcInstances = Nothing

End Sub
```

cIterator.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cIterator"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:      cIterator.cls
'             Microsoft TPC-H Kit Ver. 1.00
'             Copyright Microsoft, 1999
'             All Rights Reserved
'
'
```

```
'  PURPOSE:     Encapsulates the properties and methods of an iterator.
'               Contains functions to insert, update and delete
'               iterator_values records from the database.
'  Contact:     Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

Implements cNode

' Module level variables to store the property values
Private mintType As Integer
Private mintSequenceNo As Integer
Private mstrValue As String
Private mdbsIteratorDB As Database
Private mintOperation As Integer
Private mlngPosition As Long

Private Const mstrModuleName As String = "cIterator."
Private mstrSource As String

Public Enum ValueType
   gintFrom = 1
   gintTo
   gintStep
   gintValue
End Enum
Public Property Get Value() As String

   Value = mstrValue

End Property
Public Property Let Value(ByVal vdata As String)

   mstrValue = vdata

End Property

Public Property Get IndOperation() As Operation

   IndOperation = mintOperation

End Property
Public Property Let IndOperation(ByVal vdata As Operation)

   On Error GoTo IndOperationErr
   mstrSource = mstrModuleName & "IndOperation"

   ' The valid operations are define in the cOperations
   ' class. Check if the operation is valid
   Select Case vdata
      Case QueryOp, InsertOp, UpdateOp, DeleteOp
         mintOperation = vdata

      Case Else
         On Error GoTo 0
         Err.Raise vbObjectError + errInvalidOperation, _
               mstrSource, LoadResString(errInvalidOperation)
   End Select

   Exit Property

IndOperationErr:
   LogErrors Errors
   mstrSource = mstrModuleName & "IndOperation"
   On Error GoTo 0
   Err.Raise vbObjectError + errLetOperationFailed, _
      mstrSource, LoadResString(errLetOperationFailed)

End Property

Public Function Clone() As cIterator

   ' Creates a copy of a given Iterator

   Dim cItClone As cIterator

   On Error GoTo CloneErr

   Set cItClone = New cIterator

   ' Copy all the iterator properties to the newly
   ' created object
   cItClone.IteratorType = mintType
   cItClone.SequenceNo = mintSequenceNo
   cItClone.IndOperation = mintOperation
   cItClone.Value = mstrValue

   ' And set the return value to the newly created Iterator
   Set Clone = cItClone

   Exit Function

CloneErr:
   LogErrors Errors
   mstrSource = mstrModuleName & "Clone"
   On Error GoTo 0
   Err.Raise vbObjectError + errCloneFailed, _
         mstrSource, LoadResString(errCloneFailed)

End Function
Public Property Get SequenceNo() As Integer

   SequenceNo = mintSequenceNo

End Property

Public Property Let SequenceNo(ByVal vdata As Integer)
   mintSequenceNo = vdata
End Property

Public Sub Add(ByVal lngStepId As Long, _
      strVersion As String)
   ' Inserts a new iterator values record into the database

   Dim strInsert As String
   Dim qy As DAO.QueryDef

   On Error GoTo AddIteratorErr

   ' First check if the database object is valid
   Call CheckDB

   ' Create a temporary querydef object
   strInsert = "insert into iterator_values " & _
         "( step_id, version_no, type, " & _
         " iterator_value, sequence_no ) " & _
         " values ( [st_id], [ver_no], [it_typ], " & _
         " [it_val], [seq_no] )"
   Set qy = mdbsIteratorDB.CreateQueryDef(gstrEmptyString, strInsert)

   ' Call a procedure to execute the Querydef object
   Call AssignParameters(qy, lngStepId, strVersion)

   qy.Execute dbFailOnError
   qy.Close

   Exit Sub

AddIteratorErr:
   LogErrors Errors
```

```
    mstrSource = mstrModuleName & "AddIterator"
    On Error GoTo 0
    Err.Raise vbObjectError + errInsertIteratorFailed, _
          mstrSource, _
          LoadResString(errInsertIteratorFailed)
End Sub

Private Sub AssignParameters(qyExec As DAO.QueryDef, _
       ByVal lngStepId As Long, _
       strVersion As String)
    ' Assigns values to the parameters in the querydef object
    ' The parameter names are cryptic to make them different
    ' from the field names. When the parameter names are
    ' the same as the field names, parameters in the where
    ' clause do not get created.

    Dim prmParam As DAO.Parameter

    On Error GoTo AssignParametersErr
    mstrSource = mstrModuleName & "AssignParameters"

    For Each prmParam In qyExec.Parameters
       Select Case prmParam.Name
          Case "[st_id]"
             prmParam.Value = lngStepId

          Case "[ver_no]"
             prmParam.Value = strVersion

          Case "[it_typ]"
             prmParam.Value = mintType

          Case "[it_val]"
             prmParam.Value = mstrValue

          Case "[seq_no]"
             prmParam.Value = mintSequenceNo

          Case Else
             ' Write the parameter name that is faulty
             WriteError errInvalidParameter, mstrSource, _
                   prmParam.Name
             On Error GoTo 0
             Err.Raise errInvalidParameter, mstrSource, _
                   LoadResString(errInvalidParameter)
       End Select
    Next prmParam

    Exit Sub

AssignParametersErr:

    mstrSource = mstrModuleName & "AssignParameters"
    Call LogErrors(Errors)
    On Error GoTo 0
    Err.Raise vbObjectError + errAssignParametersFailed, _
       mstrSource, LoadResString(errAssignParametersFailed)

End Sub
Private Sub CheckDB()
    ' Check if the database object has been initialized

    If mdbsIteratorDB Is Nothing Then
       ShowError errInvalidDB
       On Error GoTo 0
       Err.Raise vbObjectError + errInvalidDB, _
          mstrModuleName, LoadResString(errInvalidDB)
    End If

End Sub

Public Sub Delete(ByVal lngStepId As Long, _
       strVersion As String)
    ' Deletes the step iterator record from the database

    Dim strDelete As String
    Dim qy As DAO.QueryDef

    On Error GoTo DeleteIteratorErr
    mstrSource = mstrModuleName & "DeleteIterator"

    ' There can be multiple iterators for a step.
    ' However the values that an iterator for a step can
    ' assume will be unique, meaning that a combination of
    ' the iterator_id and value will be unique.
    strDelete = "delete from iterator_values " & _
          " where step_id = [st_id]" & _
          " and version_no = [ver_no]" & _
          " and iterator_value = [it_val] "
    Set qy = mdbsIteratorDB.CreateQueryDef(gstrEmptyString,
strDelete)

    Call AssignParameters(qy, lngStepId, strVersion)
    qy.Execute dbFailOnError

    qy.Close

    Exit Sub

DeleteIteratorErr:
    LogErrors Errors
    mstrSource = mstrModuleName & "DeleteIterator"
    On Error GoTo 0
    Err.Raise vbObjectError + errDeleteIteratorFailed, _
          mstrSource, _
          LoadResString(errDeleteIteratorFailed)
End Sub
Public Sub Update(ByVal lngStepId As Long, strVersion As String)
    ' Updates the sequence no of the step iterator record
    ' in the database

    Dim strUpdate As String
    Dim qy As QueryDef

    On Error GoTo UpdateErr

    ' First check if the database object is valid
    Call CheckDB

    If mintType = gintValue Then
       ' If the iterator is of type value, only the sequence of the values can
get updated
       strUpdate = "Update iterator_values " & _
             " set sequence_no = [seq_no] " & _
             " where step_id = [st_id]" & _
             " and version_no = [ver_no]" & _
             " and iterator_value = [it_val] "
    Else
       ' If the iterator is of type range, only the values can get updated
       strUpdate = "Update iterator_values " & _
             " set iterator_value = [it_val] " & _
             " where step_id = [st_id]" & _
             " and version_no = [ver_no]" & _
             " and type = [it_typ] "
    End If

    Set qy = mdbsIteratorDB.CreateQueryDef(gstrEmptyString,
strUpdate)

    ' Call a procedure to assign the parameter values to the
```

```
    ' querydef object
    Call AssignParameters(qy, lngStepId, strVersion)
    qy.Execute dbFailOnError

    qy.Close

    Exit Sub

UpdateErr:
    LogErrors Errors
    mstrSource = mstrModuleName & "Update"
    On Error GoTo 0
    Err.Raise vbObjectError + errUpdateConstraintFailed, _
          mstrSource, _
          LoadResString(errUpdateConstraintFailed)

End Sub
Public Property Set NodeDB(vdata As Database)

    Set mdbsIteratorDB = vdata

End Property

Public Property Get NodeDB() As Database

    Set NodeDB = mdbsIteratorDB

End Property
Public Property Get Position() As Long

    Position = mlngPosition

End Property
Public Property Let Position(ByVal vdata As Long)

    mlngPosition = vdata

End Property

Public Property Let IteratorType(ByVal vdata As ValueType)

    On Error GoTo TypeErr
    mstrSource = mstrModuleName & "Type"

    ' These constants have been defined in the enumeration,
    ' Type, which is exposed
    Select Case vdata
       Case gintFrom, gintTo, gintStep, gintValue
          mintType = vdata

       Case Else
          On Error GoTo 0
          Err.Raise vbObjectError + errTypeInvalid, _
             mstrSource, LoadResString(errTypeInvalid)
    End Select

    Exit Property

TypeErr:
    LogErrors Errors
    mstrSource = mstrModuleName & "Type"
    On Error GoTo 0
    Err.Raise vbObjectError + errTypeInvalid, _
       mstrSource, LoadResString(errTypeInvalid)

End Property

Public Property Get IteratorType() As ValueType

    IteratorType = mintType

End Property
Public Sub Validate()

    ' No validations necessary for the iterator class

End Sub

Private Sub Class_Initialize()

    ' Initialize the operation indicator variable to Query
    ' It will be modified later by the collection class when
    ' inserts, updates or deletes are performed
    mintOperation = QueryOp

End Sub


Private Property Let cNode_IndOperation(ByVal vdata As Operation)

    On Error GoTo IndOperationErr
    mstrSource = mstrModuleName & "IndOperation"

    ' The valid operations are define in the cOperations
    ' class. Check if the operation is valid
    Select Case vdata
       Case QueryOp, InsertOp, UpdateOp, DeleteOp
          mintOperation = vdata

       Case Else
          On Error GoTo 0
          Err.Raise vbObjectError + errInvalidOperation, _
                mstrSource, LoadResString(errInvalidOperation)
    End Select

    Exit Property

IndOperationErr:
    LogErrors Errors
    mstrSource = mstrModuleName & "IndOperation"
    On Error GoTo 0
    Err.Raise vbObjectError + errLetOperationFailed, _
       mstrSource, LoadResString(errLetOperationFailed)

End Property

Private Property Get cNode_IndOperation() As Operation

    IndOperation = mintOperation

End Property

Private Property Set cNode_NodeDB(RHS As DAO.Database)

    Set mdbsIteratorDB = RHS

End Property

Private Property Get cNode_NodeDB() As DAO.Database

    Set cNode_NodeDB = mdbsIteratorDB

End Property


Private Property Let cNode_Position(ByVal vdata As Long)

    mlngPosition = vdata

End Property
```


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```
Private Property Get cNode_Position() As Long

   cNode_Position = mlngPosition

End Property


Private Sub cNode_Validate()

   ' No validations necessary for the iterator class

End Sub


Private Property Let cNode_Value(ByVal vdata As String)

   mstrValue = vdata

End Property

Private Property Get cNode_Value() As String

   Value = mstrValue

End Property
```

cManager.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cManager"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:       cManager.cls
'              Microsoft TPC-H Kit Ver. 1.00
'              Copyright Microsoft, 1999
'              All Rights Reserved
'
'
'  PURPOSE:    Encapsulates the properties and methods of a manager
step.
'              Implements the cStep class - carries out initializations
'              and validations that are specific to manager steps.
'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

Implements cStep

' Object variable to keep the step reference in
Private mcStep As cStep

' Used to indicate the source module name when errors
' are raised by this class
Private mstrSource As String
Private Const mstrModuleName As String = "cManager."
Private Sub cStep_AddAllIterators()

   Call mcStep.AddAllIterators

End Sub

Private Property Let cStep_StartDir(ByVal RHS As String)

   mcStep.StartDir = RHS

End Property

Private Property Get cStep_StartDir() As String

   cStep_StartDir = mcStep.StartDir

End Property
Private Sub cStep_Delete()

   Call mcStep.Delete

End Sub

Private Property Set cStep_NodeDB(RHS As DAO.Database)

   Set mcStep.NodeDB = RHS

End Property

Private Function cStep_IncVersionY() As String

   cStep_IncVersionY = mcStep.IncVersionY

End Function
Private Function cStep_IsNewVersion() As Boolean
   cStep_IsNewVersion = mcStep.IsNewVersion
End Function
Private Function cStep_OldVersionNo() As String
   cStep_OldVersionNo = mcStep.OldVersionNo
End Function

Private Function cStep_IncVersionX() As String

   cStep_IncVersionX = mcStep.IncVersionX

End Function
Private Sub cStep_UpdateIteratorVersion()

   Call mcStep.UpdateIteratorVersion

End Sub

Private Function cStep_IteratorCount() As Long

   cStep_IteratorCount = mcStep.IteratorCount

End Function

Private Sub cStep_UnloadIterators()

   Call mcStep.UnloadIterators

End Sub

Private Sub cStep_DeleteIterator(cItRecord As cIterator)

   Call mcStep.DeleteIterator(cItRecord)

End Sub
Private Property Get cStep_IteratorName() As String

   cStep_IteratorName = mcStep.IteratorName

End Property
Private Property Let cStep_IteratorName(ByVal RHS As String)

   mcStep.IteratorName = RHS
```

```
End Property

Private Sub cStep_SaveIterators()

   Call mcStep.SaveIterators

End Sub
Private Sub cStep_LoadIterator(cItRecord As cIterator)

   Call mcStep.LoadIterator(cItRecord)

End Sub

Private Property Let cStep_Position(ByVal RHS As Long)

   mcStep.Position = RHS

End Property
Private Sub cStep_InsertIterator(cItRecord As cIterator)

   Call mcStep.InsertIterator(cItRecord)

End Sub
Private Function cStep_Iterators() As Variant

   cStep_Iterators = mcStep.Iterators

End Function
Private Sub cStep_ModifyIterator(cItRecord As cIterator)

   Call mcStep.ModifyIterator(cItRecord)

End Sub
Private Sub cStep_RemoveIterator(cItRecord As cIterator)

   Call mcStep.RemoveIterator(cItRecord)

End Sub
Private Sub cStep_UpdateIterator(cItRecord As cIterator)

   Call mcStep.UpdateIterator(cItRecord)

End Sub
Private Sub cStep_AddIterator(cItRecord As cIterator)

   Call mcStep.AddIterator(cItRecord)

End Sub

Private Property Get cStep_Position() As Long

   cStep_Position = mcStep.Position

End Property

Private Function cStep_Clone(Optional cCloneStep As cStep) As cStep

   Dim cNewManager As cManager

   Set cNewManager = New cManager
   Set cStep_Clone = mcStep.Clone(cNewManager)

End Function

Private Property Get cStep_IndOperation() As Operation

   cStep_IndOperation = mcStep.IndOperation

End Property

Private Property Let cStep_IndOperation(ByVal RHS As Operation)

   mcStep.IndOperation = RHS

End Property

Private Property Get cStep_NextStepId() As Long

   cStep_NextStepId = mcStep.NextStepId

End Property

Private Property Let cStep_OutputFile(ByVal RHS As String)

   mcStep.OutputFile = RHS

End Property

Private Property Get cStep_OutputFile() As String

   cStep_OutputFile = mcStep.OutputFile

End Property

Private Property Let cStep_ErrorFile(ByVal RHS As String)

   mcStep.ErrorFile = RHS

End Property

Private Property Get cStep_ErrorFile() As String

   cStep_ErrorFile = mcStep.ErrorFile

End Property
'Private Property Let cStep_LogFile(ByVal RHS As String)
'
'   mcStep.LogFile = RHS
'
'End Property
'
'Private Property Get cStep_LogFile() As String
'
'   cStep_LogFile = mcStep.LogFile
'
'End Property

Private Property Let cStep_ArchivedFlag(ByVal RHS As Boolean)

   mcStep.ArchivedFlag = RHS

End Property

Private Property Get cStep_ArchivedFlag() As Boolean

   cStep_ArchivedFlag = mcStep.ArchivedFlag

End Property

Private Property Get cStep_NodeDB() As DAO.Database

   Set cStep_NodeDB = mcStep.NodeDB

End Property

Private Sub Class_Initialize()

   ' Create the object
   Set mcStep = New cStep
```

```
    ' Initialize the object with valid values for a manager step
    ' The global flag should be the first field to be initialized
    ' since subsequent validations might try to check if the
    ' step being created is global
    mcStep.GlobalFlag = False
'    mcStep.GlobalRunMethod = gintNoOption
    mcStep.StepType = gintManagerStep

    ' Since the manager step does not take any action, the step
    ' text and file name will always be empty
    mcStep.StepText = gstrEmptyString
    mcStep.StepTextFile = gstrEmptyString

    ' Since the manager step does not take any action, execution
    ' properties for the step will be empty
    mcStep.ExecutionMechanism = gintNoOption
    mcStep.FailureDetails = gstrEmptyString
    mcStep.ContinuationCriteria = gintNoOption

End Sub
Private Sub Class_Terminate()

    ' Remove the step object
    Set mcStep = Nothing

End Sub
Private Sub cStep_Add()

    ' Call the Add method of the step class to carry out the insert
    mcStep.Add

End Sub
Private Property Get cStep_ContinuationCriteria() As
ContinuationCriteria

    cStep_ContinuationCriteria = mcStep.ContinuationCriteria

End Property

Private Property Let cStep_ContinuationCriteria(ByVal RHS As
ContinuationCriteria)

    ' Since a manager step cannot take any action, the continuation
    ' criteria property does not apply to it
    mcStep.ContinuationCriteria = gintNoOption

End Property

Private Property Let cStep_DegreeParallelism(ByVal RHS As String)

    mcStep.DegreeParallelism = RHS

End Property

Private Property Get cStep_DegreeParallelism() As String

    cStep_DegreeParallelism = mcStep.DegreeParallelism

End Property

Private Sub cStep_DeleteStep()

    On Error GoTo cStep_DeleteStepErr
    mstrSource = mstrModuleName & "cStep_DeleteStep"

    mcStep.Delete
    Exit Sub

cStep_DeleteStepErr:
    LogErrors Errors
    mstrSource = mstrModuleName & "cStep_DeleteStep"
    On Error GoTo 0
    Err.Raise vbObjectError + errDeleteStepFailed, _
        mstrSource, _
        LoadResString(errDeleteStepFailed)

End Sub

Private Property Get cStep_EnabledFlag() As Boolean

    cStep_EnabledFlag = mcStep.EnabledFlag

End Property

Private Property Let cStep_EnabledFlag(ByVal RHS As Boolean)

    mcStep.EnabledFlag = RHS

End Property

Private Property Let cStep_ExecutionMechanism(ByVal RHS As
ExecutionMethod)

    ' Since a manager step cannot take any action, the Execution
    ' Mechanism property does not apply to it
    mcStep.ExecutionMechanism = gintNoOption

End Property

Private Property Get cStep_ExecutionMechanism() As
ExecutionMethod

    cStep_ExecutionMechanism = mcStep.ExecutionMechanism

End Property

Private Property Let cStep_FailureDetails(ByVal RHS As String)

    ' Since a manager step cannot take any action, the Failure
    ' Details property does not apply to it
    mcStep.FailureDetails = gstrEmptyString

End Property

Private Property Get cStep_FailureDetails() As String

    cStep_FailureDetails = mcStep.FailureDetails

End Property

Private Property Get cStep_GlobalFlag() As Boolean

    cStep_GlobalFlag = mcStep.GlobalFlag

End Property

Private Property Let cStep_GlobalFlag(ByVal RHS As Boolean)

    ' Set the global flag to false - this flag is initialized when
    ' an instance of the class is created. Just making sure that
    ' nobody changes the value inadvertently
    mcStep.GlobalFlag = False

End Property
Private Sub cStep_Modify()

    ' Call the Modify method of the step class to carry out the update
    mcStep.Modify

End Sub
```

```
Private Property Let cStep_ParentStepId(ByVal RHS As Long)

   mcStep.ParentStepId = RHS

End Property

Private Property Get cStep_ParentStepId() As Long

   cStep_ParentStepId = mcStep.ParentStepId

End Property

Private Property Let cStep_ParentVersionNo(ByVal RHS As String)

   mcStep.ParentVersionNo = RHS

End Property

Private Property Get cStep_ParentVersionNo() As String

   cStep_ParentVersionNo = mcStep.ParentVersionNo

End Property

Private Property Let cStep_SequenceNo(ByVal RHS As Integer)

   mcStep.SequenceNo = RHS

End Property

Private Property Get cStep_SequenceNo() As Integer

   cStep_SequenceNo = mcStep.SequenceNo

End Property

Private Property Let cStep_StepId(ByVal RHS As Long)

   mcStep.StepId = RHS

End Property

Private Property Get cStep_StepId() As Long

   cStep_StepId = mcStep.StepId

End Property


Private Property Let cStep_StepLabel(ByVal RHS As String)

   mcStep.StepLabel = RHS

End Property

Private Property Get cStep_StepLabel() As String

   cStep_StepLabel = mcStep.StepLabel

End Property


Private Property Let cStep_StepLevel(ByVal RHS As Integer)

   mcStep.StepLevel = RHS

End Property

Private Property Get cStep_StepLevel() As Integer

   cStep_StepLevel = mcStep.StepLevel

End Property

Private Property Let cStep_StepText(ByVal RHS As String)

   ' Since the manager step does not take any action, the step
   ' text and file name will always be empty
   mcStep.StepText = gstrEmptyString

End Property

Private Property Get cStep_StepText() As String

   cStep_StepText = mcStep.StepText

End Property

Private Property Let cStep_StepTextFile(ByVal RHS As String)

   ' Since the manager step does not take any action, the step
   ' text and file name will always be empty
   mcStep.StepTextFile = gstrEmptyString

End Property

Private Property Get cStep_StepTextFile() As String

   cStep_StepTextFile = mcStep.StepTextFile

End Property

Private Property Let cStep_StepType(RHS As gintStepType)

   mcStep.StepType = gintManagerStep

End Property

Private Property Get cStep_StepType() As gintStepType

   cStep_StepType = mcStep.StepType

End Property

Private Sub cStep_Validate()
   ' The validate routines for each of the steps will
   ' carry out the specific validations for the type and
   ' call the generic validation routine

   On Error GoTo cStep_ValidateErr
   mstrSource = mstrModuleName & "cStep_Validate"

   ' Validations specific to manager steps

   ' Check if the step text or a file name has been
   ' specified
   If Not StringEmpty(mcStep.StepText) Or Not
StringEmpty(mcStep.StepTextFile) Then
      ShowError errTextAndFileNullForManager
      On Error GoTo 0
      Err.Raise vbObjectError + errValidateFailed, _
            gstrSource, _
            LoadResString(errValidateFailed)
   End If

   If mcStep.ExecutionMechanism <> gintNoOption Then
      ShowError errExecutionMechanismInvalid
      On Error GoTo 0
      Err.Raise vbObjectError + errValidateFailed, _
```

```
            gstrSource, _
            LoadResString(errValidateFailed)
    End If

    If mcStep.FailureDetails <> gstrEmptyString Then
        ShowError errFailureDetailsNullForMgr
        On Error GoTo 0
        Err.Raise vbObjectError + errValidateFailed, _
            gstrSource, _
            LoadResString(errValidateFailed)
    End If

    If mcStep.ContinuationCriteria <> gintNoOption Then
        ShowError errContCriteriaInvalid
        On Error GoTo 0
        Err.Raise vbObjectError + errValidateFailed, _
            gstrSource, _
            LoadResString(errValidateFailed)
    End If

    mcStep.Validate

    Exit Sub

cStep_ValidateErr:
    LogErrors Errors
    mstrSource = mstrModuleName & "cStep_Validate"
    On Error GoTo 0
    Err.Raise vbObjectError + errValidateFailed, _
        mstrSource, _
        LoadResString(errValidateFailed)
End Sub

Private Property Let cStep_VersionNo(ByVal RHS As String)

    mcStep.VersionNo = RHS

End Property

Private Property Get cStep_VersionNo() As String

    cStep_VersionNo = mcStep.VersionNo

End Property

Private Property Let cStep_WorkspaceId(ByVal RHS As Long)

    mcStep.WorkspaceId = RHS

End Property

Private Property Get cStep_WorkspaceId() As Long

    cStep_WorkspaceId = mcStep.WorkspaceId

End Property
```

cNode.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cNode"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:        cNode.cls
'            Microsoft TPC-H Kit Ver. 1.00
'            Copyright Microsoft, 1999
'            All Rights Reserved
'
'
'  PURPOSE:     Defines the properties that an object has to implement.
'  Contact:     Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

Public Property Get IndOperation() As Operation
End Property
Public Property Let IndOperation(ByVal vdata As Operation)
End Property
Public Sub Validate()
End Sub
Public Property Get Value() As String
End Property
Public Property Let Value(ByVal vdata As String)
End Property

Public Property Get NodeDB() As Database
End Property
Public Property Set NodeDB(vdata As Database)
End Property

Public Property Get Position() As Long
End Property
Public Property Let Position(ByVal vdata As Long)
End Property
```

cNodeCollections.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cNodeCollections"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:        cNodeCollections.cls
'            Microsoft TPC-H Kit Ver. 1.00
'            Copyright Microsoft, 1999
'            All Rights Reserved
'
'
'  PURPOSE:    Implements an array of objects.
'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

' Node counter
Private mlngNodeCount As Long
Private mdbsNodeDb As Database
Private mcarrNodes() As Object

' Used to indicate the source module name when errors
' are raised by this class
Private mstrSource As String
Private Const mstrModuleName As String = "cNodeCollections."

Public Property Set Item(ByVal Position As Long, _
        ByVal objNode As Object)

    ' Returns the element at the passed in position in the array
    If Position >= 0 And Position < mlngNodeCount Then
        Set mcarrNodes(Position) = objNode
    Else
        On Error GoTo 0
```

```
      Err.Raise vbObjectError + errItemDoesNotExist, mstrSource, _
         LoadResString(errItemDoesNotExist)
   End If

End Property
Public Property Get Item(ByVal Position As Long) As Object
Attribute Item.VB_UserMemId = 0

   ' Returns the element at the passed in position in the array
   If Position >= 0 And Position < mlngNodeCount Then
      Set Item = mcarrNodes(Position)
   Else
      On Error GoTo 0
      Err.Raise vbObjectError + errItemDoesNotExist, mstrSource, _
         LoadResString(errItemDoesNotExist)
   End If

End Property

Public Sub Commit(ByVal cSaveObj As Object, _
      ByVal lngIndex As Long)
   ' This procedure checks if any changes have been made to the
   ' passed in object. If so, it calls the corresponding method
   ' to commit the changes.

   On Error GoTo CommitErr
   mstrSource = mstrModuleName & "Commit"

   Select Case cSaveObj.IndOperation
      Case QueryOp
         ' No changes were made to the queried parameter.
         ' Do nothing

      Case InsertOp
         cSaveObj.Add
         cSaveObj.IndOperation = QueryOp

      Case UpdateOp
         cSaveObj.Modify
         cSaveObj.IndOperation = QueryOp

      Case DeleteOp
         cSaveObj.Delete
         ' Now we can remove the record from the array
         Call Unload(lngIndex)

   End Select

   Exit Sub

CommitErr:
   LogErrors Errors
   mstrSource = mstrModuleName & "Commit"
   On Error GoTo 0
   Err.Raise vbObjectError + errCommitFailed, _
         mstrSource, _
         LoadResString(errCommitFailed)

End Sub
Public Sub Save(ByVal lngWorkspace As Long)
   ' Calls a procedure to commit all changes for the passed
   ' in workspace.

   Dim lngIndex As Long

   On Error GoTo SaveErr

   ' Find all parameters in the array with a matching workspace id
   ' It is important to step backwards through the array, since
   ' we delete parameter records as we go along!

   For lngIndex = mlngNodeCount - 1 To 0 Step -1
      If mcarrNodes(lngIndex).WorkspaceId = lngWorkspace Then

         ' Call a procedure to commit all changes to the
         ' parameter record, if any
         Call Commit(mcarrNodes(lngIndex), lngIndex)

      End If
   Next lngIndex

   Exit Sub

SaveErr:
   LogErrors Errors
   mstrSource = mstrModuleName & "Save"
   On Error GoTo 0
   Err.Raise vbObjectError + errSaveFailed, _
         mstrSource, _
         LoadResString(errSaveFailed)

End Sub
Public Property Get Count() As Long

   Count = mlngNodeCount

End Property

Public Property Get NodeDB() As Database

   Set NodeDB = mdbsNodeDb

End Property
Public Property Set NodeDB(vdata As Database)

   Set mdbsNodeDb = vdata

End Property

Public Sub Load(cNodeToLoad As Object)
   ' Adds the passed in object to the array

   On Error GoTo LoadErr

   ' If this procedure is called by the add to array procedure,
   ' the database object has already been initialized
   If cNodeToLoad.NodeDB Is Nothing Then

      ' All the Nodes will be initialized with the database
      ' objects before being added to the array
      Set cNodeToLoad.NodeDB = mdbsNodeDb

   End If

   ReDim Preserve mcarrNodes(mlngNodeCount)

   ' Set the newly added element in the array to the passed in Node
   cNodeToLoad.Position = mlngNodeCount
   Set mcarrNodes(mlngNodeCount) = cNodeToLoad

   mlngNodeCount = mlngNodeCount + 1

   Exit Sub

LoadErr:
   LogErrors Errors
   On Error GoTo 0
   Err.Raise vbObjectError + errLoadFailed, mstrModuleName &
"Load", _
         LoadResString(errLoadFailed)
```

```
End Sub
Public Sub Unload(lngDeletePosition As Long)
   ' Unloads the passed in object from the array

   On Error GoTo UnloadErr

   If lngDeletePosition < (mlngNodeCount - 1) Then

      ' Set the Node at the position being deleted to
      ' the last Node in the Node array
      Set mcarrNodes(lngDeletePosition) =
mcarrNodes(mlngNodeCount - 1)
      mcarrNodes(lngDeletePosition).Position = lngDeletePosition
   End If

   ' Delete the last Node from the array
   mlngNodeCount = mlngNodeCount - 1
   If mlngNodeCount > 0 Then
      ReDim Preserve mcarrNodes(0 To mlngNodeCount - 1)
   Else
      ReDim mcarrNodes(0)
   End If

   Exit Sub

UnloadErr:
   LogErrors Errors
   mstrSource = mstrModuleName & "Unload"
   On Error GoTo 0
   Err.Raise vbObjectError + errUnloadFailed, _
         mstrSource, _
         LoadResString(errUnloadFailed)

End Sub
Public Sub Delete(lngDeletePosition As Long)
   ' Deletes the object at the specified position in the
   ' array

   Dim cDeleteObj As Object

   On Error GoTo DeleteErr
   mstrSource = mstrModuleName & "Delete"

   Set cDeleteObj = mcarrNodes(lngDeletePosition)

   If cDeleteObj.IndOperation = InsertOp Then
      ' If we are deleting a record that has just been inserted,
      ' blow it away
      Call Unload(lngDeletePosition)
   Else
      ' Set the operation for the deleted object to indicate a
      ' delete - we actually delete the element only at the time
      ' of a save operation
      cDeleteObj.IndOperation = DeleteOp
   End If

   Exit Sub

DeleteErr:
   LogErrors Errors
   mstrSource = mstrModuleName & "Delete"
   On Error GoTo 0
   Err.Raise vbObjectError + errDeleteFailed, _
         mstrSource, _
         LoadResString(errDeleteFailed)

End Sub
Public Sub Modify(cModifiedNode As Object)
   ' Sets the object at the passed in position to the
   ' modified object passed in

   On Error GoTo ModifyErr

   ' First check if the record is valid - all objects that
   ' use this collection class must have a Validate routine
   cModifiedNode.Validate

   ' If we are updating a record that hasn't yet been inserted,
   ' do not change the operation indicator - or we try to update
   ' a non-existant record
   If cModifiedNode.IndOperation <> InsertOp Then
      ' Set the operations to indicate an update
      cModifiedNode.IndOperation = UpdateOp
   End If

   ' Modify the object at the queried position - the Position
   ' will be maintained by this class
   Set mcarrNodes(cModifiedNode.Position) = cModifiedNode

   Exit Sub

ModifyErr:
   LogErrors Errors
   mstrSource = mstrModuleName & "Modify"
   On Error GoTo 0
   Err.Raise vbObjectError + errModifyFailed, _
         mstrSource, _
         LoadResString(errModifyFailed)

End Sub
Public Sub Add(cNodeToAdd As Object)

   On Error GoTo AddErr

   Set cNodeToAdd.NodeDB = mdbsNodeDb

   ' First check if the record is valid
   cNodeToAdd.Validate

   ' Set the operation to indicate an insert
   cNodeToAdd.IndOperation = InsertOp

   ' Call a procedure to load the record in the array
   Call Load(cNodeToAdd)

   Exit Sub

AddErr:
   LogErrors Errors
   mstrSource = mstrModuleName & "Add"
   On Error GoTo 0
   Err.Raise vbObjectError + errAddFailed, _
         mstrSource, _
         LoadResString(errAddFailed)

End Sub

Private Sub Class_Terminate()

   ReDim mcarrNodes(0)
   mlngNodeCount = 0

End Sub
```

Common.bas

```
Attribute VB_Name = "Common"
'  FILE:      Common.bas
'             Microsoft TPC-H Kit Ver. 1.00
'             Copyright Microsoft, 1999
```

```
'           All Rights Reserved
'
'
'  PURPOSE:    Module containing common functionality throughout
'           StepMaster
'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

Private Const mstrModuleName As String = "Common."

' Used to separate the variable data from the constant error
' message being raised when a context-sensitive error is displayed
Private Const mintDelimiter As String = " : "
Private Const mstrFormatString = "mmddyy"

' Identifiers for the different labels that need to be loaded
' into the tree view for each workspace
Public Const mstrWorkspacePrefix = "W"
Public Const mstrParameterPrefix = "P"
Public Const mstrParamConnectionPrefix = "C"
Public Const mstrConnectionDtlPrefix = "N"
Public Const mstrParamExtensionPrefix = "E"
Public Const mstrParamBuiltInPrefix = "B"
Public Const gstrGlobalStepPrefix = "G"
Public Const gstrManagerStepPrefix = "M"
Public Const gstrWorkerStepPrefix = "S"
Public Const gstrDummyPrefix = "D"
Public Const mstrLabelPrefix = "L"
Public Const mstrInstancePrefix = "I"
Public Function LabelStep(lngWorkspaceIdentifier As Long) As String
   ' Returns the step label for the workspace identifier passed in
   ' Basically this is a wrapper around the MakeKeyValid function

   LabelStep = MakeKeyValid(gintStepLabel, gintStepLabel,
lngWorkspaceIdentifier)

End Function


Public Function JulianDateToString(dt64Bit As Currency) As String

   Dim lYear As Long
   Dim lMonth As Long
   Dim lDay As Long
   Dim lHour As Long
   Dim lMin As Long
   Dim lSec As Long
   Dim lMs As Long

   Call JulianToTime(dt64Bit, lYear, lMonth, lDay, lHour, lMin, lSec,
lMs)
   JulianDateToString = Format$(lYear, gsYearFormat) &
gsDateSeparator & _
         Format$(lMonth, gsDtFormat) & gsDateSeparator & _
         Format$(lDay, gsDtFormat) & gstrBlank & _
         Format$(lHour, gsTmFormat) & gsTimeSeparator & _
         Format$(lMin, gsTmFormat) & gsTimeSeparator & _
         Format$(lSec, gsTmFormat) & gsMsSeparator & _
         Format$(lMs, gsMSecondFormat)

End Function
Public Sub DeleteFile(strFile As String, Optional ByVal
bCheckIfEmpty As Boolean = False)

   ' Ensure that there is only a single file of the name before delete, since
   ' Kill supports wildcards and can potentially delete a number of files
   Dim strTemp As String

   If CheckFileExists(strFile) Then
      If bCheckIfEmpty Then
         If FileLen(strFile) = 0 Then
            Kill strFile
         End If
      Else
         Kill strFile
      End If
   End If

End Sub
Public Function CheckFileExists(strFile As String) As Boolean

   ' Returns true if the passed in file exists
   ' Raises an error if multiple files are found (filename contains a
wildcard)
   CheckFileExists = False

   If Not StringEmpty(Dir(strFile)) Then
      If Not StringEmpty(Dir()) Then
         On Error GoTo 0
         Err.Raise vbObjectError + errDeleteSingleFile, _
            mstrModuleName & "DeleteFile",
LoadResString(errDeleteSingleFile)
      End If

      CheckFileExists = True
   End If

End Function

Public Function GetVersionString() As String
GetVersionString = "Version " & gsVersion
End Function

Function IsLabel(strKey As String) As Boolean

   ' The tree view control on frmMain can contain two types of
   ' nodes -
   ' 1. Nodes that contain data for the workspace - this could
   ' be data for the different types of steps or parameters
   ' 2. Nodes that display static data - these kind of nodes
   ' are referred to as label nodes e.g. "Global Steps" is a
   ' label node
   ' This function returns True if the passed in key corresponds
   ' to a label node

   IsLabel = InStr(strKey, mstrLabelPrefix) > 0

End Function

Function MakeKeyValid(lngIdentifier As Long, _
   intTypeOfNode As Integer, _
   Optional ByVal WorkspaceId As Long = 0, _
   Optional ByVal InstanceId As Long = 0) As String

   ' We use a numbering scheme while loading the tree view with
   ' all node data, since it needs a unique key and we want to
   ' use the key to identify the data it contains.
   ' Moreover, add a character to the beginning of the identifier
   ' so that the tree view control accepts it as a valid string,
   ' viz. "456" doesn't work, so change it to "W456"
   ' The general scheme is to concatenate a Label with the Identifier
   ' e.g A Global Step Node will have the Label, G and the Step Id
   ' concatenated to form the unique key
   ' The list of all such node types is given below
   ' 1. "W" + Workspace_Id for Workspace nodes
   ' 2. "P" + Parameter_Id for Parameter nodes
   ' 3. "M" + Step_Id for Manager Step nodes
   ' 4. "S" + Step_Id for Worker Step nodes
   ' 5. "G" + Step_Id for Global Step nodes
```

```
    ' 6. Instance_id + "I" + Step_Id for Instance nodes
    ' 7. Workspace_id + "L" + the label identifier = node type for all
Label nodes
    ' Since the manager, worker and global steps are stored in the
    ' same table and the step identifiers will always be unique, we
    ' can use the same character as the prefix, but this is a
    ' convenient way to know the type of step being processed.
    ' The workspace id is appended to the label identifier to make
    ' it unique, since multiple workspaces may be open during a session
    ' Strip the prefix characters off while saving the Ids to the db

    Dim strPrefixChar As String

    On Error GoTo MakeKeyValidErr
    gstrSource = mstrModuleName & "MakeKeyValid"

    Select Case intTypeOfNode
        Case gintWorkspace
            strPrefixChar = mstrWorkspacePrefix
        Case gintGlobalStep
            strPrefixChar = gstrGlobalStepPrefix
        Case gintManagerStep
            strPrefixChar = gstrManagerStepPrefix
        Case gintWorkerStep
            strPrefixChar = gstrWorkerStepPrefix
        Case gintRunManager, gintRunWorker
            If InstanceId = 0 Then
                On Error GoTo 0
                Err.Raise vbObjectError + errMandatoryParameterMissing, _
                    gstrSource, _
                    LoadResString(errMandatoryParameterMissing)
            End If
            ' Concatenate the instance identifier and the step
            ' identifier to form a unique key
            strPrefixChar = Trim$(Str$(InstanceId)) & mstrInstancePrefix
        Case gintParameter
            strPrefixChar = mstrParameterPrefix
        Case gintNodeParamConnection
            strPrefixChar = mstrParamConnectionPrefix
        Case gintConnectionDtl
            strPrefixChar = mstrConnectionDtlPrefix
        Case gintNodeParamExtension
            strPrefixChar = mstrParamExtensionPrefix
        Case gintNodeParamBuiltIn
            strPrefixChar = mstrParamBuiltInPrefix
        Case gintGlobalsLabel, gintParameterLabel,
gintParamConnectionLabel, _
                gintConnDtlLabel, _
                gintParamExtensionLabel, gintParamBuiltInLabel,
gintGlobalStepLabel, _
                gintStepLabel
            If WorkspaceId = 0 Then
                ' The Workspace Id has to be specified for a label node
                ' Otherwise it will not be possible to generate unique label
                ' identifiers if multiple workspaces are open
                On Error GoTo 0
                Err.Raise vbObjectError + errWorkspaceIdMandatory, _
                    gstrSource, _
                    LoadResString(errWorkspaceIdMandatory)
            End If
            ' For all labels, the workspace identifier and the
            ' label prefix are concatenated to form the key
            strPrefixChar = Trim$(Str$(WorkspaceId)) & mstrLabelPrefix
        Case Else
                On Error GoTo 0
                Err.Raise vbObjectError + errInvalidNodeType, _
                    gstrSource, _
                    LoadResString(errInvalidNodeType)
    End Select
    MakeKeyValid = strPrefixChar & Trim$(Str$(lngIdentifier))

    Exit Function

MakeKeyValidErr:
    Call LogErrors(Errors)
    On Error GoTo 0
    Err.Raise vbObjectError + errMakeKeyValidFailed, _
            gstrSource, _
            LoadResString(errMakeKeyValidFailed)

End Function

Function MakeIdentifierValid(strKey As String) As Long

    ' Returns the Identifier corresponding to the passed in key
    ' (Reverse of what was done in MakeKeyValid)

    On Error GoTo MakeIdentifierValidErr

    If IsLabel(strKey) Then
        ' If the key corresponds to a label node, the identifier
        ' appears to the right of the label prefix
        MakeIdentifierValid = Val(Mid(strKey, InStr(strKey,
mstrLabelPrefix) + 1))
    ElseIf InStr(strKey, mstrInstancePrefix) = 0 Then
        ' For all other nodes, stripping the first character off
        ' returns a valid Id
        MakeIdentifierValid = Val(Mid(strKey, 2))
    Else
        ' Instance node - strip of all characters till the
        ' instance prefix
        MakeIdentifierValid = Val(Mid(strKey, InStr(strKey,
mstrInstancePrefix) + 1))
    End If

    Exit Function

MakeIdentifierValidErr:
    Call LogErrors(Errors)
    On Error GoTo 0
    Err.Raise vbObjectError + errMakeIdentifierValidFailed, _
            mstrModuleName & "MakeIdentifierValid", _
            LoadResString(errMakeIdentifierValidFailed)

End Function
Public Function IsInstanceNode(strNodeKey As String) As Boolean

    ' Returns true if the passed in node key corresponds to a step instance
    IsInstanceNode = InStr(strNodeKey, mstrInstancePrefix) > 0

End Function
Public Function IsBuiltInLabel(strNodeKey As String) As Boolean

    ' Returns true if the passed in node key corresponds to a step instance
    IsBuiltInLabel = (IsLabel(strNodeKey) And _
        (MakeIdentifierValid(strNodeKey) = gintParamBuiltInLabel))

End Function

Public Sub ShowBusy()
    ' Modifies the mousepointer to indicate that the
    ' application is busy

    On Error Resume Next

    Screen.MousePointer = vbHourglass

End Sub
Public Sub ShowFree()
```

```
    ' Modifies the mousepointer to indicate that the
    ' application has finished processing and is ready
    ' to accept user input

    On Error Resume Next

    Screen.MousePointer = vbDefault

End Sub

Public Function InstrR(strMain As String, _
        strSearch As String) As Integer
    ' Finds the last occurrence of the passed in string

    Dim intPos As Integer
    Dim intPrev As Integer

    On Error GoTo InstrRErr

    intPrev = intPos
    intPos = InStr(1, strMain, strSearch)

    Do While intPos > 0
        intPrev = intPos
        intPos = InStr(intPos + 1, strMain, strSearch)
    Loop
    InstrR = intPrev

    Exit Function

InstrRErr:
    Call LogErrors(Errors)
    gstrSource = mstrModuleName & "InstrR"
    On Error GoTo 0
    Err.Raise vbObjectError + errInstrRFailed, _
        gstrSource, _
        LoadResString(errInstrRFailed)

End Function

Public Function GetDefaultDir(lWspId As Long, WspParameters As
cArrParameters) As String

    Dim sDir As String
    sDir = SubstituteParameters( _
            gstrEnvVarSeparator & PARAM_DEFAULT_DIR &
gstrEnvVarSeparator, _
            lWspId, WspParameters:=WspParameters)
    MakePathValid (sDir & gstrFileSeparator & "a.txt")
    GetDefaultDir = GetShortName(sDir)
    If StringEmpty(GetDefaultDir) Then
        GetDefaultDir = App.Path
    End If

End Function

Public Sub AddArrayElement(ByRef arrNodes() As Object, _
        ByVal objToAdd As Object, _
        ByRef lngCount As Long)
    ' Adds the passed in object to the array

    On Error GoTo AddArrayElementErr

    ' Increase the array dimension and add the object to it
    ReDim Preserve arrNodes(lngCount)
    Set arrNodes(lngCount) = objToAdd
    lngCount = lngCount + 1

    Exit Sub

AddArrayElementErr:
    LogErrors Errors
    gstrSource = mstrModuleName & "AddArrayElement"
    On Error GoTo 0
    Err.Raise vbObjectError + errAddArrayElementFailed, _
            gstrSource, _
            LoadResString(errAddArrayElementFailed)

End Sub


Public Function CheckForNullField(rstRecords As Recordset,
strFieldName As String) As String

    ' Returns an empty string if a given field is null
    On Error GoTo CheckForNullFieldErr

    If IsNull(rstRecords.Fields(strFieldName)) Then
        CheckForNullField = gstrEmptyString
    Else
        CheckForNullField = rstRecords.Fields(strFieldName)
    End If
    Exit Function

CheckForNullFieldErr:
    Call LogErrors(Errors)
    On Error GoTo 0
    Err.Raise vbObjectError + errCheckForNullFieldFailed, _
            mstrModuleName & "CheckForNullField", _
            LoadResString(errCheckForNullFieldFailed)

End Function

Public Function ErrorOnNullField(rstRecords As Recordset,
strFieldName As String) As Variant

    ' If a given field is null, raises an error
    ' Else, returns the field value in a variant
    ' The calling function must convert the return value to the
    ' appropriate type
    On Error GoTo ErrorOnNullFieldErr
    gstrSource = mstrModuleName & "ErrorOnNullField"

    If IsNull(rstRecords.Fields(strFieldName)) Then
        On Error GoTo 0
        Err.Raise vbObjectError + errMandatoryFieldNull, _
            gstrSource, _
            strFieldName & mintDelimiter &
LoadResString(errMandatoryFieldNull)
    Else
        ErrorOnNullField = rstRecords.Fields(strFieldName)
    End If
    Exit Function

ErrorOnNullFieldErr:
    Call LogErrors(Errors)
    On Error GoTo 0
    Err.Raise vbObjectError + errUnableToCheckNull, _
        gstrSource, _
        strFieldName & mintDelimiter &
LoadResString(errUnableToCheckNull)

End Function
Public Function StringEmpty(strCheckString As String) As Boolean

    StringEmpty = (strCheckString = gstrEmptyString)

End Function
Public Function GetIteratorValue(cStepIterators As cRunColIt, _
        ByVal strItName As String)
```

```
    Dim lngIndex As Long
    Dim strValue As String

    On Error GoTo GetIteratorValueErr
    gstrSource = mstrModuleName & "GetIteratorValue"

    ' Find the iterator in the Iterators collection
    For lngIndex = 0 To cStepIterators.Count - 1
        If cStepIterators(lngIndex).IteratorName = strItName Then
            strValue = cStepIterators(lngIndex).Value
            Exit For
        End If
    Next lngIndex

    If lngIndex > cStepIterators.Count - 1 Then
        ' The iterator has not been defined for the branch
        ' Raise an error
        On Error GoTo 0
        Err.Raise vbObjectError + errParamNameInvalid, _
                gstrSource, _
                LoadResString(errParamNameInvalid)
    End If

    GetIteratorValue = strValue
    Exit Function

GetIteratorValueErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    gstrSource = mstrModuleName & "GetIteratorValue"
    On Error GoTo 0
    Err.Raise vbObjectError + errGetParamValueFailed, _
            gstrSource, _
            LoadResString(errGetParamValueFailed)

End Function
Public Function SubstituteParameters(ByVal strComString As String, _
        ByVal lngWorkspaceId As Long, _
        Optional StepIterators As cRunColIt = Nothing, _
        Optional WspParameters As cArrParameters = Nothing) As String
    ' This function substitutes all parameter names and
    ' environment variables in the passed in string with
    ' their values. It also substitutes the value for the
    ' iterators, if any.
    ' Since the syntax is to enclose parameter names and
    ' environment variables in "%", we check if a given
    ' variable is a parameter - if so, we substitute the
    ' parameter value - else we try to get the value from
    ' the environment

    Dim intPos As Integer
    Dim intEndPos As Integer
    Dim strEnvVariable As String
    Dim strValue As String
    Dim strCommand As String
    Dim cTempStr As cStringSM

    ' Initialize the return value of the function to the
    ' passed in command
    strCommand = strComString

    If WspParameters Is Nothing Then Set WspParameters =
gcParameters

    Set cTempStr = New cStringSM

    intPos = InStr(strCommand, gstrEnvVarSeparator)
    Do While intPos <> 0
        If Mid(strCommand, intPos + 1, 1) = gstrEnvVarSeparator Then
            ' Wildcard character - to be substituted by a single % - later!
            intPos = intPos + 2
            If intPos > Len(strCommand) Then Exit Do
        Else
            ' Extract the environment variable from the passed
            ' in string
            intEndPos = InStr(intPos + 1, strCommand,
gstrEnvVarSeparator)

            If intEndPos > 0 Then
                strEnvVariable = Mid(strCommand, intPos + 1, intEndPos -
intPos - 1)
            Else
                On Error GoTo 0
                Err.Raise vbObjectError + errParamSeparatorMissing, _
                        gstrSource, _
                        LoadResString(errParamSeparatorMissing)
            End If
            strValue = gstrEmptyString

            ' Get the value of the variable and call a function
            ' to replace the variable with it's value
            strValue = GetValue(strEnvVariable, lngWorkspaceId,
StepIterators, WspParameters)
            ' The function raises an error if the variable is
            ' not found
            strCommand = cTempStr.ReplaceSubString(strCommand, _
                    gstrEnvVarSeparator & strEnvVariable &
gstrEnvVarSeparator, _
                    strValue)
        End If

        intPos = InStr(intPos, strCommand, gstrEnvVarSeparator)
    Loop

    strCommand = cTempStr.ReplaceSubString(strCommand, _
            gstrEnvVarSeparator & gstrEnvVarSeparator,
gstrEnvVarSeparator)

    Set cTempStr = Nothing
    SubstituteParameters = strCommand

End Function
Private Function GetValue(ByVal strParameter As String, _
        ByVal lngWorkspaceId As Long, _
        cStepIterators As cRunColIt, _
        WspParameters As cArrParameters) As String
    ' This function returns the value for the passed in
    ' parameter - it may be a workspace parameter, an
    ' environment variable or an iterator

    Dim intPos As Integer
    Dim intEndPos As Integer
    Dim strVariable As String
    Dim strValue As String
    Dim cParamRec As cParameter

    On Error GoTo GetValueErr

    ' Initialize the return value of the function to the
    ' empty
    strValue = gstrEmptyString

    intPos = InStr(strParameter, gstrEnvVarSeparator)
    If intPos > 0 Then
        ' Extract the variable from the passed in string
        intEndPos = InStr(intPos + 1, strParameter, gstrEnvVarSeparator)
        If intEndPos = 0 Then
            intEndPos = Len(strParameter)
        End If
```

```
      strVariable = Mid(strParameter, intPos + 1, intEndPos - intPos - 1)
   Else
      ' The separator charactor has not been passed in -
      ' try to find the value of the passed in parameter
      strVariable = strParameter
   End If

   If Not StringEmpty(strVariable) Then
      ' Check if this is the timestamp parameter first
      If strVariable = gstrTimeStamp Then
         strValue = Format$(Now, mstrFormatString, _
               vbUseSystemDayOfWeek, vbUseSystem)
      Else
         ' Try to find a parameter for the workspace with
         ' the same name
         Set cParamRec =
WspParameters.GetParameterValue(lngWorkspaceId, _
               strVariable)
         If cParamRec Is Nothing Then
            If Not cStepIterators Is Nothing Then
               ' If the string is not a parameter, then check
               ' if it is an iterator
               strValue = GetIteratorValue(cStepIterators, strVariable)
            End If

            If StringEmpty(strValue) Then
               ' Neither - Check if it is an environment variable
               strValue = Environ$(strVariable)
               If StringEmpty(strValue) Then
                  On Error GoTo 0
                  WriteError errSubValuesFailed, _
                        OptArgs:="Invalid parameter: " & gstrSQ &
strVariable & gstrSQ
                  Err.Raise vbObjectError + errSubValuesFailed, _
                        mstrModuleName & "GetValue", _
                        LoadResString(errSubValuesFailed) & "Invalid
parameter: " & gstrSQ & strVariable & gstrSQ
               End If
            End If
         Else
            strValue = cParamRec.ParameterValue
         End If
      End If
   End If

   GetValue = strValue

   Exit Function

GetValueErr:
   If Err.Number = vbObjectError + errParamNameInvalid Then
      ' If the parameter has not been defined for the
      ' workspace then check if it is an environment
      ' variable
      Resume Next
   End If

   ' Log the error code raised by Visual Basic
   Call LogErrors(Errors)
   gstrSource = mstrModuleName & "GetValue"
   WriteError errSubValuesFailed, gstrSource, "Parameter: " & gstrSQ
& strVariable & gstrSQ
   On Error GoTo 0
   Err.Raise vbObjectError + errSubValuesFailed, _
         gstrSource, _
         LoadResString(errSubValuesFailed) & "Parameter: " & gstrSQ
& strVariable & gstrSQ

End Function

Public Function SQLFixup(strField As String) As String
   ' Returns a string that can be executed by SQL Server

   Dim cMyStr As New cStringSM
   Dim strTemp As String

   On Error GoTo SQLFixupErr

   strTemp = strField
   SQLFixup = strTemp

   ' Single-quotes have to be replaced by two single-quotes,
   ' since a single-quote is the identifier delimiter
   ' character - call a procedure to do the replace
'    SQLFixup = cMyStr.ReplaceSubString(strTemp, gstrDQ, "\" &
gstrDQ)

   ' Replace pipe characters with the corresponding chr function
   ' SQLFixup = cMyStr.ReplaceSubString(strTemp, gstrDQ, gstrDQ &
gstrDQ)

   Exit Function

SQLFixupErr:
   gstrSource = mstrModuleName & "SQLFixup"
   LogErrors Errors
   On Error GoTo 0
   Err.Raise vbObjectError + errMakeFieldValidFailed, _
         gstrSource, LoadResString(errMakeFieldValidFailed)

End Function
Public Function TranslateStepLabel(sLabel As String) As String
   ' Translates the passed in step label to a valid file name
   ' All characters in the label that are invalid for filenames (viz. \ / : * ?
" < > |)
   ' and spaces are substituted with underscores - also ensure that the
resulting filename
   ' is not greater than 255 characters
   Dim cTempStr As New cStringSM
   TranslateStepLabel = cTempStr.ReplaceSubString(sLabel,
gstrFileSeparator, "_")
   TranslateStepLabel =
cTempStr.ReplaceSubString(TranslateStepLabel, "/", gstrUnderscore)
   TranslateStepLabel =
cTempStr.ReplaceSubString(TranslateStepLabel, ":", gstrUnderscore)
   TranslateStepLabel =
cTempStr.ReplaceSubString(TranslateStepLabel, "*", gstrUnderscore)
   TranslateStepLabel =
cTempStr.ReplaceSubString(TranslateStepLabel, "?", gstrUnderscore)
   TranslateStepLabel =
cTempStr.ReplaceSubString(TranslateStepLabel, gstrDQ,
gstrUnderscore)
   TranslateStepLabel =
cTempStr.ReplaceSubString(TranslateStepLabel, "<", gstrUnderscore)
   TranslateStepLabel =
cTempStr.ReplaceSubString(TranslateStepLabel, ">", gstrUnderscore)
   TranslateStepLabel =
cTempStr.ReplaceSubString(TranslateStepLabel, "|", gstrUnderscore)
   TranslateStepLabel =
cTempStr.ReplaceSubString(TranslateStepLabel, gstrBlank,
gstrUnderscore)

   ' Commas are substituted with underscores since the command shell
uses a comma to
   ' delimit commands
   TranslateStepLabel =
cTempStr.ReplaceSubString(TranslateStepLabel, ",", gstrUnderscore)

   If Len(TranslateStepLabel) > MAX_PATH Then
      TranslateStepLabel = Mid(TranslateStepLabel, 1, MAX_PATH)
```

```
    End If

End Function

Public Function TypeOfObject(ByVal objNode As Object) As Integer
    ' Determines the type of object that is passed in

    On Error GoTo TypeOfObjectErr
    gstrSource = mstrModuleName & "TypeOfObject"

    Select Case TypeName(objNode)
        Case "cWorkspace"
            TypeOfObject = gintWorkspace

        Case "cParameter"
            TypeOfObject = gintParameter

        Case "cConnection"
            TypeOfObject = gintParameterConnect

        Case "cConnDtl"
            TypeOfObject = gintConnectionDtl

        Case "cGlobalStep"
            TypeOfObject = gintGlobalStep

        Case "cManager"
            TypeOfObject = gintManagerStep

        Case "cWorker"
            TypeOfObject = gintWorkerStep

        Case "cStep"
            ' If a step record is passed in, call a function
            ' to determine the type of step
            TypeOfObject = TypeOfStep(StepClass:=objNode)

        Case Else
            WriteError errTypeOfObjectFailed, gstrSource, _
                TypeName(objNode)
            On Error GoTo 0
            Err.Raise vbObjectError + errTypeOfObjectFailed, _
                gstrSource, _
                LoadResString(errTypeOfObjectFailed)
    End Select

    Exit Function

TypeOfObjectErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    On Error GoTo 0
    Err.Raise vbObjectError + errTypeOfObjectFailed, _
        gstrSource, _
        LoadResString(errTypeOfObjectFailed)

End Function
```

ConnDtlCommon.bas

```
Attribute VB_Name = "ConnDtlCommon"
'  FILE:      ConnDtlCommon.bas
'             Microsoft TPC-H Kit Ver. 1.00
'             Copyright Microsoft, 1999
'             All Rights Reserved
'
'
'  PURPOSE:   Contains functionality common across StepMaster and
'             SMRunOnly, pertaining to connections
'             Specifically, functions to load connections in an array
'             and so on.
'  Contact:   Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

' Used to indicate the source module name when errors
' are raised by this module
Private Const mstrModuleName As String = "ConnDtlCommon."

Public Sub LoadRSInConnDtlArray(rstConns As Recordset, cConns As
cConnDtls)

    Dim cNewConnDtl As cConnDtl

    On Error GoTo LoadRSInConnDtlArrayErr

    If rstConns.RecordCount = 0 Then
        Exit Sub
    End If

    rstConns.MoveFirst
    While Not rstConns.EOF

        Set cNewConnDtl = New cConnDtl

        ' Initialize ConnDtl values
        ' Call a procedure to raise an error if mandatory fields are null.
        cNewConnDtl.ConnNameId = ErrorOnNullField(rstConns,
FLD_ID_CONN_NAME)
        cNewConnDtl.WorkspaceId = ErrorOnNullField(rstConns,
FLD_ID_WORKSPACE)
        cNewConnDtl.ConnName = CStr(ErrorOnNullField(rstConns,
FLD_CONN_DTL_CONNECTION_NAME))
        cNewConnDtl.ConnectionString = CheckForNullField(rstConns,
FLD_CONN_DTL_CONNECTION_STRING)
        cNewConnDtl.ConnType = CheckForNullField(rstConns,
FLD_CONN_DTL_CONNECTION_TYPE)

        cConns.Load cNewConnDtl

        Set cNewConnDtl = Nothing
        rstConns.MoveNext
    Wend

    Exit Sub

LoadRSInConnDtlArrayErr:
    LogErrors Errors
    gstrSource = mstrModuleName & "LoadRSInConnDtlArray"
    On Error GoTo 0
    Err.Raise vbObjectError + errLoadRsInArrayFailed, gstrSource, _
        LoadResString(errLoadRsInArrayFailed)
End Sub
```

ConnectionCommon.bas

```
Attribute VB_Name = "ConnectionCommon"
'  FILE:      ConnnectionCommon.bas
'             Microsoft TPC-H Kit Ver. 1.00
'             Copyright Microsoft, 1999
'             All Rights Reserved
'
'
'  PURPOSE:   Contains functionality common across StepMaster and
'             SMRunOnly, pertaining to connection strings
'             Specifically, functions to load connections strings
'             in an array and so on.
'  Contact:   Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit
```

```
' Used to indicate the source module name when errors
' are raised by this module
Private Const mstrModuleName As String = "ConnectionCommon."

Public Sub LoadRecordsetInConnectionArray(rstConns As Recordset,
cConns As cConnections)

   Dim cNewConnection As cConnection

   On Error GoTo LoadRecordsetInConnectionArrayErr

   If rstConns.RecordCount = 0 Then
      Exit Sub
   End If

   rstConns.MoveFirst
   While Not rstConns.EOF

      Set cNewConnection = New cConnection

      ' Initialize Connection values
      ' Call a procedure to raise an error if mandatory fields are null.
      cNewConnection.ConnectionId = ErrorOnNullField(rstConns,
"connection_id")
      cNewConnection.WorkspaceId = CStr(ErrorOnNullField(rstConns,
FLD_ID_WORKSPACE))
      cNewConnection.ConnectionName =
CStr(ErrorOnNullField(rstConns, "connection_name"))
      cNewConnection.ConnectionValue =
CheckForNullField(rstConns, "connection_value")
      cNewConnection.Description = CheckForNullField(rstConns,
"description")

      cNewConnection.NoCountDisplay = CheckForNullField(rstConns,
"no_count_display")
      cNewConnection.NoExecute = CheckForNullField(rstConns,
"no_execute")
      cNewConnection.ParseQueryOnly = CheckForNullField(rstConns,
"parse_query_only")
      cNewConnection.QuotedIdentifiers =
CheckForNullField(rstConns, "ANSI_quoted_identifiers")
      cNewConnection.AnsiNulls = CheckForNullField(rstConns,
"ANSI_nulls")
      cNewConnection.ShowQueryPlan = CheckForNullField(rstConns,
"show_query_plan")
      cNewConnection.ShowStatsTime = CheckForNullField(rstConns,
"show_stats_time")
      cNewConnection.ShowStatsIO = CheckForNullField(rstConns,
"show_stats_io")
      cNewConnection.ParseOdbcMsg = CheckForNullField(rstConns,
"parse_odbc_msg_prefixes")
      cNewConnection.RowCount = CheckForNullField(rstConns,
"row_count")
      cNewConnection.TsqlBatchSeparator =
CheckForNullField(rstConns, "tsql_batch_separator")
      cNewConnection.QueryTimeOut = CheckForNullField(rstConns,
"query_time_out")
      cNewConnection.ServerLanguage = CheckForNullField(rstConns,
"server_language")
      cNewConnection.CharacterTranslation =
CheckForNullField(rstConns, "character_translation")
      cNewConnection.RegionalSettings = CheckForNullField(rstConns,
"regional_settings")

      cConns.Load cNewConnection

      Set cNewConnection = Nothing
      rstConns.MoveNext
   Wend
   Exit Sub

LoadRecordsetInConnectionArrayErr:
   LogErrors Errors
   gstrSource = mstrModuleName &
"LoadRecordsetInConnectionArray"
   On Error GoTo 0
   Err.Raise vbObjectError + errLoadRsInArrayFailed, gstrSource, _
         LoadResString(errLoadRsInArrayFailed)
End Sub
```

cParameter.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cParameter"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:       cParameter.cls
'              Microsoft TPC-H Kit Ver. 1.00
'              Copyright Microsoft, 1999
'              All Rights Reserved
'
'
'  PURPOSE:    Encapsulates the properties and methods of a
parameter.
'              Contains functions to insert, update and delete
'              workspace_parameters records from the database.
'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit
Option Base 0

' Local variable(s) to hold property value(s)
Private mlngWorkspaceId As Long
Private mlngParameterId As Long
Private mstrParameterName As String
Private mstrParameterValue As String
Private mstrDescription As String
Private mintParameterType As Integer
Private mdbsStepMaster As Database
Private mintOperation As Operation
Private mlngPosition As Long

' Used to indicate the source module name when errors
' are raised by this class
Private mstrSource As String
Private Const mstrModuleName As String = "cParameter."

' The cSequence class is used to generate unique parameter identifiers
Private mParameterSeq As cSequence

' The StringSM class is used to carry out string operations
Private mFieldValue As cStringSM

' Parameter types
Public Enum ParameterType
   gintParameterGeneric = 0
   gintParameterConnect
   gintParameterApplication
   gintParameterBuiltIn
End Enum


Private Sub AssignParameters(qyExec As DAO.QueryDef)
```

```
    ' Assigns values to the parameters in the querydef object
    ' The parameter names are cryptic to make them different
    ' from the field names. When the parameter names are
    ' the same as the field names, parameters in the where
    ' clause do not get created.

    Dim prmParam As DAO.Parameter

    On Error GoTo AssignParametersErr

    For Each prmParam In qyExec.Parameters
        Select Case prmParam.Name
            Case "[w_id]"
                prmParam.Value = mlngWorkspaceId

            Case "[p_id]"
                prmParam.Value = mlngParameterId

            Case "[p_name]"
                prmParam.Value = mstrParameterName

            Case "[p_value]"
                prmParam.Value = mstrParameterValue

            Case "[desc]"
                prmParam.Value = mstrDescription

            Case "[p_type]"
                prmParam.Value = mintParameterType

            Case Else
                ' Write the parameter name that is faulty
                WriteError errInvalidParameter, mstrSource, _
                        prmParam.Name
                On Error GoTo 0
                Err.Raise errInvalidParameter, mstrModuleName &
"AssignParameters", _
                        LoadResString(errInvalidParameter)
        End Select
    Next prmParam

'   qyExec.Parameters("w_id").Value = mlngWorkspaceId
'   qyExec.Parameters("p_id").Value = mlngParameterId
'   qyExec.Parameters("p_name").Value = mstrParameterName
'   qyExec.Parameters("p_value").Value = mstrParameterValue
'

    Exit Sub

AssignParametersErr:

    mstrSource = mstrModuleName & "AssignParameters"
    Call LogErrors(Errors)
    On Error GoTo 0
    Err.Raise vbObjectError + errAssignParametersFailed, _
        mstrSource, LoadResString(errAssignParametersFailed)

End Sub

Public Property Let Position(ByVal RHS As Long)

    mlngPosition = RHS

End Property

Public Property Get Position() As Long

    Position = mlngPosition

End Property

Public Function Clone() As cParameter

    ' Creates a copy of a given parameter

    Dim cCloneParam As cParameter

    On Error GoTo CloneErr
    mstrSource = mstrModuleName & "Clone"

    Set cCloneParam = New cParameter

    ' Copy all the parameter properties to the newly
    ' created parameter
    Set cCloneParam.NodeDB = mdbsStepMaster
    cCloneParam.WorkspaceId = mlngWorkspaceId
    cCloneParam.ParameterId = mlngParameterId
    cCloneParam.ParameterName = mstrParameterName
    cCloneParam.ParameterValue = mstrParameterValue
    cCloneParam.Description = mstrDescription
    cCloneParam.ParameterType = mintParameterType
    cCloneParam.IndOperation = mintOperation
    cCloneParam.Position = mlngPosition

    ' And set the return value to the newly created parameter
    Set Clone = cCloneParam
    Set cCloneParam = Nothing

    Exit Function

CloneErr:
    LogErrors Errors
    mstrSource = mstrModuleName & "Clone"
    On Error GoTo 0
    Err.Raise vbObjectError + errCloneFailed, _
        mstrSource, LoadResString(errCloneFailed)

End Function
Public Property Set NodeDB(vdata As Database)

    Set mdbsStepMaster = vdata

End Property
Public Property Get NodeDB() As Database

    Set NodeDB = mdbsStepMaster

End Property

Private Sub CheckDupParameterName()
    ' Check if the parameter name already exists in the workspace

    Dim rstParameter As Recordset
    Dim strSql As String
    Dim qy As DAO.QueryDef

    On Error GoTo CheckDupParameterNameErr
    mstrSource = mstrModuleName & "CheckDupParameterName"

    ' Create a recordset object to retrieve the count of all parameters
    ' for the workspace with the same name
    strSql = "Select count(*) as parameter_count " & _
        " from workspace_parameters " & _
        " where workspace_id = [w_id]" & _
        " and parameter_name = [p_name]" & _
        " and parameter_id <> [p_id]"

    Set qy = mdbsStepMaster.CreateQueryDef(gstrEmptyString, strSql)
    Call AssignParameters(qy)
```

```
    Set rstParameter = qy.OpenRecordset(dbOpenForwardOnly)

    If rstParameter![parameter_count] > 0 Then
        rstParameter.Close
        qy.Close
        ShowError errDuplicateParameterName
        On Error GoTo 0
        Err.Raise vbObjectError + errDuplicateParameterName, _
            mstrSource, LoadResString(errDuplicateParameterName)
    End If

    rstParameter.Close
    qy.Close

    Exit Sub

CheckDupParameterNameErr:
    LogErrors Errors
    mstrSource = mstrModuleName & "CheckDupParameterName"
    On Error GoTo 0
    Err.Raise vbObjectError + errCheckDupParameterNameFailed, _
        mstrSource, LoadResString(errCheckDupParameterNameFailed)

End Sub
Private Sub CheckDB()
    ' Check if the database object has been initialized

    If mdbsStepMaster Is Nothing Then
        On Error GoTo 0
        Err.Raise vbObjectError + errInvalidDB, _
            mstrModuleName & "CheckDB", LoadResString(errInvalidDB)
    End If

End Sub
Public Property Let ParameterValue(vdata As String)

    mstrParameterValue = vdata

End Property
Public Property Let Description(vdata As String)

    mstrDescription = vdata

End Property
Public Property Let ParameterType(vdata As ParameterType)

    mintParameterType = vdata

End Property

Public Property Let ParameterName(vdata As String)

    If vdata = gstrEmptyString Then

        ShowError errParameterNameMandatory
        On Error GoTo 0
        ' Propogate this error back to the caller
        Err.Raise vbObjectError + errParameterNameMandatory, _
            mstrSource, LoadResString(errParameterNameMandatory)
    Else
        mstrParameterName = vdata
    End If

End Property

Public Property Let ParameterId(vdata As Long)
    mlngParameterId = vdata
End Property

Public Property Let IndOperation(ByVal vdata As Operation)

    ' The valid operations are define in the cOperations
    ' class. Check if the operation is valid
    Select Case vdata
        Case QueryOp, InsertOp, UpdateOp, DeleteOp
            mintOperation = vdata

        Case Else
            On Error GoTo 0
            Err.Raise vbObjectError + errInvalidOperation, _
                mstrSource, LoadResString(errInvalidOperation)
    End Select

End Property
Public Sub Validate()
    ' Each distinct object will have a Validate method which
    ' will check if the class properties are valid. This method
    ' will be used to check interdependant properties that
    ' cannot be validated by the let procedures.
    ' It should be called by the add and modify methods of the class

    On Error GoTo ValidateErr

    ' Check if the db object is valid
    Call CheckDB

    ' Call procedure to raise an error if the parameter name
    ' already exists in the workspace -
    ' if there are duplicates, we don't know what value for the
    ' parameter to use at runtime
    Call CheckDupParameterName

    Exit Sub

ValidateErr:

    mstrSource = mstrModuleName & "Validate"
    Call LogErrors(Errors)
    On Error GoTo 0
    Err.Raise vbObjectError + errValidateFailed, _
        mstrSource, LoadResString(errValidateFailed)

End Sub
Public Property Let WorkspaceId(vdata As Long)

    mlngWorkspaceId = vdata

End Property

Public Sub Add()

    Dim strInsert As String
    Dim qy As DAO.QueryDef

    On Error GoTo AddErr

    ' Validate the record before trying to insert the record
    Call Validate

    ' Create a temporary querydef object
    strInsert = "insert into workspace_parameters " & _
            "( workspace_id, parameter_id, " & _
            " parameter_name, parameter_value, " & _
            " description, parameter_type ) " & _
            " values ( [w_id], [p_id], [p_name], [p_value], [desc], [p_type] )
"
    Set qy = mdbsStepMaster.CreateQueryDef(gstrEmptyString,
strInsert)

    ' Call a procedure to assign the parameter values
```

```
   Call AssignParameters(qy)

   qy.Execute dbFailOnError
   qy.Close

'    strInsert = "insert into workspace_parameters " & _
'           "( workspace_id, parameter_id, " & _
'           " parameter_name, parameter_value ) " & _
'           " values ( " & _
'           Str(mlngWorkspaceId) & ", " & Str(mlngParameterId) & _
'           ", " &
mFieldValue.MakeStringFieldValid(mstrParameterName) & _
'           ", " &
mFieldValue.MakeStringFieldValid(mstrParameterValue) & " ) "
'    mdbsStepMaster.Execute strInsert, dbFailOnError +
dbSQLPassThrough

   Exit Sub

AddErr:

   mstrSource = mstrModuleName & "Add"
   Call LogErrors(Errors)
   On Error GoTo 0
   Err.Raise vbObjectError + errParameterInsertFailed, _
      mstrSource, LoadResString(errParameterInsertFailed)

End Sub
Public Sub Delete()

   Dim strDelete As String
   Dim qy As DAO.QueryDef

   On Error GoTo DeleteErr

   ' Check if the db object is valid
   Call CheckDB

   strDelete = "delete from workspace_parameters " & _
         " where parameter_id = [p_id]"
   Set qy = mdbsStepMaster.CreateQueryDef(gstrEmptyString,
strDelete)

   Call AssignParameters(qy)
   qy.Execute dbFailOnError

   qy.Close

   Exit Sub

DeleteErr:
   LogErrors Errors
   mstrSource = mstrModuleName & "Delete"
   On Error GoTo 0
   Err.Raise vbObjectError + errDeleteParameterFailed, _
         mstrSource, _
         LoadResString(errDeleteParameterFailed)

End Sub

Public Sub Modify()

   Dim strUpdate As String
   Dim qy As QueryDef

   On Error GoTo ModifyErr

   ' Validate the updated values before trying to modify the db
   Call Validate

   ' Create a temporary querydef object with the modify string
   strUpdate = "update workspace_parameters " & _
         " set workspace_id = [w_id], " & _
         "parameter_name = [p_name], " & _
         "parameter_value = [p_value], " & _
         "description = [desc], " & _
         "parameter_type = [p_type] " & _
         " where parameter_id = [p_id]"
   Set qy = mdbsStepMaster.CreateQueryDef(gstrEmptyString,
strUpdate)

   ' Call a procedure to assign the parameter values to the
   ' querydef object
   Call AssignParameters(qy)
   qy.Execute dbFailOnError

   qy.Close

'    mdbsStepMaster.Execute strUpdate, dbFailOnError
'
   Exit Sub

ModifyErr:

   mstrSource = mstrModuleName & "Modify"
   Call LogErrors(Errors)
   On Error GoTo 0
   Err.Raise vbObjectError + errParameterUpdateFailed, _
      mstrSource, LoadResString(errParameterUpdateFailed)

End Sub
Public Property Get ParameterName() As String

   ParameterName = mstrParameterName

End Property

Public Property Get ParameterId() As Long

   ParameterId = mlngParameterId

End Property
Public Property Get NextIdentifier() As Long

   Dim lngNextId As Long

   On Error GoTo NextIdentifierErr

   ' First check if the database object is valid
   Call CheckDB

   ' Retrieve the next identifier using the sequence class
   Set mParameterSeq = New cSequence
   Set mParameterSeq.IdDatabase = mdbsStepMaster
   mParameterSeq.IdentifierColumn = FLD_ID_PARAMETER
   lngNextId = mParameterSeq.Identifier
   Set mParameterSeq = Nothing

   NextIdentifier = lngNextId
   Exit Property

NextIdentifierErr:
   LogErrors Errors
   mstrSource = mstrModuleName & "NextIdentifier"
   On Error GoTo 0
   Err.Raise vbObjectError + errIdGetFailed, _
      mstrSource, LoadResString(errIdGetFailed)

End Property
Public Property Get IndOperation() As Operation
```

```
    IndOperation = mintOperation

End Property

Public Property Get WorkspaceId() As Long

    WorkspaceId = mlngWorkspaceId

End Property

Public Property Get ParameterValue() As String

    ParameterValue = mstrParameterValue

End Property
Public Property Get Description() As String

    Description = mstrDescription

End Property
Public Property Get ParameterType() As ParameterType

    ParameterType = mintParameterType

End Property


Private Sub Class_Initialize()

    Set mFieldValue = New cStringSM

    ' Initialize the operation indicator variable to Query
    ' It will be modified later by the collection class when
    ' inserts, updates or deletes are performed
    mintOperation = QueryOp

End Sub

Private Sub Class_Terminate()

    Set mdbsStepMaster = Nothing
    Set mFieldValue = Nothing

End Sub
```

cRunColIt.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cRunColIt"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:       cRunColIt.cls
'              Microsoft TPC-H Kit Ver. 1.00
'              Copyright Microsoft, 1999
'              All Rights Reserved
'
'
'  PURPOSE:    This module implements a stack of Iterator nodes.
'              Ensures that only cRunItNode objects are stored in the stack.
'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

' Used to indicate the source module name when errors
' are raised by this class
Private Const mstrModuleName As String = "cRunColIt."
Private mstrSource As String

Private mcIterators As cStack
Public Sub Clear()

    mcIterators.Clear

End Sub

Private Sub Class_Initialize()

    Set mcIterators = New cStack

End Sub

Private Sub Class_Terminate()

    Set mcIterators = Nothing

End Sub


Public Function Value(strItName As String) As String

    Dim lngIndex As Long

    For lngIndex = 0 To mcIterators.Count - 1
        If mcIterators(lngIndex).IteratorName = strItName Then
            Value = mcIterators(lngIndex).Value
            Exit For
        End If
    Next lngIndex

End Function

Public Property Get Item(ByVal Position As Long) As cRunItNode
Attribute Item.VB_UserMemId = 0

    Set Item = mcIterators(Position)

End Property


Public Function Count() As Long

    Count = mcIterators.Count

End Function

Public Function Pop() As cRunItNode

    Set Pop = mcIterators.Pop

End Function

Public Sub Push(objToPush As cRunItNode)

    Call mcIterators.Push(objToPush)

End Sub
```

cRunInst.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
  Persistable = 0  'NotPersistable
  DataBindingBehavior = 0  'vbNone
```

```
  DataSourceBehavior  = 0  'vbNone
  MTSTransactionMode  = 0  'NotAnMTSObject
END
Attribute VB_Name = "cRunInst"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:       cRunColIt.cls
'            Microsoft TPC-H Kit Ver. 1.00
'            Copyright Microsoft, 1999
'            All Rights Reserved
'
'
'  PURPOSE:     This module controls the run processing. It runs a
branch
'            at a time and raises events when each step completes
execution.
'  Contact:     Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

' Used to indicate the source module name when errors
' are raised by this class
Private Const mstrModuleName As String = "cRunInst."
Private mstrSource As String

' Local variable(s) to hold property value(s)
Private mstrRootKey As String
Public WspId As Long
Private mcParameters As cArrParameters
Private mcRunSteps As cArrSteps
Private mcRunConstraints As cArrConstraints
Public RunConnections As cConnections
Public RunConnDtls As cConnDtls
Private mcvntWspPreCons As Variant
Private mcvntWspPostCons As Variant
Private mcNavSteps As cStepTree

Private mcInstances As cInstances
Private mcFreeSteps As cVectorLng
Private mcFailures As cFailedSteps
Private mblnAsk As Boolean   ' Set to True when the a step with
continuation criteria=Ask fails
Private mblnAbort As Boolean ' Set to True when the run is aborted
Private msAbortDtls As String
Private mbarrFree() As Byte
Private WithEvents mcTermSteps As cTermSteps
Attribute mcTermSteps.VB_VarHelpID = -1
Public RunId As Long
Public CreateInputFiles As Boolean

Private Enum WspLogEvents
   mintRunStart
   mintRunComplete
   mintStepStart
   mintStepComplete
End Enum

Private mcWspLog As cFileSM

Private mstrCurBranchRoot As String
Private mcDummyRootInstance As cInstance

' Key for the dummy root instance - Should be a key that is invalid for
an actual step record
Private Const mstrDummyRootKey As String = "D"

' Public events to notify the calling function of the
' start and end time for each step
Public Event RunStart(dtmStartTime As Currency, strWspLog As
String)
Public Event RunComplete(dtmEndTime As Currency)
Public Event StepStart(cStepRecord As cStep, dtmStartTime As
Currency, _
      lngInstanceId As Long, lParentInstanceId As Long, sPath As
String, _
      sIts As String, sItValue As String)
Public Event StepComplete(cStepRecord As cStep, dtmEndTime As
Currency, lngInstanceId As Long, lElapsed As Long)
Public Event ProcessStart(cStepRecord As cStep, strCommand As
String, _
      dtmStartTime As Currency, lngInstanceId As Long,
lParentInstanceId As Long, _
      sItValue As String)
Public Event ProcessComplete(cStepRecord As cStep, dtmEndTime As
Currency, lngInstanceId As Long, lElapsed As Long)

' The class that will execute each step - we trap the events
' that are raised by it when a step starts/completes
' execution
Private WithEvents cExecStep1 As cRunStep
Attribute cExecStep1.VB_VarHelpID = -1
Private WithEvents cExecStep2 As cRunStep
Attribute cExecStep2.VB_VarHelpID = -1
Private WithEvents cExecStep3 As cRunStep
Attribute cExecStep3.VB_VarHelpID = -1
Private WithEvents cExecStep4 As cRunStep
Attribute cExecStep4.VB_VarHelpID = -1
Private WithEvents cExecStep5 As cRunStep
Attribute cExecStep5.VB_VarHelpID = -1
Private WithEvents cExecStep6 As cRunStep
Attribute cExecStep6.VB_VarHelpID = -1
Private WithEvents cExecStep7 As cRunStep
Attribute cExecStep7.VB_VarHelpID = -1
Private WithEvents cExecStep8 As cRunStep
Attribute cExecStep8.VB_VarHelpID = -1
Private WithEvents cExecStep9 As cRunStep
Attribute cExecStep9.VB_VarHelpID = -1

Private WithEvents cExecStep10 As cRunStep
Attribute cExecStep10.VB_VarHelpID = -1
Private WithEvents cExecStep11 As cRunStep
Attribute cExecStep11.VB_VarHelpID = -1
Private WithEvents cExecStep12 As cRunStep
Attribute cExecStep12.VB_VarHelpID = -1
Private WithEvents cExecStep13 As cRunStep
Attribute cExecStep13.VB_VarHelpID = -1
Private WithEvents cExecStep14 As cRunStep
Attribute cExecStep14.VB_VarHelpID = -1
Private WithEvents cExecStep15 As cRunStep
Attribute cExecStep15.VB_VarHelpID = -1
Private WithEvents cExecStep16 As cRunStep
Attribute cExecStep16.VB_VarHelpID = -1
Private WithEvents cExecStep17 As cRunStep
Attribute cExecStep17.VB_VarHelpID = -1
Private WithEvents cExecStep18 As cRunStep
Attribute cExecStep18.VB_VarHelpID = -1
Private WithEvents cExecStep19 As cRunStep
Attribute cExecStep19.VB_VarHelpID = -1

Private WithEvents cExecStep20 As cRunStep
Attribute cExecStep20.VB_VarHelpID = -1
Private WithEvents cExecStep21 As cRunStep
Attribute cExecStep21.VB_VarHelpID = -1
Private WithEvents cExecStep22 As cRunStep
Attribute cExecStep22.VB_VarHelpID = -1
Private WithEvents cExecStep23 As cRunStep
Attribute cExecStep23.VB_VarHelpID = -1
Private WithEvents cExecStep24 As cRunStep
```

```
Attribute cExecStep24.VB_VarHelpID = -1
Private WithEvents cExecStep25 As cRunStep
Attribute cExecStep25.VB_VarHelpID = -1
Private WithEvents cExecStep26 As cRunStep
Attribute cExecStep26.VB_VarHelpID = -1
Private WithEvents cExecStep27 As cRunStep
Attribute cExecStep27.VB_VarHelpID = -1
Private WithEvents cExecStep28 As cRunStep
Attribute cExecStep28.VB_VarHelpID = -1
Private WithEvents cExecStep29 As cRunStep
Attribute cExecStep29.VB_VarHelpID = -1

Private WithEvents cExecStep30 As cRunStep
Attribute cExecStep30.VB_VarHelpID = -1
Private WithEvents cExecStep31 As cRunStep
Attribute cExecStep31.VB_VarHelpID = -1
Private WithEvents cExecStep32 As cRunStep
Attribute cExecStep32.VB_VarHelpID = -1
Private WithEvents cExecStep33 As cRunStep
Attribute cExecStep33.VB_VarHelpID = -1
Private WithEvents cExecStep34 As cRunStep
Attribute cExecStep34.VB_VarHelpID = -1
Private WithEvents cExecStep35 As cRunStep
Attribute cExecStep35.VB_VarHelpID = -1
Private WithEvents cExecStep36 As cRunStep
Attribute cExecStep36.VB_VarHelpID = -1
Private WithEvents cExecStep37 As cRunStep
Attribute cExecStep37.VB_VarHelpID = -1
Private WithEvents cExecStep38 As cRunStep
Attribute cExecStep38.VB_VarHelpID = -1
Private WithEvents cExecStep39 As cRunStep
Attribute cExecStep39.VB_VarHelpID = -1

Private WithEvents cExecStep40 As cRunStep
Attribute cExecStep40.VB_VarHelpID = -1
Private WithEvents cExecStep41 As cRunStep
Attribute cExecStep41.VB_VarHelpID = -1
Private WithEvents cExecStep42 As cRunStep
Attribute cExecStep42.VB_VarHelpID = -1
Private WithEvents cExecStep43 As cRunStep
Attribute cExecStep43.VB_VarHelpID = -1
Private WithEvents cExecStep44 As cRunStep
Attribute cExecStep44.VB_VarHelpID = -1
Private WithEvents cExecStep45 As cRunStep
Attribute cExecStep45.VB_VarHelpID = -1
Private WithEvents cExecStep46 As cRunStep
Attribute cExecStep46.VB_VarHelpID = -1
Private WithEvents cExecStep47 As cRunStep
Attribute cExecStep47.VB_VarHelpID = -1
Private WithEvents cExecStep48 As cRunStep
Attribute cExecStep48.VB_VarHelpID = -1
Private WithEvents cExecStep49 As cRunStep
Attribute cExecStep49.VB_VarHelpID = -1

Private WithEvents cExecStep50 As cRunStep
Attribute cExecStep50.VB_VarHelpID = -1
Private WithEvents cExecStep51 As cRunStep
Attribute cExecStep51.VB_VarHelpID = -1
Private WithEvents cExecStep52 As cRunStep
Attribute cExecStep52.VB_VarHelpID = -1
Private WithEvents cExecStep53 As cRunStep
Attribute cExecStep53.VB_VarHelpID = -1
Private WithEvents cExecStep54 As cRunStep
Attribute cExecStep54.VB_VarHelpID = -1
Private WithEvents cExecStep55 As cRunStep
Attribute cExecStep55.VB_VarHelpID = -1
Private WithEvents cExecStep56 As cRunStep
Attribute cExecStep56.VB_VarHelpID = -1
Private WithEvents cExecStep57 As cRunStep
Attribute cExecStep57.VB_VarHelpID = -1
Private WithEvents cExecStep58 As cRunStep
Attribute cExecStep58.VB_VarHelpID = -1
Private WithEvents cExecStep59 As cRunStep
Attribute cExecStep59.VB_VarHelpID = -1

Private WithEvents cExecStep60 As cRunStep
Attribute cExecStep60.VB_VarHelpID = -1
Private WithEvents cExecStep61 As cRunStep
Attribute cExecStep61.VB_VarHelpID = -1
Private WithEvents cExecStep62 As cRunStep
Attribute cExecStep62.VB_VarHelpID = -1
Private WithEvents cExecStep63 As cRunStep
Attribute cExecStep63.VB_VarHelpID = -1
Private WithEvents cExecStep64 As cRunStep
Attribute cExecStep64.VB_VarHelpID = -1
Private WithEvents cExecStep65 As cRunStep
Attribute cExecStep65.VB_VarHelpID = -1
Private WithEvents cExecStep66 As cRunStep
Attribute cExecStep66.VB_VarHelpID = -1
Private WithEvents cExecStep67 As cRunStep
Attribute cExecStep67.VB_VarHelpID = -1
Private WithEvents cExecStep68 As cRunStep
Attribute cExecStep68.VB_VarHelpID = -1
Private WithEvents cExecStep69 As cRunStep
Attribute cExecStep69.VB_VarHelpID = -1

Private WithEvents cExecStep70 As cRunStep
Attribute cExecStep70.VB_VarHelpID = -1
Private WithEvents cExecStep71 As cRunStep
Attribute cExecStep71.VB_VarHelpID = -1
Private WithEvents cExecStep72 As cRunStep
Attribute cExecStep72.VB_VarHelpID = -1
Private WithEvents cExecStep73 As cRunStep
Attribute cExecStep73.VB_VarHelpID = -1
Private WithEvents cExecStep74 As cRunStep
Attribute cExecStep74.VB_VarHelpID = -1
Private WithEvents cExecStep75 As cRunStep
Attribute cExecStep75.VB_VarHelpID = -1
Private WithEvents cExecStep76 As cRunStep
Attribute cExecStep76.VB_VarHelpID = -1
Private WithEvents cExecStep77 As cRunStep
Attribute cExecStep77.VB_VarHelpID = -1
Private WithEvents cExecStep78 As cRunStep
Attribute cExecStep78.VB_VarHelpID = -1
Private WithEvents cExecStep79 As cRunStep
Attribute cExecStep79.VB_VarHelpID = -1

Private WithEvents cExecStep80 As cRunStep
Attribute cExecStep80.VB_VarHelpID = -1
Private WithEvents cExecStep81 As cRunStep
Attribute cExecStep81.VB_VarHelpID = -1
Private WithEvents cExecStep82 As cRunStep
Attribute cExecStep82.VB_VarHelpID = -1
Private WithEvents cExecStep83 As cRunStep
Attribute cExecStep83.VB_VarHelpID = -1
Private WithEvents cExecStep84 As cRunStep
Attribute cExecStep84.VB_VarHelpID = -1
Private WithEvents cExecStep85 As cRunStep
Attribute cExecStep85.VB_VarHelpID = -1
Private WithEvents cExecStep86 As cRunStep
Attribute cExecStep86.VB_VarHelpID = -1
Private WithEvents cExecStep87 As cRunStep
Attribute cExecStep87.VB_VarHelpID = -1
Private WithEvents cExecStep88 As cRunStep
Attribute cExecStep88.VB_VarHelpID = -1
Private WithEvents cExecStep89 As cRunStep
Attribute cExecStep89.VB_VarHelpID = -1

Private WithEvents cExecStep90 As cRunStep
Attribute cExecStep90.VB_VarHelpID = -1
```

```
Private WithEvents cExecStep91 As cRunStep
Attribute cExecStep91.VB_VarHelpID = -1
Private WithEvents cExecStep92 As cRunStep
Attribute cExecStep92.VB_VarHelpID = -1
Private WithEvents cExecStep93 As cRunStep
Attribute cExecStep93.VB_VarHelpID = -1
Private WithEvents cExecStep94 As cRunStep
Attribute cExecStep94.VB_VarHelpID = -1
Private WithEvents cExecStep95 As cRunStep
Attribute cExecStep95.VB_VarHelpID = -1
Private WithEvents cExecStep96 As cRunStep
Attribute cExecStep96.VB_VarHelpID = -1
Private WithEvents cExecStep97 As cRunStep
Attribute cExecStep97.VB_VarHelpID = -1
Private WithEvents cExecStep98 As cRunStep
Attribute cExecStep98.VB_VarHelpID = -1
Private WithEvents cExecStep99 As cRunStep
Attribute cExecStep99.VB_VarHelpID = -1

Private Const msIt As String = " Iterator: "
Private Const msItValue As String = " Value: "
Public Sub Abort()

   On Error GoTo AbortErr

   ' Make sure that we don't execute any more steps
   Call StopRun

   If cExecStep1 Is Nothing And cExecStep2 Is Nothing And
cExecStep3 Is Nothing And cExecStep4 Is Nothing And cExecStep5 Is
Nothing And cExecStep6 Is Nothing And cExecStep7 Is Nothing And
cExecStep8 Is Nothing And cExecStep9 Is Nothing And _
      cExecStep10 Is Nothing And cExecStep11 Is Nothing And
cExecStep12 Is Nothing And cExecStep13 Is Nothing And
cExecStep14 Is Nothing And cExecStep15 Is Nothing And
cExecStep16 Is Nothing And cExecStep17 Is Nothing And
cExecStep18 Is Nothing And cExecStep19 Is Nothing And _
      cExecStep20 Is Nothing And cExecStep21 Is Nothing And
cExecStep22 Is Nothing And cExecStep23 Is Nothing And
cExecStep24 Is Nothing And cExecStep25 Is Nothing And
cExecStep26 Is Nothing And cExecStep27 Is Nothing And
cExecStep28 Is Nothing And cExecStep29 Is Nothing And _
      cExecStep30 Is Nothing And cExecStep31 Is Nothing And
cExecStep32 Is Nothing And cExecStep33 Is Nothing And
cExecStep34 Is Nothing And cExecStep35 Is Nothing And
cExecStep36 Is Nothing And cExecStep37 Is Nothing And
cExecStep38 Is Nothing And cExecStep39 Is Nothing And _
      cExecStep40 Is Nothing And cExecStep41 Is Nothing And
cExecStep42 Is Nothing And cExecStep43 Is Nothing And
cExecStep44 Is Nothing And cExecStep45 Is Nothing And
cExecStep46 Is Nothing And cExecStep47 Is Nothing And
cExecStep48 Is Nothing And cExecStep49 Is Nothing And _
      cExecStep50 Is Nothing And cExecStep51 Is Nothing And
cExecStep52 Is Nothing And cExecStep53 Is Nothing And
cExecStep54 Is Nothing And cExecStep55 Is Nothing And
cExecStep56 Is Nothing And cExecStep57 Is Nothing And
cExecStep58 Is Nothing And cExecStep59 Is Nothing And _
      cExecStep60 Is Nothing And cExecStep61 Is Nothing And
cExecStep62 Is Nothing And cExecStep63 Is Nothing And
cExecStep64 Is Nothing And cExecStep65 Is Nothing And
cExecStep66 Is Nothing And cExecStep67 Is Nothing And
cExecStep68 Is Nothing And cExecStep69 Is Nothing And _
      cExecStep70 Is Nothing And cExecStep71 Is Nothing And
cExecStep72 Is Nothing And cExecStep73 Is Nothing And
cExecStep74 Is Nothing And cExecStep75 Is Nothing And
cExecStep76 Is Nothing And cExecStep77 Is Nothing And
cExecStep78 Is Nothing And cExecStep79 Is Nothing And _
      cExecStep80 Is Nothing And cExecStep81 Is Nothing And
cExecStep82 Is Nothing And cExecStep83 Is Nothing And
cExecStep84 Is Nothing And cExecStep85 Is Nothing And
cExecStep86 Is Nothing And cExecStep87 Is Nothing And
cExecStep88 Is Nothing And cExecStep89 Is Nothing And _
      cExecStep90 Is Nothing And cExecStep91 Is Nothing And
cExecStep92 Is Nothing And cExecStep93 Is Nothing And
cExecStep94 Is Nothing And cExecStep95 Is Nothing And
cExecStep96 Is Nothing And cExecStep97 Is Nothing And
cExecStep98 Is Nothing And cExecStep99 Is Nothing Then
      ' Then...
      WriteToWspLog (mintRunComplete)
      RaiseEvent RunComplete(Determine64BitTime())
   Else
      ' Abort each of the steps that is currently executing.
      If Not cExecStep1 Is Nothing Then
         cExecStep1.Abort
      End If

      If Not cExecStep2 Is Nothing Then
         cExecStep2.Abort
      End If

      If Not cExecStep3 Is Nothing Then
         cExecStep3.Abort
      End If

      If Not cExecStep4 Is Nothing Then
         cExecStep4.Abort
      End If

      If Not cExecStep5 Is Nothing Then
         cExecStep5.Abort
      End If

      If Not cExecStep6 Is Nothing Then
         cExecStep6.Abort
      End If

      If Not cExecStep7 Is Nothing Then
         cExecStep7.Abort
      End If

      If Not cExecStep8 Is Nothing Then
         cExecStep8.Abort
      End If

      If Not cExecStep9 Is Nothing Then
         cExecStep9.Abort
      End If

      If Not cExecStep10 Is Nothing Then
         cExecStep10.Abort
      End If

      If Not cExecStep11 Is Nothing Then
         cExecStep11.Abort
      End If

      If Not cExecStep12 Is Nothing Then
         cExecStep12.Abort
      End If

      If Not cExecStep13 Is Nothing Then
         cExecStep13.Abort
      End If

      If Not cExecStep14 Is Nothing Then
         cExecStep14.Abort
      End If

      If Not cExecStep15 Is Nothing Then
         cExecStep15.Abort
```

```
End If

If Not cExecStep16 Is Nothing Then
   cExecStep16.Abort
End If

If Not cExecStep17 Is Nothing Then
   cExecStep17.Abort
End If

If Not cExecStep18 Is Nothing Then
   cExecStep18.Abort
End If

If Not cExecStep19 Is Nothing Then
   cExecStep19.Abort
End If

If Not cExecStep20 Is Nothing Then
   cExecStep20.Abort
End If

If Not cExecStep21 Is Nothing Then
   cExecStep21.Abort
End If

If Not cExecStep22 Is Nothing Then
   cExecStep22.Abort
End If

If Not cExecStep23 Is Nothing Then
   cExecStep23.Abort
End If

If Not cExecStep24 Is Nothing Then
   cExecStep24.Abort
End If

If Not cExecStep25 Is Nothing Then
   cExecStep25.Abort
End If

If Not cExecStep26 Is Nothing Then
   cExecStep26.Abort
End If

If Not cExecStep27 Is Nothing Then
   cExecStep27.Abort
End If

If Not cExecStep28 Is Nothing Then
   cExecStep28.Abort
End If

If Not cExecStep29 Is Nothing Then
   cExecStep29.Abort
End If

' ============== 30 - 39 ==============
If Not cExecStep30 Is Nothing Then
   cExecStep30.Abort
End If

If Not cExecStep31 Is Nothing Then
   cExecStep31.Abort
End If

If Not cExecStep32 Is Nothing Then
   cExecStep32.Abort
End If

If Not cExecStep33 Is Nothing Then
   cExecStep33.Abort
End If

If Not cExecStep34 Is Nothing Then
   cExecStep34.Abort
End If

If Not cExecStep35 Is Nothing Then
   cExecStep35.Abort
End If

If Not cExecStep36 Is Nothing Then
   cExecStep36.Abort
End If

If Not cExecStep37 Is Nothing Then
   cExecStep37.Abort
End If

If Not cExecStep38 Is Nothing Then
   cExecStep38.Abort
End If

If Not cExecStep39 Is Nothing Then
   cExecStep39.Abort
End If

' ============== 40 - 49 ==============
If Not cExecStep40 Is Nothing Then
   cExecStep40.Abort
End If

If Not cExecStep41 Is Nothing Then
   cExecStep41.Abort
End If

If Not cExecStep42 Is Nothing Then
   cExecStep42.Abort
End If

If Not cExecStep43 Is Nothing Then
   cExecStep43.Abort
End If

If Not cExecStep44 Is Nothing Then
   cExecStep44.Abort
End If

If Not cExecStep45 Is Nothing Then
   cExecStep45.Abort
End If

If Not cExecStep46 Is Nothing Then
   cExecStep46.Abort
End If

If Not cExecStep47 Is Nothing Then
   cExecStep47.Abort
End If

If Not cExecStep48 Is Nothing Then
   cExecStep48.Abort
End If

If Not cExecStep49 Is Nothing Then
   cExecStep49.Abort
End If
```

```
' ============== 50 - 59 ==============
If Not cExecStep50 Is Nothing Then
   cExecStep50.Abort
End If

If Not cExecStep51 Is Nothing Then
   cExecStep51.Abort
End If

If Not cExecStep52 Is Nothing Then
   cExecStep52.Abort
End If

If Not cExecStep53 Is Nothing Then
   cExecStep53.Abort
End If

If Not cExecStep54 Is Nothing Then
   cExecStep54.Abort
End If

If Not cExecStep55 Is Nothing Then
   cExecStep55.Abort
End If

If Not cExecStep56 Is Nothing Then
   cExecStep56.Abort
End If

If Not cExecStep57 Is Nothing Then
   cExecStep57.Abort
End If

If Not cExecStep58 Is Nothing Then
   cExecStep58.Abort
End If

If Not cExecStep59 Is Nothing Then
   cExecStep59.Abort
End If

' ============== 60 - 69 ==============
If Not cExecStep60 Is Nothing Then
   cExecStep60.Abort
End If

If Not cExecStep61 Is Nothing Then
   cExecStep61.Abort
End If

If Not cExecStep62 Is Nothing Then
   cExecStep62.Abort
End If

If Not cExecStep63 Is Nothing Then
   cExecStep63.Abort
End If

If Not cExecStep64 Is Nothing Then
   cExecStep64.Abort
End If

If Not cExecStep65 Is Nothing Then
   cExecStep65.Abort
End If

If Not cExecStep66 Is Nothing Then
   cExecStep66.Abort
End If

If Not cExecStep67 Is Nothing Then
   cExecStep67.Abort
End If

If Not cExecStep68 Is Nothing Then
   cExecStep68.Abort
End If

If Not cExecStep69 Is Nothing Then
   cExecStep69.Abort
End If

' ============== 70 - 79 ==============
If Not cExecStep70 Is Nothing Then
   cExecStep70.Abort
End If

If Not cExecStep71 Is Nothing Then
   cExecStep71.Abort
End If

If Not cExecStep72 Is Nothing Then
   cExecStep72.Abort
End If

If Not cExecStep73 Is Nothing Then
   cExecStep73.Abort
End If

If Not cExecStep74 Is Nothing Then
   cExecStep74.Abort
End If

If Not cExecStep75 Is Nothing Then
   cExecStep75.Abort
End If

If Not cExecStep76 Is Nothing Then
   cExecStep76.Abort
End If

If Not cExecStep77 Is Nothing Then
   cExecStep77.Abort
End If

If Not cExecStep78 Is Nothing Then
   cExecStep78.Abort
End If

If Not cExecStep79 Is Nothing Then
   cExecStep79.Abort
End If

' ============== 80 - 89 ==============
If Not cExecStep80 Is Nothing Then
   cExecStep80.Abort
End If

If Not cExecStep81 Is Nothing Then
   cExecStep81.Abort
End If

If Not cExecStep82 Is Nothing Then
   cExecStep82.Abort
End If

If Not cExecStep83 Is Nothing Then
   cExecStep83.Abort
End If
```

```
    If Not cExecStep84 Is Nothing Then
        cExecStep84.Abort
    End If

    If Not cExecStep85 Is Nothing Then
        cExecStep85.Abort
    End If

    If Not cExecStep86 Is Nothing Then
        cExecStep86.Abort
    End If

    If Not cExecStep87 Is Nothing Then
        cExecStep87.Abort
    End If

    If Not cExecStep88 Is Nothing Then
        cExecStep88.Abort
    End If

    If Not cExecStep89 Is Nothing Then
        cExecStep89.Abort
    End If

    ' ============== 90 - 99 ==============
    If Not cExecStep90 Is Nothing Then
        cExecStep90.Abort
    End If

    If Not cExecStep91 Is Nothing Then
        cExecStep91.Abort
    End If

    If Not cExecStep92 Is Nothing Then
        cExecStep92.Abort
    End If

    If Not cExecStep93 Is Nothing Then
        cExecStep93.Abort
    End If

    If Not cExecStep94 Is Nothing Then
        cExecStep94.Abort
    End If

    If Not cExecStep95 Is Nothing Then
        cExecStep95.Abort
    End If

    If Not cExecStep96 Is Nothing Then
        cExecStep96.Abort
    End If

    If Not cExecStep97 Is Nothing Then
        cExecStep97.Abort
    End If

    If Not cExecStep98 Is Nothing Then
        cExecStep98.Abort
    End If

    If Not cExecStep99 Is Nothing Then
        cExecStep99.Abort
    End If

  End If

  Exit Sub

AbortErr:
  Call LogErrors(Errors)
  On Error GoTo 0
  ShowError errAbortFailed
  ' Try to abort the remaining steps, if any
  Resume Next

End Sub
Public Sub AbortSiblings(cTermInstance As cInstance)

  On Error GoTo AbortSiblingsErr

  ' Abort each of the steps that is currently executing.
  If Not cExecStep1 Is Nothing Then
    If cExecStep1.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
      cExecStep1.Abort
    End If
  End If

  If Not cExecStep2 Is Nothing Then
    If cExecStep2.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
      cExecStep2.Abort
    End If
  End If

  If Not cExecStep3 Is Nothing Then
    If cExecStep3.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
      cExecStep3.Abort
    End If
  End If

  If Not cExecStep4 Is Nothing Then
    If cExecStep4.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
      cExecStep4.Abort
    End If
  End If

  If Not cExecStep5 Is Nothing Then
    If cExecStep5.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
      cExecStep5.Abort
    End If
  End If

  If Not cExecStep6 Is Nothing Then
    If cExecStep6.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
      cExecStep6.Abort
    End If
  End If

  If Not cExecStep7 Is Nothing Then
    If cExecStep7.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
      cExecStep7.Abort
    End If
  End If

  If Not cExecStep8 Is Nothing Then
    If cExecStep8.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
      cExecStep8.Abort
    End If
  End If

  If Not cExecStep9 Is Nothing Then
```

```
      If cExecStep9.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep9.Abort
      End If
   End If

   If Not cExecStep10 Is Nothing Then
      If cExecStep10.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep10.Abort
      End If
   End If

   If Not cExecStep11 Is Nothing Then
      If cExecStep11.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep11.Abort
      End If
   End If

   If Not cExecStep12 Is Nothing Then
      If cExecStep12.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep12.Abort
      End If
   End If

   If Not cExecStep13 Is Nothing Then
      If cExecStep13.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep13.Abort
      End If
   End If

   If Not cExecStep14 Is Nothing Then
      If cExecStep14.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep14.Abort
      End If
   End If

   If Not cExecStep15 Is Nothing Then
      If cExecStep15.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep15.Abort
      End If
   End If

   If Not cExecStep16 Is Nothing Then
      If cExecStep16.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep16.Abort
      End If
   End If

   If Not cExecStep17 Is Nothing Then
      If cExecStep17.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep17.Abort
      End If
   End If

   If Not cExecStep18 Is Nothing Then
      If cExecStep18.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep18.Abort
      End If
   End If

   If Not cExecStep19 Is Nothing Then
      If cExecStep19.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep19.Abort
      End If
   End If

   If Not cExecStep20 Is Nothing Then
      If cExecStep20.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep20.Abort
      End If
   End If

   If Not cExecStep21 Is Nothing Then
      If cExecStep21.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep21.Abort
      End If
   End If

   If Not cExecStep22 Is Nothing Then
      If cExecStep22.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep22.Abort
      End If
   End If

   If Not cExecStep23 Is Nothing Then
      If cExecStep23.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep23.Abort
      End If
   End If

   If Not cExecStep24 Is Nothing Then
      If cExecStep24.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep24.Abort
      End If
   End If

   If Not cExecStep25 Is Nothing Then
      If cExecStep25.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep25.Abort
      End If
   End If

   If Not cExecStep26 Is Nothing Then
      If cExecStep26.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep26.Abort
      End If
   End If

   If Not cExecStep27 Is Nothing Then
      If cExecStep27.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep27.Abort
      End If
   End If

   If Not cExecStep28 Is Nothing Then
      If cExecStep28.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep28.Abort
      End If
   End If

   If Not cExecStep29 Is Nothing Then
```

```
      If cExecStep29.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep29.Abort
      End If
   End If

   ' ============ 30 =================
   If Not cExecStep30 Is Nothing Then
      If cExecStep30.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep30.Abort
      End If
   End If

   If Not cExecStep31 Is Nothing Then
      If cExecStep31.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep31.Abort
      End If
   End If

   If Not cExecStep32 Is Nothing Then
      If cExecStep32.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep32.Abort
      End If
   End If

   If Not cExecStep33 Is Nothing Then
      If cExecStep33.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep33.Abort
      End If
   End If

   If Not cExecStep34 Is Nothing Then
      If cExecStep34.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep34.Abort
      End If
   End If

   If Not cExecStep35 Is Nothing Then
      If cExecStep35.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep35.Abort
      End If
   End If

   If Not cExecStep36 Is Nothing Then
      If cExecStep36.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep36.Abort
      End If
   End If

   If Not cExecStep37 Is Nothing Then
      If cExecStep37.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep37.Abort
      End If
   End If

   If Not cExecStep38 Is Nothing Then
      If cExecStep38.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep38.Abort
      End If
   End If

   If Not cExecStep39 Is Nothing Then
      If cExecStep39.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep39.Abort
      End If
   End If

   ' ============ 40 =================
   If Not cExecStep40 Is Nothing Then
      If cExecStep40.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep40.Abort
      End If
   End If

   If Not cExecStep41 Is Nothing Then
      If cExecStep41.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep41.Abort
      End If
   End If

   If Not cExecStep42 Is Nothing Then
      If cExecStep42.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep42.Abort
      End If
   End If

   If Not cExecStep43 Is Nothing Then
      If cExecStep43.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep43.Abort
      End If
   End If

   If Not cExecStep44 Is Nothing Then
      If cExecStep44.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep44.Abort
      End If
   End If

   If Not cExecStep45 Is Nothing Then
      If cExecStep45.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep45.Abort
      End If
   End If

   If Not cExecStep46 Is Nothing Then
      If cExecStep46.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep46.Abort
      End If
   End If

   If Not cExecStep47 Is Nothing Then
      If cExecStep47.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep47.Abort
      End If
   End If

   If Not cExecStep48 Is Nothing Then
      If cExecStep48.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep48.Abort
      End If
   End If
```

```
    If Not cExecStep49 Is Nothing Then
        If cExecStep49.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep49.Abort
        End If
    End If

    ' ============ 50 ================
    If Not cExecStep50 Is Nothing Then
        If cExecStep50.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep50.Abort
        End If
    End If

    If Not cExecStep51 Is Nothing Then
        If cExecStep51.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep51.Abort
        End If
    End If

    If Not cExecStep52 Is Nothing Then
        If cExecStep52.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep52.Abort
        End If
    End If

    If Not cExecStep53 Is Nothing Then
        If cExecStep53.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep53.Abort
        End If
    End If

    If Not cExecStep54 Is Nothing Then
        If cExecStep54.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep54.Abort
        End If
    End If

    If Not cExecStep55 Is Nothing Then
        If cExecStep55.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep55.Abort
        End If
    End If

    If Not cExecStep56 Is Nothing Then
        If cExecStep56.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep56.Abort
        End If
    End If

    If Not cExecStep57 Is Nothing Then
        If cExecStep57.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep57.Abort
        End If
    End If

    If Not cExecStep58 Is Nothing Then
        If cExecStep58.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep58.Abort
        End If
    End If

    If Not cExecStep59 Is Nothing Then
        If cExecStep59.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep59.Abort
        End If
    End If

    ' ============ 60 ================
    If Not cExecStep60 Is Nothing Then
        If cExecStep60.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep60.Abort
        End If
    End If

    If Not cExecStep61 Is Nothing Then
        If cExecStep61.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep61.Abort
        End If
    End If

    If Not cExecStep62 Is Nothing Then
        If cExecStep62.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep62.Abort
        End If
    End If

    If Not cExecStep63 Is Nothing Then
        If cExecStep63.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep63.Abort
        End If
    End If

    If Not cExecStep64 Is Nothing Then
        If cExecStep64.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep64.Abort
        End If
    End If

    If Not cExecStep65 Is Nothing Then
        If cExecStep65.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep65.Abort
        End If
    End If

    If Not cExecStep66 Is Nothing Then
        If cExecStep66.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep66.Abort
        End If
    End If

    If Not cExecStep67 Is Nothing Then
        If cExecStep67.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep67.Abort
        End If
    End If

    If Not cExecStep68 Is Nothing Then
        If cExecStep68.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep68.Abort
```

```
        End If
    End If

    If Not cExecStep69 Is Nothing Then
        If cExecStep69.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep69.Abort
        End If
    End If

    ' ============ 70 ================
    If Not cExecStep70 Is Nothing Then
        If cExecStep70.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep70.Abort
        End If
    End If

    If Not cExecStep71 Is Nothing Then
        If cExecStep71.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep71.Abort
        End If
    End If

    If Not cExecStep72 Is Nothing Then
        If cExecStep72.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep72.Abort
        End If
    End If

    If Not cExecStep73 Is Nothing Then
        If cExecStep73.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep73.Abort
        End If
    End If

    If Not cExecStep74 Is Nothing Then
        If cExecStep74.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep74.Abort
        End If
    End If

    If Not cExecStep75 Is Nothing Then
        If cExecStep75.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep75.Abort
        End If
    End If

    If Not cExecStep76 Is Nothing Then
        If cExecStep76.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep76.Abort
        End If
    End If

    If Not cExecStep77 Is Nothing Then
        If cExecStep77.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep77.Abort
        End If
    End If

    If Not cExecStep78 Is Nothing Then
        If cExecStep78.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep78.Abort
        End If
    End If

    If Not cExecStep79 Is Nothing Then
        If cExecStep79.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep79.Abort
        End If
    End If

    ' ============ 80 ================
    If Not cExecStep80 Is Nothing Then
        If cExecStep80.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep80.Abort
        End If
    End If

    If Not cExecStep81 Is Nothing Then
        If cExecStep81.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep81.Abort
        End If
    End If

    If Not cExecStep82 Is Nothing Then
        If cExecStep82.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep82.Abort
        End If
    End If

    If Not cExecStep83 Is Nothing Then
        If cExecStep83.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep83.Abort
        End If
    End If

    If Not cExecStep84 Is Nothing Then
        If cExecStep84.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep84.Abort
        End If
    End If

    If Not cExecStep85 Is Nothing Then
        If cExecStep85.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep85.Abort
        End If
    End If

    If Not cExecStep86 Is Nothing Then
        If cExecStep86.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep86.Abort
        End If
    End If

    If Not cExecStep87 Is Nothing Then
        If cExecStep87.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
            cExecStep87.Abort
        End If
    End If

    If Not cExecStep88 Is Nothing Then
```

```
      If cExecStep88.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep88.Abort
      End If
   End If

   If Not cExecStep89 Is Nothing Then
      If cExecStep89.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep89.Abort
      End If
   End If

   ' ============ 90 =================
   If Not cExecStep90 Is Nothing Then
      If cExecStep90.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep90.Abort
      End If
   End If

   If Not cExecStep91 Is Nothing Then
      If cExecStep91.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep91.Abort
      End If
   End If

   If Not cExecStep92 Is Nothing Then
      If cExecStep92.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep92.Abort
      End If
   End If

   If Not cExecStep93 Is Nothing Then
      If cExecStep93.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep93.Abort
      End If
   End If

   If Not cExecStep94 Is Nothing Then
      If cExecStep94.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep94.Abort
      End If
   End If

   If Not cExecStep95 Is Nothing Then
      If cExecStep95.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep95.Abort
      End If
   End If

   If Not cExecStep96 Is Nothing Then
      If cExecStep96.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep96.Abort
      End If
   End If

   If Not cExecStep97 Is Nothing Then
      If cExecStep97.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep97.Abort
      End If
   End If

   If Not cExecStep98 Is Nothing Then
      If cExecStep98.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep98.Abort
      End If
   End If

   If Not cExecStep99 Is Nothing Then
      If cExecStep99.ExecuteStep.ParentStepId =
cTermInstance.Step.ParentStepId Then
         cExecStep99.Abort
      End If
   End If

   Exit Sub

AbortSiblingsErr:
   Call LogErrors(Errors)
   On Error GoTo 0
   ShowError errAbortFailed
   ' Try to abort the remaining steps, if any
   Resume Next

End Sub
Private Sub ExecutionFailed(cTermStep As cRunStep)
   ' Called when execution of a step fails for any reason - ensure that
execution
   ' continues

   On Error GoTo ExecutionFailedErr

   Call AddFreeProcess(cTermStep.Index)

   Call RunBranch(mstrCurBranchRoot)

   Exit Sub

ExecutionFailedErr:
   ' Log the error code raised by Visual Basic - do not raise an error
here!
   Call LogErrors(Errors)

End Sub
Private Sub FreeExecStep(lngIndex As Long)
   ' Frees an instance of a cExecuteSM object depending on the index
   On Error GoTo FreeExecStepErr

   Select Case lngIndex + 1
      Case 1
         Set cExecStep1 = Nothing
      Case 2
         Set cExecStep2 = Nothing
      Case 3
         Set cExecStep3 = Nothing
      Case 4
         Set cExecStep4 = Nothing
      Case 5
         Set cExecStep5 = Nothing
      Case 6
         Set cExecStep6 = Nothing
      Case 7
         Set cExecStep7 = Nothing
      Case 8
         Set cExecStep8 = Nothing
      Case 9
         Set cExecStep9 = Nothing
      Case 10
         Set cExecStep10 = Nothing
      Case 11
         Set cExecStep11 = Nothing
```

```
Case 12
   Set cExecStep12 = Nothing
Case 13
   Set cExecStep13 = Nothing
Case 14
   Set cExecStep14 = Nothing
Case 15
   Set cExecStep15 = Nothing
Case 16
   Set cExecStep16 = Nothing
Case 17
   Set cExecStep17 = Nothing
Case 18
   Set cExecStep18 = Nothing
Case 19
   Set cExecStep19 = Nothing
Case 20
   Set cExecStep20 = Nothing
Case 21
   Set cExecStep21 = Nothing
Case 22
   Set cExecStep22 = Nothing
Case 23
   Set cExecStep23 = Nothing
Case 24
   Set cExecStep24 = Nothing
Case 25
   Set cExecStep25 = Nothing
Case 26
   Set cExecStep26 = Nothing
Case 27
   Set cExecStep27 = Nothing
Case 28
   Set cExecStep28 = Nothing
Case 29
   Set cExecStep29 = Nothing
Case 30
   Set cExecStep30 = Nothing
Case 31
   Set cExecStep31 = Nothing
Case 32
   Set cExecStep32 = Nothing
Case 33
   Set cExecStep33 = Nothing
Case 34
   Set cExecStep34 = Nothing
Case 35
   Set cExecStep35 = Nothing
Case 36
   Set cExecStep36 = Nothing
Case 37
   Set cExecStep37 = Nothing
Case 38
   Set cExecStep38 = Nothing
Case 39
   Set cExecStep39 = Nothing
Case 40
   Set cExecStep40 = Nothing
Case 41
   Set cExecStep41 = Nothing
Case 42
   Set cExecStep42 = Nothing
Case 43
   Set cExecStep43 = Nothing
Case 44
   Set cExecStep44 = Nothing
Case 45
   Set cExecStep45 = Nothing
Case 46
   Set cExecStep46 = Nothing
Case 47
   Set cExecStep47 = Nothing
Case 48
   Set cExecStep48 = Nothing
Case 49
   Set cExecStep49 = Nothing
Case 50
   Set cExecStep50 = Nothing
Case 51
   Set cExecStep51 = Nothing
Case 52
   Set cExecStep52 = Nothing
Case 53
   Set cExecStep53 = Nothing
Case 54
   Set cExecStep54 = Nothing
Case 55
   Set cExecStep55 = Nothing
Case 56
   Set cExecStep56 = Nothing
Case 57
   Set cExecStep57 = Nothing
Case 58
   Set cExecStep58 = Nothing
Case 59
   Set cExecStep59 = Nothing
Case 60
   Set cExecStep60 = Nothing
Case 61
   Set cExecStep61 = Nothing
Case 62
   Set cExecStep62 = Nothing
Case 63
   Set cExecStep63 = Nothing
Case 64
   Set cExecStep64 = Nothing
Case 65
   Set cExecStep65 = Nothing
Case 66
   Set cExecStep66 = Nothing
Case 67
   Set cExecStep67 = Nothing
Case 68
   Set cExecStep68 = Nothing
Case 69
   Set cExecStep69 = Nothing
Case 70
   Set cExecStep70 = Nothing
Case 71
   Set cExecStep71 = Nothing
Case 72
   Set cExecStep72 = Nothing
Case 73
   Set cExecStep73 = Nothing
Case 74
   Set cExecStep74 = Nothing
Case 75
   Set cExecStep75 = Nothing
Case 76
   Set cExecStep76 = Nothing
Case 77
   Set cExecStep77 = Nothing
Case 78
   Set cExecStep78 = Nothing
Case 79
   Set cExecStep79 = Nothing
Case 80
   Set cExecStep80 = Nothing
Case 81
   Set cExecStep81 = Nothing
```


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```
        Case 82
            Set cExecStep82 = Nothing
        Case 83
            Set cExecStep83 = Nothing
        Case 84
            Set cExecStep84 = Nothing
        Case 85
            Set cExecStep85 = Nothing
        Case 86
            Set cExecStep86 = Nothing
        Case 87
            Set cExecStep87 = Nothing
        Case 88
            Set cExecStep88 = Nothing
        Case 89
            Set cExecStep89 = Nothing
        Case 90
            Set cExecStep90 = Nothing
        Case 91
            Set cExecStep91 = Nothing
        Case 92
            Set cExecStep92 = Nothing
        Case 93
            Set cExecStep93 = Nothing
        Case 94
            Set cExecStep94 = Nothing
        Case 95
            Set cExecStep95 = Nothing
        Case 96
            Set cExecStep96 = Nothing
        Case 97
            Set cExecStep97 = Nothing
        Case 98
            Set cExecStep98 = Nothing
        Case 99
            Set cExecStep99 = Nothing
        Case Else
            BugAssert False, "FreeExecStep: Invalid index value!"
    End Select

    Exit Sub

FreeExecStepErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)

End Sub
Private Sub ProcessAskFailures()
    ' This procedure is called when a step with a continuation criteria =
Ask has failed.
    ' Wait for all running processes to complete before displaying an
Abort/Retry/Fail
    ' message to the user. We process every Ask step that has failed and
use a simple
    ' algorithm to determine what to do next.
    ' 1. An abort response to any failure results in an immediate abort of
the run
    ' 2. A continue means the run continues - this failure is popped off the
failure list.
    ' 3. A retry means that the execution details for the instance are
cleared and the
    '    step is re-executed.
    Dim lIndex As Long
    Dim cStepRec As cStep
    Dim cNextInst As cInstance
    Dim cFailureRec As cFailedStep

    On Error GoTo ProcessAskFailuresErr

    ' Display a popup message for all steps that have failed with a
continuation
    ' criteria of Ask
    For lIndex = mcFailures.Count - 1 To 0 Step -1

        Set cFailureRec = mcFailures(lIndex)

        If cFailureRec.ContCriteria = gintOnFailureAsk Then
            Set cStepRec = mcRunSteps.QueryStep(cFailureRec.StepId)
            ' Ask the user whether to abort/retry/continue
            #If RUN_ONLY Then
                cFailureRec.AskResponse = ShowMessageBox(0, _
                        "Step '" & GetStepNodeText(cStepRec) & "' failed. " & _
                        "Select Abort to abort run and Ignore to continue. " & _
                        "Select Retry to re-execute the failed step.", _
                        "Step Failure", _
                        MB_ABORTRETRYIGNORE + MB_APPLMODAL +
MB_ICONEXCLAMATION)
            #Else
                cFailureRec.AskResponse =
ShowMessageBox(frmRunning.hWnd, _
                        "Step '" & GetStepNodeText(cStepRec) & "' failed. " & _
                        "Select Abort to abort run and Ignore to continue. " & _
                        "Select Retry to re-execute the failed step.", _
                        "Step Failure", _
                        MB_ABORTRETRYIGNORE + MB_APPLMODAL +
MB_ICONEXCLAMATION)
            #End If

            ' Process an abort response immediately
            If cFailureRec.AskResponse = IDABORT Then
                mblnAbort = True
                Set cNextInst =
mcInstances.QueryInstance(cFailureRec.InstanceId)
                Call RunPendingSiblings(cNextInst, cFailureRec.EndTime)
                Exit For
            End If
        End If

    Next lIndex

    ' Process all failed steps for which we have Ignore and Retry
responses.
    If Not mblnAbort Then
        ' Navigate in reverse order since we'll be deleting items from the
collection
        For lIndex = mcFailures.Count - 1 To 0 Step -1
            If mcFailures(lIndex).ContCriteria = gintOnFailureAsk Then
                mblnAsk = False
                Set cFailureRec = mcFailures.Delete(lIndex)

                Select Case cFailureRec.AskResponse
                    Case IDABORT
                        BugAssert True

                    Case IDRETRY
                        ' Delete all instances for the failed step and re-try
                        ' Returns a parent instance reference
                        Set cNextInst = ProcessRetryStep(cFailureRec)
                        Call RunPendingStepInBranch(mstrCurBranchRoot,
cNextInst)

                    Case IDIGNORE
                        Set cNextInst =
mcInstances.QueryInstance(cFailureRec.InstanceId)
                        Call RunPendingSiblings(cNextInst,
cFailureRec.EndTime)

                End Select
            End If
```

```
        Next lIndex
    End If

    Exit Sub

ProcessAskFailuresErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    Err.Raise vbObjectError + errExecuteBranchFailed,
mstrModuleName, _
            LoadResString(errExecuteBranchFailed)

End Sub
Private Function ProcessRetryStep(cFailureRec As cFailedStep) As
cInstance
    ' This procedure is called when a step with a continuation criteria =
Ask has failed
    ' and the user wants to re-execute the step.
    ' We delete all existing instances for the step and reset the iterator, if
    ' any on the parent instance - this way we ensure that the step will be
executed
    ' in the next pass.
    Dim lIndex As Long
    Dim cParentInstance As cInstance
    Dim cSubStepRec As cSubStep
    Dim cStepRec As cStep

    On Error GoTo ProcessRetryStepErr

    ' Navigate in reverse order since we'll be deleting items from the
collection
    For lIndex = mcInstances.Count - 1 To 0 Step -1

        If mcInstances(lIndex).Step.StepId = cFailureRec.StepId Then
            Set cParentInstance =
mcInstances.QueryInstance(mcInstances(lIndex).ParentInstanceId)
            Set cSubStepRec =
cParentInstance.QuerySubStep(cFailureRec.StepId)
            Set cStepRec = mcRunSteps.QueryStep(cFailureRec.StepId)

            ' Decrement the child count on the parent instance and reset the
            ' step iterators on the sub-step record, if any -
            ' all the iterations of the step will be re-executed.
            cParentInstance.ChildDeleted cFailureRec.StepId
            cParentInstance.AllComplete = False
            cParentInstance.AllStarted = False

            cSubStepRec.InitializeIt cStepRec, mcParameters

            ' Now delete the current instance
            Set ProcessRetryStep = mcInstances.Delete(lIndex)
        End If
    Next lIndex

    Exit Function

ProcessRetryStepErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    Err.Raise vbObjectError + errExecuteBranchFailed,
mstrModuleName, _
            LoadResString(errExecuteBranchFailed)

End Function


Private Sub RunNextStep(ByVal dtmCompleteTime As Currency,
ByVal lngIndex As Long, _
        ByVal InstanceId As Long, ByVal ExecutionStatus As
InstanceStatus)

    ' Checks if there are any steps remaining to be
    ' executed in the current branch. If so, it executes
    ' the step.
    Dim cTermInstance As cInstance
    Dim cFailure As cFailedStep

    On Error GoTo RunNextStepErr

    BugMessage "RunNextStep: cExecStep" & CStr(lngIndex + 1) & "
has completed."

    Call mcTermSteps.Delete
    Call FreeExecStep(lngIndex)

    ' Call a procedure to add the freed up object to the list
    Call AddFreeProcess(lngIndex)

    Set cTermInstance = mcInstances.QueryInstance(InstanceId)
    cTermInstance.Status = ExecutionStatus

    If ExecutionStatus = gintFailed Then
        If cTermInstance.Step.ContinuationCriteria =
gintOnFailureAbortSiblings Then
            Call AbortSiblings(cTermInstance)
        End If

        If Not mcFailures.StepFailed(cTermInstance.Step.StepId) Then
            Set cFailure = New cFailedStep
            cFailure.InstanceId = cTermInstance.InstanceId
            cFailure.StepId = cTermInstance.Step.StepId
            cFailure.ParentStepId = cTermInstance.Step.ParentStepId
            cFailure.ContCriteria = cTermInstance.Step.ContinuationCriteria
            cFailure.EndTime = dtmCompleteTime
            mcFailures.Add cFailure
            Set cFailure = Nothing
        End If
    End If

    If ExecutionStatus = gintFailed And
cTermInstance.Step.ContinuationCriteria = gintOnFailureAbort Then
        If StringEmpty(msAbortDtls) Then
            ' Initialize the abort message
            msAbortDtls = "Step '" &
GetStepNodeText(cTermInstance.Step) & "' failed. " & _
                "Aborting execution. Please check the error file for details."
        End If
        Call Abort
    ElseIf ExecutionStatus = gintFailed And
cTermInstance.Step.ContinuationCriteria = gintOnFailureAsk Then
        mblnAsk = True

        ' If the step failed due to a Cancel operation (Abort), abort the run
        If mblnAbort Then
            Call RunPendingSiblings(cTermInstance, dtmCompleteTime)
        End If
    Else
        Call RunPendingSiblings(cTermInstance, dtmCompleteTime)
    End If

    If mblnAbort Then
        If Not AnyStepRunning(mcFreeSteps, mbarrFree) And Not
StringEmpty(msAbortDtls) Then
            ' Display an error only if the abort is due to a failure
            ' We had to abort since a step failed - since no other steps are
currently
            ' running, we can display a message to the user saying that we
had to abort
            #If RUN_ONLY Then
                Call ShowMessageBox(0, msAbortDtls, "Run Aborted", _
```

```
                MB_APPLMODAL + MB_OK +
MB_ICONEXCLAMATION)
        #Else
            Call ShowMessageBox(frmRunning.hWnd, msAbortDtls,
"Run Aborted", _
                MB_APPLMODAL + MB_OK +
MB_ICONEXCLAMATION)
        #End If
'           MsgBox msAbortDtls, vbOKOnly, "Run Aborted"
      End If
   ElseIf mblnAsk Then
      If Not AnyStepRunning(mcFreeSteps, mbarrFree) Then
         ' Ask the user whether to abort/retry/ignore failed steps
         Call ProcessAskFailures
      End If
   End If

   Exit Sub

RunNextStepErr:
   ' Log the error code raised by Visual Basic
   Call LogErrors(Errors)
   WriteError errExecuteBranchFailed, mstrSource
   Call ResetForm(lngIndex)

End Sub
Public Sub StopRun()

   ' Setting the Abort flag to True will ensure that we
   ' don't execute any more steps
   mblnAbort = True

End Sub

Private Sub CreateDummyInstance(strRootKey As String)

   Dim cNewInstance As cInstance
   Dim cSubStepDtls  As cStep
   Dim lngSubStepId As Long

   On Error GoTo CreateDummyInstanceErr

   ' Create a new instance of the step
   ' initialize substeps for the step
   Set cNewInstance = New cInstance

   ' There can be multiple iterations of the top level nodes
   ' running at the same time, but only one branch at any
   ' time - so enforce a degree of parallelism of 1 on this
   ' node!
   Set cNewInstance.Step = New cStep
   cNewInstance.DegreeParallelism = 1
   cNewInstance.Key = mstrDummyRootKey

   cNewInstance.InstanceId = NewInstanceId
   cNewInstance.ParentInstanceId = 0

   lngSubStepId = MakeIdentifierValid(strRootKey)

   Set cSubStepDtls = mcRunSteps.QueryStep(lngSubStepId)
   If cSubStepDtls.EnabledFlag Then
      ' Create a child node for the step corresponding to
      ' the root node of the branch being currently executed,
      ' only if it has been enabled
      Call cNewInstance.CreateSubStep(cSubStepDtls, mcParameters)
   End If

   mcInstances.Add cNewInstance
   Set cNewInstance.Iterators = DetermineIterators(cNewInstance)

   ' Set a reference to the newly created dummy instance
   Set mcDummyRootInstance = cNewInstance

   Set cNewInstance = Nothing

   Exit Sub

CreateDummyInstanceErr:
   ' Log the error code raised by Visual Basic
   Call LogErrors(Errors)
   On Error GoTo 0
   mstrSource = mstrModuleName & "CreateDummyInstance"
   Err.Raise vbObjectError + errCreateInstanceFailed, _
         mstrSource, LoadResString(errCreateInstanceFailed)

End Sub
Private Function CreateInstance(cExecStep As cStep, _
      cParentInstance As cInstance) As cInstance
   ' Creates a new instance of the passed in step. Returns
   ' a reference to the newly created instance object.

   Dim cNewInstance As cInstance
   Dim nodChild As cStep
   Dim lngSubStepId As Long

   On Error GoTo CreateInstanceErr

   ' Create a new instance of the step
   ' initialize substeps for the step
   Set cNewInstance = New cInstance
   Set cNewInstance.Step = cExecStep
   cNewInstance.Key = MakeKeyValid(cExecStep.StepId,
cExecStep.StepType)
   cNewInstance.ParentInstanceId = cParentInstance.InstanceId
   cNewInstance.InstanceId = NewInstanceId
   ' Validate the degree of parallelism field before assigning it to the
instance -
   ' (the parameter value might have been set to an invalid value at
runtime)
   Call ValidateParallelism(cExecStep.DegreeParallelism, _
         cExecStep.WorkspaceId, ParamsInWsp:=mcParameters)
   cNewInstance.DegreeParallelism =
SubstituteParameters(cExecStep.DegreeParallelism, _
         cExecStep.WorkspaceId, WspParameters:=mcParameters)

   If mcNavSteps.HasChild(StepKey:=cNewInstance.Key) Then
      Set nodChild =
mcNavSteps.ChildStep(StepKey:=cNewInstance.Key)
      Do
         If nodChild.EnabledFlag Then
            ' Create nodes for all it's substeps only
            ' if the substeps have been enabled
            Call cNewInstance.CreateSubStep(nodChild, mcParameters)
         End If

         Set nodChild = mcNavSteps.NextStep(StepId:=nodChild.StepId)
      Loop While (Not nodChild Is Nothing)
   End If

   mcInstances.Add cNewInstance
   Set cNewInstance.Iterators = DetermineIterators(cNewInstance)

   ' Increment the number of executing steps on the parent
   cParentInstance.ChildExecuted (cExecStep.StepId)

   Set CreateInstance = cNewInstance

   Exit Function

CreateInstanceErr:
```

```
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    On Error GoTo 0
    mstrSource = mstrModuleName & "CreateInstance"
    Err.Raise vbObjectError + errCreateInstanceFailed, _
          mstrSource, LoadResString(errCreateInstanceFailed)

End Function
Private Function DetermineIterators(cInstanceRec As cInstance) As
cRunColIt
    ' Returns a collection of all the iterator values for this
    ' instance - since an iterator that is defined at a
    ' particular level can be used in all it's substeps, we
    ' need to navigate the step tree all the way to the root

    Dim cRunIts As cRunColIt
    Dim cRunIt As cRunItNode
    Dim cStepIt As cIterator
    Dim cParentInst As cInstance
    Dim cSubStepRec As cSubStep
    Dim cSubStepDtls As cStep
    Dim lngSubStepId As Long
    Dim lngIndex As Long

    On Error GoTo DetermineIteratorsErr

    Set cRunIts = New cRunColIt

    If cInstanceRec.ParentInstanceId > 0 Then
        ' The last iterator for an instance of a step is stored
        ' on it's parent! So navigate up before beginning the
        ' search for iterator values.
        Set cParentInst =
mcInstances.QueryInstance(cInstanceRec.ParentInstanceId)

        ' Get the sub-step record for the current step
        ' on it's parent's instance!
        lngSubStepId = cInstanceRec.Step.StepId
        Set cSubStepRec = cParentInst.QuerySubStep(lngSubStepId)
        Set cSubStepDtls = mcRunSteps.QueryStep(lngSubStepId)

        ' And determine the next iteration value for the
        ' substep in this instance
        Set cStepIt = cSubStepRec.NewIteration(cSubStepDtls)

        If Not cStepIt Is Nothing Then
            ' Add the iterator details to the collection since
            ' an iterator has been defined for the step
            Set cRunIt = New cRunItNode
            cRunIt.IteratorName = cSubStepDtls.IteratorName
            cRunIt.Value = SubstituteParameters(cStepIt.Value,
cSubStepDtls.WorkspaceId, WspParameters:=mcParameters)
            cRunIt.StepId = cSubStepRec.StepId
            cRunIts.Push cRunIt
        End If

        ' Since the parent instance has all the iterators upto
        ' that level, read them and push them on to the stack for
        ' this instance
        For lngIndex = 0 To cParentInst.Iterators.Count - 1
            Set cRunIt = cParentInst.Iterators(lngIndex)
            cRunIts.Push cRunIt
        Next lngIndex
    End If

    Set DetermineIterators = cRunIts

    Exit Function

DetermineIteratorsErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    On Error GoTo 0
    mstrSource = mstrModuleName & "DetermineIterators"
    Err.Raise vbObjectError + errExecInstanceFailed, _
          mstrSource, LoadResString(errExecInstanceFailed)

End Function
Private Function DetermineConstraints(cInstanceRec As cInstance, _
        intConsType As ConstraintType) As Variant
    ' Returns a collection of all the constraints for this
    ' instance of the passed in type - all the constraints defined
    ' for the manager are executed first, followed by those defined
    ' for the step. If a step has an iterator defined for it, each
    ' constraint is executed only once.

    Dim cParentInst As cInstance
    Dim cTempInst As cInstance
    Dim vntConstraints As Variant
    Dim vntTempCons As Variant
    Dim cColConstraints() As Variant
    Dim lngConsCount As Long

    On Error GoTo DetermineConstraintsErr

    Set cTempInst = cInstanceRec
    lngConsCount = 0

    ' Go all the way to the root
    Do
        If cTempInst.ParentInstanceId > 0 Then
            Set cParentInst =
mcInstances.QueryInstance(cTempInst.ParentInstanceId)
        Else
            Set cParentInst = Nothing
        End If

        ' Check if the step has an iterator defined for it
        If cTempInst.ValidForIteration(cParentInst, intConsType) Then
            vntTempCons = mcRunConstraints.ConstraintsForStep( _
                  cTempInst.Step.StepId, cTempInst.Step.VersionNo, _
                  intConsType, blnSort:=True, _
                  blnGlobal:=False, blnGlobalConstraintsOnly:=False)

            If Not IsEmpty(vntTempCons) Then
                ReDim Preserve cColConstraints(lngConsCount)
                cColConstraints(lngConsCount) = vntTempCons
                lngConsCount = lngConsCount + 1
            End If
        End If

        Set cTempInst = cParentInst

    Loop While Not cTempInst Is Nothing

    If lngConsCount > 0 Then
        vntTempCons = OrderConstraints(cColConstraints, intConsType)
    End If

    DetermineConstraints = vntTempCons

    Exit Function

DetermineConstraintsErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    On Error GoTo 0
    mstrSource = mstrModuleName & "DetermineConstraints"
    Err.Raise vbObjectError + errExecInstanceFailed, _
          mstrSource, LoadResString(errExecInstanceFailed)
```

```
End Function
Private Function GetInstanceToExecute(cParentNode As cInstance, _
      cSubStepRec As cSubStep, _
      cSubStepDtls As cStep) As cInstance

   Dim cSubStepInst As cInstance

   On Error GoTo GetInstanceToExecuteErr

   BugAssert Not (cParentNode Is Nothing Or _
         cSubStepRec Is Nothing Or _
         cSubStepDtls Is Nothing), _
         "GetInstanceToExecute: Input invalid"

   ' Check if it has iterators
   If cSubStepDtls.IteratorCount = 0 Then
      ' Check if the step has been executed
      If cSubStepRec.TasksRunning = 0 And
cSubStepRec.TasksComplete = 0 And _
            Not
mcInstances.CompletedInstanceExists(cParentNode.InstanceId,
cSubStepDtls) Then
         ' The sub-step hasn't been executed yet.
         ' Create an instance for it and exit
         Set cSubStepInst = CreateInstance(cSubStepDtls, cParentNode)
      Else
         Set cSubStepInst = Nothing
      End If
   Else
      ' Check if there are pending iterations for the sub-step
      If Not cSubStepRec.NextIteration(cSubStepDtls) Is Nothing Then
         ' Pending iterations exist - create an instance for the sub-step and
exit
         Set cSubStepInst = CreateInstance(cSubStepDtls, cParentNode)
      Else
         ' No more iterations - continue with the next substep
         Set cSubStepInst = Nothing
      End If
   End If

   Set GetInstanceToExecute = cSubStepInst
   Exit Function

GetInstanceToExecuteErr:
   ' Log the error code raised by Visual Basic
   Call LogErrors(Errors)
   On Error GoTo 0
   mstrSource = mstrModuleName & "GetInstanceToExecute"
   Err.Raise vbObjectError + errNavInstancesFailed, _
         mstrSource, LoadResString(errNavInstancesFailed)

End Function

Public Function InstancesForStep(lngStepId As Long, ByRef StepStatus
As InstanceStatus) As cInstances
   ' Returns an array of all the instances for a step
   Dim lngIndex As Long
   Dim cTempInst As cInstance
   Dim cStepInstances As cInstances
   Dim cStepRec As cStep

   On Error GoTo InstancesForStepErr

   Set cStepInstances = New cInstances

   For lngIndex = 0 To mcInstances.Count - 1
      Set cTempInst = mcInstances(lngIndex)

      If cTempInst.Step.StepId = lngStepId Then
         cStepInstances.Add cTempInst
      End If
   Next lngIndex

   If cStepInstances.Count = 0 Then
      Set cStepRec = mcRunSteps.QueryStep(lngStepId)
      If Not mcFailures.ExecuteSubStep(cStepRec.ParentStepId) Then
         StepStatus = gintAborted
      End If
      Set cStepRec = Nothing
   End If

   ' Set the return value of the function to the array of
   ' constraints that has been built above
   Set InstancesForStep = cStepInstances

   Set cStepInstances = Nothing
   Exit Function

InstancesForStepErr:
   ' Log the error code raised by Visual Basic
   Call LogErrors(Errors)
   On Error GoTo 0
   mstrSource = mstrModuleName & "InstancesForStep"
   Err.Raise vbObjectError + errNavInstancesFailed, mstrSource, _
         LoadResString(errNavInstancesFailed)

End Function
Private Sub RemoveFreeProcess(lngRunningProcess As Long)
   ' Removes the passed in element from the collection of
   ' free objects

   ' Confirm that the last element in the array is the one
   ' we need to delete
   If mcFreeSteps(mcFreeSteps.Count - 1) = lngRunningProcess Then
      mcFreeSteps.Delete Position:=mcFreeSteps.Count - 1
   Else
      ' Ask the class to find the element and delete it
      mcFreeSteps.Delete Item:=lngRunningProcess
   End If

End Sub
Private Sub AddFreeProcess(lngTerminatedProcess As Long)
   ' Adds the passed in element to the collection of
   ' free objects

   mcFreeSteps.Add lngTerminatedProcess

End Sub

Private Sub ResetForm(Optional ByVal lngIndex As Long)

   Dim lngTemp As Long

   On Error GoTo ResetFormErr

   ' Check if there are any running instances to wait for
   If mcFreeSteps.Count <> glngNumConcurrentProcesses Then

      For lngTemp = 0 To mcFreeSteps.Count - 1
         If mcFreeSteps(lngTemp) = lngIndex Then
            Exit For
         End If
      Next lngTemp

      If lngTemp <= mcFreeSteps.Count - 1 Then
         ' This process that just completed did not exist in the list of
         ' free processes
         Call AddFreeProcess(lngIndex)
      End If
```

```
      If Not AnyStepRunning(mcFreeSteps, mbarrFree) Then
         WriteToWspLog (mintRunComplete)
         ' All steps are complete
         RaiseEvent RunComplete(Determine64BitTime())
      End If
   Else
      WriteToWspLog (mintRunComplete)
      RaiseEvent RunComplete(Determine64BitTime())
   End If

   Exit Sub

ResetFormErr:

End Sub
Private Function NewInstanceId() As Long
   ' Will return new instance id's - uses a static counter
   ' that it increments each time
   Static lngInstance As Long

   lngInstance = lngInstance + 1
   NewInstanceId = lngInstance

End Function

Private Function RunPendingStepInBranch(strCurBranchRoot As
String, _
      Optional cExecInstance As cInstance = Nothing) As cInstance
   ' Runs a worker step in the branch being executed, if
   ' there are any pending execution
   ' This function is also called when a step has just completed
   ' execution - in which case the terminated instance is
   ' passed in as the optional parameter. When that happens,
   ' we first try to execute the siblings of the terminated
   ' step if any are pending execution.
   ' If the terminated instance has not been passed in, we
   ' start with the dummy root instance and navigate down,
   ' trying to find a pending worker step.

   Dim cExecSubStep As cStep
   Dim cParentInstance As cInstance
   Dim cNextInst As cInstance

   On Error GoTo RunPendingStepInBranchErr

   If Not cExecInstance Is Nothing Then
      ' Called when an instance has terminated
      ' When a worker step terminates, then we need to
      ' decremement the number of running steps on it's
      ' manager
      Set cParentInstance = _
            mcInstances.QueryInstance(cExecInstance.ParentInstanceId)

   Else
      If StringEmpty(strCurBranchRoot) Or mcDummyRootInstance Is
Nothing Then
         ' Run complete - event raised by Run method
         Set RunPendingStepInBranch = Nothing
         Exit Function
      End If

      ' If there are no pending steps on the root instance,
      ' then there are no steps within the branch that need
      ' to be executed
      If mcDummyRootInstance.AllComplete Or
mcDummyRootInstance.AllStarted Then
         Set RunPendingStepInBranch = Nothing
         Exit Function
      End If
      Set cParentInstance = mcDummyRootInstance
   End If

   Do
      Set cNextInst = GetSubStepToExecute(cParentInstance)
      If cNextInst Is Nothing Then
         ' There are no steps within the branch that can
         ' be executed - If we are at the dummy instance,
         ' this branch has completed executing
         If cParentInstance.Key = mstrDummyRootKey Then
            Set cNextInst = Nothing
            Exit Do
         Else
            ' Go to the parent instance and try to find
            ' some other sibling is pending execution
            Set cNextInst =
mcInstances.QueryInstance(cParentInstance.ParentInstanceId)

            If cParentInstance.SubSteps.Count = 0 Then
               cNextInst.ChildTerminated cParentInstance.Step.StepId
            End If
         End If
      End If

      BugAssert Not cNextInst Is Nothing
      Set cParentInstance = cNextInst

   Loop While cNextInst.Step.StepType <> gintWorkerStep

   If Not cNextInst Is Nothing Then
      Call ExecuteStep(cNextInst)
   End If

   Set RunPendingStepInBranch = cNextInst

   Exit Function

RunPendingStepInBranchErr:
   ' Log the error code raised by Visual Basic
   Call LogErrors(Errors)
   On Error GoTo 0
   Err.Raise vbObjectError + errNavInstancesFailed, _
         mstrModuleName & "RunPendingStepInBranch",
LoadResString(errNavInstancesFailed)

End Function
Private Function RunPendingSibling(cTermInstance As cInstance, _
      dtmCompleteTime As Currency) As cInstance
   ' This process is called when a step terminates. Tries to
   ' run a sibling of the terminated step, if one is pending
   ' execution.

   Dim cParentInstance As cInstance
   Dim cNextInst As cInstance

   On Error GoTo RunPendingSiblingErr

   If StringEmpty(mstrCurBranchRoot) Or mcDummyRootInstance Is
Nothing Then
      ' Run complete - event raised by Run method
      Set RunPendingSibling = Nothing
      Exit Function
   End If

   BugAssert cTermInstance.ParentInstanceId > 0, "Orphaned instance
in array!"

   ' When a worker step terminates, then we need to
   ' decremement the number of running steps on it's
```

```
    ' manager
    Set cParentInstance =
mcInstances.QueryInstance(cTermInstance.ParentInstanceId)

    ' Decrement the number of running processes on the
    ' parent by 1
    Call cParentInstance.ChildTerminated(cTermInstance.Step.StepId)

    ' The first step that terminates has to be a worker
    ' If it is complete, update the completed steps on the
    ' parent by 1.
    Call cParentInstance.ChildCompleted(cTermInstance.Step.StepId)
    cParentInstance.AllStarted = False

    Do
        Set cNextInst = GetSubStepToExecute(cParentInstance,
dtmCompleteTime)
        If cNextInst Is Nothing Then
            If cParentInstance.Key = mstrDummyRootKey Then
                Set cNextInst = Nothing
                Exit Do
            Else
                ' Go to the parent instance and try to find
                ' some other sibling is pending execution
                Set cNextInst =
mcInstances.QueryInstance(cParentInstance.ParentInstanceId)
                If cParentInstance.IsRunning Then
                    cNextInst.AllStarted = True
                Else
                    ' No more sub-steps to execute
                    Call
cNextInst.ChildCompleted(cParentInstance.Step.StepId)
                    Call
cNextInst.ChildTerminated(cParentInstance.Step.StepId)
                    cNextInst.AllStarted = False
                End If
            End If
        End If

        BugAssert Not cNextInst Is Nothing
        Set cParentInstance = cNextInst

    Loop While cNextInst.Step.StepType <> gintWorkerStep

    If Not cNextInst Is Nothing Then
        Call ExecuteStep(cNextInst)
    End If

    Set RunPendingSibling = cNextInst

    Exit Function

RunPendingSiblingErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    On Error GoTo 0
    mstrSource = mstrModuleName & "RunPendingSibling"
    Err.Raise vbObjectError + errNavInstancesFailed, mstrSource, _
        LoadResString(errNavInstancesFailed)

End Function
Private Sub RunPendingSiblings(cTermInstance As cInstance, _
        dtmCompleteTime As Currency)
    ' This process is called when a step terminates. Tries to
    ' run siblings of the terminated step, if they are pending
    ' execution.

    Dim cExecInst As cInstance

    On Error GoTo RunPendingSiblingsErr

    BugMessage "In RunPendingSiblings"

    ' Call a procedure to run the sibling of the terminated
    ' step, if any. This procedure will also update the
    ' number of complete/running tasks on the manager steps.
    Set cExecInst = RunPendingSibling(cTermInstance,
dtmCompleteTime)

    If Not cExecInst Is Nothing Then
        Do
            ' Execute any other pending steps in the branch.
            ' The step that has just terminated might be
            ' the last one that was executing in a sub-branch.
            ' That would mean that we can execute another
            ' sub-branch that might involve more than 1 step.
            ' Pass the just executed step as a parameter.
            Set cExecInst = RunPendingStepInBranch(mstrCurBranchRoot,
cExecInst)
        Loop While Not cExecInst Is Nothing
    Else
        If Not mcDummyRootInstance.IsRunning Then
            ' All steps have been executed in the branch - run
            ' a new branch
            Call RunNewBranch
        Else
            ' There are no more steps to execute in the current
            ' branch but we have running processes.
        End If
    End If

    Exit Sub

RunPendingSiblingsErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    On Error GoTo 0
    mstrSource = mstrModuleName & "RunPendingSiblings"
    Err.Raise vbObjectError + errNavInstancesFailed, _
            mstrSource, LoadResString(errNavInstancesFailed)

End Sub

Private Sub NoSubStepsToExecute(cMgrInstance As cInstance,
Optional dtmCompleteTime As Currency = gdtmEmpty)
    ' Called when we cannot find any more substeps to run for
    ' manager step - set the allcomplete or allstarted
    ' properties to true

    If cMgrInstance.IsRunning() Then
        cMgrInstance.AllStarted = True
    Else
        cMgrInstance.AllComplete = True
        If dtmCompleteTime <> gdtmEmpty Then
            ' Update the end time on the manager step
            Call TimeCompleteUpdateForStep(cMgrInstance,
dtmCompleteTime)
        End If
    End If

End Sub

Private Function GetSubStepToExecute(cParentNode As cInstance, _
        Optional dtmCompleteTime As Currency = 0) As cInstance
    ' Returns the child of the passed in node that is to be
    ' executed next. Checks if we are in the middle of an instance
    ' being executed in which case it returns the pending
    ' instance. Creates a new instance if there are pending
    ' instances for a sub-step.

    Dim lngIndex As Long
```

```
    Dim cSubStepRec As cSubStep
    Dim cSubStepDtls As cStep
    Dim cSubStepInst As cInstance

    On Error GoTo GetSubStepToExecuteErr

    ' There are a number of cases that need to be accounted
    ' for here.
    ' 1. While traversing through all enabled nodes for the
    ' first time - instance records may not exist for the
    ' substeps.
    ' 2. Instance records exist, and there are processes
    ' that need to be executed for a sub-step
    ' 3. There are no more processes that need to be currently
    ' executed (till a process completes)
    ' 4. There are no more processes that need to be executed
    ' (All substeps have completed execution)

    ' This is the only point where we check the Abort flag -
    ' since this is the heart of the navigation routine that
    ' selects processes to execute. Also, when a step terminates
    ' selection of the next process goes through here.
    If mblnAbort Then
        Set GetSubStepToExecute = Nothing
        cParentNode.Status = gintAborted
        Exit Function
    End If

    If mblnAsk Then
        Set GetSubStepToExecute = Nothing
        Exit Function
    End If

    If Not mcFailures.ExecuteSubStep(cParentNode.Step.StepId) Then
        Set GetSubStepToExecute = Nothing
        cParentNode.Status = gintAborted
        Exit Function
    End If

    ' First check if there are pending steps for the parent!
    If cParentNode.IsPending Then
        ' Loop through all the sub-steps for the parent node
        For lngIndex = 0 To cParentNode.SubSteps.Count - 1
            Set cSubStepRec = cParentNode.SubSteps(lngIndex)
            Set cSubStepDtls =
mcRunSteps.QueryStep(cSubStepRec.StepId)
            If Not mcInstances.InstanceAborted(cSubStepRec) Then
                ' Check if the sub-step is a worker
                If cSubStepDtls.StepType = gintWorkerStep Then
                    ' Find/create an instance to execute
                    Set cSubStepInst = GetInstanceToExecute( _
                        cParentNode, cSubStepRec, cSubStepDtls)
                    If Not cSubStepInst Is Nothing Then
                        Exit For
                    Else
                        ' Continue w/ the next sub-step
                    End If
                Else
                    ' The sub-step is a manager step
                    ' Check if there are any pending instances for
                    ' the manager
                    Set cSubStepInst = mcInstances.QueryPendingInstance( _
                        cParentNode.InstanceId, cSubStepRec.StepId)
                    If cSubStepInst Is Nothing Then
                        ' Find/create an instance to execute
                        Set cSubStepInst = GetInstanceToExecute( _
                            cParentNode, cSubStepRec, cSubStepDtls)
                        If Not cSubStepInst Is Nothing Then
                            Exit For
                        Else
                            ' Continue w/ the next sub-step
                        End If
                    Else
                        ' We have found a pending instance for the
                        ' sub-step (manager) - exit the loop
                        Exit For
                    End If
                End If
            End If
        Next lngIndex

        If lngIndex > cParentNode.SubSteps.Count - 1 Or
cParentNode.SubSteps.Count = 0 Then
            ' If we could not find any sub-steps to execute,
            ' mark the parent node as complete/all started
            Call NoSubStepsToExecute(cParentNode, dtmCompleteTime)
            Set cSubStepInst = Nothing
        End If
    End If

    Set GetSubStepToExecute = cSubStepInst
    Exit Function

GetSubStepToExecuteErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    On Error GoTo 0
    mstrSource = mstrModuleName & "GetSubStepToExecute"
    Err.Raise vbObjectError + errNavInstancesFailed, mstrSource, _
        LoadResString(errNavInstancesFailed)

End Function

Private Sub TimeCompleteUpdateForStep(cMgrInstance As cInstance,
ByVal EndTime As Currency)

    ' Called when there are no more sub-steps to execute for
    ' the manager step. It updates the end time and status on
    ' the manager.
    Dim lElapsed As Long

    On Error GoTo TimeCompleteUpdateForStepErr

    If cMgrInstance.Key <> mstrDummyRootKey Then
        cMgrInstance.EndTime = EndTime
        cMgrInstance.Status = gintComplete
        lElapsed = (EndTime - cMgrInstance.StartTime) * 10000
        cMgrInstance.ElapsedTime = lElapsed
        RaiseEvent StepComplete(cMgrInstance.Step, EndTime,
cMgrInstance.InstanceId, lElapsed)
    End If

    Exit Sub

TimeCompleteUpdateForStepErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    WriteError errUpdateDisplayFailed, mstrModuleName &
"TimeCompleteUpdateForStep"

End Sub

Private Function GetFreeObject() As Long

    ' Check the array of free objects and retrieve the first one
    If mcFreeSteps.Count > 0 Then
        GetFreeObject = mcFreeSteps(mcFreeSteps.Count - 1)
    Else
        mstrSource = mstrModuleName & "GetFreeObject"
        ShowError errMaxProcessesExceeded
```

```
      On Error GoTo 0
      Err.Raise vbObjectError + errMaxProcessesExceeded, _
            mstrSource, _
            LoadResString(errMaxProcessesExceeded)
   End If

End Function
Private Function StepTerminated(cCompleteStep As cStep, ByVal
dtmCompleteTime As Currency, _
      ByVal lngIndex As Long, ByVal InstanceId As Long, ByVal
ExecutionStatus As InstanceStatus) As cStep
   ' This procedure is called whenever a step terminates.
   Dim cTermRec As cTermStep
   Dim cInstRec As cInstance
   Dim cStartInst As cInstance
   Dim lElapsed As Long
   Dim sLogLabel As String
   Dim LogLabels As New cVectorStr
   Dim iItIndex As Long

   On Error GoTo StepTerminatedErr

   Set cInstRec = mcInstances.QueryInstance(InstanceId)
   If dtmCompleteTime <> 0 And cInstRec.StartTime <> 0 Then
      ' Convert to milliseconds since that is the default precision
      lElapsed = (dtmCompleteTime - cInstRec.StartTime) * 10000
   Else
      lElapsed = 0
   End If

   Set cStartInst = cInstRec
   iItIndex = 0
   Do While cInstRec.Key <> mstrDummyRootKey
      sLogLabel = gstrSQ & cInstRec.Step.StepLabel & gstrSQ

      If iItIndex < cInstRec.Iterators.Count Then
         If cStartInst.Iterators(iItIndex).StepId = cInstRec.Step.StepId
Then
            sLogLabel = sLogLabel & msIt & gstrSQ &
cStartInst.Iterators(iItIndex).IteratorName & gstrSQ & _
                  msItValue & gstrSQ &
cStartInst.Iterators(iItIndex).Value & gstrSQ
            iItIndex = iItIndex + 1
         End If
      End If

      If cInstRec.Key = cStartInst.Key Then
         ' Append the execution status
         sLogLabel = sLogLabel & " Status: " & gstrSQ &
gsExecutionStatus(ExecutionStatus) & gstrSQ
         If ExecutionStatus = gintFailed Then
            ' Append the continuation criteria for the step since it failed
            sLogLabel = sLogLabel & " Continuation Criteria: " & gstrSQ
& gsContCriteria(cInstRec.Step.ContinuationCriteria) & gstrSQ
         End If
      End If
      LogLabels.Add sLogLabel

      Set cInstRec =
mcInstances.QueryInstance(cInstRec.ParentInstanceId)
   Loop

   Call WriteToWspLog(mintStepComplete, LogLabels,
dtmCompleteTime)
   Set LogLabels = Nothing

   ' Adds the terminated step details to a queue.
   Set cTermRec = New cTermStep
   cTermRec.ExecutionStatus = ExecutionStatus
   cTermRec.Index = lngIndex
   cTermRec.InstanceId = InstanceId
   cTermRec.TimeComplete = dtmCompleteTime
   Call mcTermSteps.Add(cTermRec)
   Set cTermRec = Nothing

   RaiseEvent StepComplete(cCompleteStep, dtmCompleteTime,
InstanceId, lElapsed)

   Exit Function

StepTerminatedErr:
   ' Log the error code raised by Visual Basic
   Call LogErrors(Errors)
   WriteError errExecuteBranchFailed, mstrSource
   Call ResetForm(lngIndex)

End Function
Public Property Let RootKey(ByVal vdata As String)

   mstrRootKey = vdata

End Property

Public Property Get RootKey() As String
   RootKey = mstrRootKey
End Property

Private Function InitExecStep() As cRunStep
   ' Since arrays of objects cannot be declared as WithEvents,
   ' we use a limited number of objects and set a maximum
   ' on the number of steps that can run in parallel
   ' This is a wrapper that will create an instance of
   ' a cExecuteSM object depending on the index
   Dim lngIndex As Long

   On Error GoTo InitExecStepErr

   lngIndex = GetFreeObject

   Select Case lngIndex + 1
      Case 1
         Set cExecStep1 = New cRunStep
         Set InitExecStep = cExecStep1
      Case 2
         Set cExecStep2 = New cRunStep
         Set InitExecStep = cExecStep2
      Case 3
         Set cExecStep3 = New cRunStep
         Set InitExecStep = cExecStep3
      Case 4
         Set cExecStep4 = New cRunStep
         Set InitExecStep = cExecStep4
      Case 5
         Set cExecStep5 = New cRunStep
         Set InitExecStep = cExecStep5
      Case 6
         Set cExecStep6 = New cRunStep
         Set InitExecStep = cExecStep6
      Case 7
         Set cExecStep7 = New cRunStep
         Set InitExecStep = cExecStep7
      Case 8
         Set cExecStep8 = New cRunStep
         Set InitExecStep = cExecStep8
      Case 9
         Set cExecStep9 = New cRunStep
         Set InitExecStep = cExecStep9
      Case 10
         Set cExecStep10 = New cRunStep
         Set InitExecStep = cExecStep10
```

```
Case 11
   Set cExecStep11 = New cRunStep
   Set InitExecStep = cExecStep11
Case 12
   Set cExecStep12 = New cRunStep
   Set InitExecStep = cExecStep12
Case 13
   Set cExecStep13 = New cRunStep
   Set InitExecStep = cExecStep13
Case 14
   Set cExecStep14 = New cRunStep
   Set InitExecStep = cExecStep14
Case 15
   Set cExecStep15 = New cRunStep
   Set InitExecStep = cExecStep15
Case 16
   Set cExecStep16 = New cRunStep
   Set InitExecStep = cExecStep16
Case 17
   Set cExecStep17 = New cRunStep
   Set InitExecStep = cExecStep17
Case 18
   Set cExecStep18 = New cRunStep
   Set InitExecStep = cExecStep18
Case 19
   Set cExecStep19 = New cRunStep
   Set InitExecStep = cExecStep19
Case 20
   Set cExecStep20 = New cRunStep
   Set InitExecStep = cExecStep20
Case 21
   Set cExecStep21 = New cRunStep
   Set InitExecStep = cExecStep21
Case 22
   Set cExecStep22 = New cRunStep
   Set InitExecStep = cExecStep22
Case 23
   Set cExecStep23 = New cRunStep
   Set InitExecStep = cExecStep23
Case 24
   Set cExecStep24 = New cRunStep
   Set InitExecStep = cExecStep24
Case 25
   Set cExecStep25 = New cRunStep
   Set InitExecStep = cExecStep25
Case 26
   Set cExecStep26 = New cRunStep
   Set InitExecStep = cExecStep26
Case 27
   Set cExecStep27 = New cRunStep
   Set InitExecStep = cExecStep27
Case 28
   Set cExecStep28 = New cRunStep
   Set InitExecStep = cExecStep28
Case 29
   Set cExecStep29 = New cRunStep
   Set InitExecStep = cExecStep29
Case 30
   Set cExecStep30 = New cRunStep
   Set InitExecStep = cExecStep30
Case 31
   Set cExecStep31 = New cRunStep
   Set InitExecStep = cExecStep31
Case 32
   Set cExecStep32 = New cRunStep
   Set InitExecStep = cExecStep32
Case 33
   Set cExecStep33 = New cRunStep
   Set InitExecStep = cExecStep33
Case 34
   Set cExecStep34 = New cRunStep
   Set InitExecStep = cExecStep34
Case 35
   Set cExecStep35 = New cRunStep
   Set InitExecStep = cExecStep35
Case 36
   Set cExecStep36 = New cRunStep
   Set InitExecStep = cExecStep36
Case 37
   Set cExecStep37 = New cRunStep
   Set InitExecStep = cExecStep37
Case 38
   Set cExecStep38 = New cRunStep
   Set InitExecStep = cExecStep38
Case 39
   Set cExecStep39 = New cRunStep
   Set InitExecStep = cExecStep39
Case 40
   Set cExecStep40 = New cRunStep
   Set InitExecStep = cExecStep40
Case 41
   Set cExecStep41 = New cRunStep
   Set InitExecStep = cExecStep41
Case 42
   Set cExecStep42 = New cRunStep
   Set InitExecStep = cExecStep42
Case 43
   Set cExecStep43 = New cRunStep
   Set InitExecStep = cExecStep43
Case 44
   Set cExecStep44 = New cRunStep
   Set InitExecStep = cExecStep44
Case 45
   Set cExecStep45 = New cRunStep
   Set InitExecStep = cExecStep45
Case 46
   Set cExecStep46 = New cRunStep
   Set InitExecStep = cExecStep46
Case 47
   Set cExecStep47 = New cRunStep
   Set InitExecStep = cExecStep47
Case 48
   Set cExecStep48 = New cRunStep
   Set InitExecStep = cExecStep48
Case 49
   Set cExecStep49 = New cRunStep
   Set InitExecStep = cExecStep49
Case 50
   Set cExecStep50 = New cRunStep
   Set InitExecStep = cExecStep50
Case 51
   Set cExecStep51 = New cRunStep
   Set InitExecStep = cExecStep51
Case 52
   Set cExecStep52 = New cRunStep
   Set InitExecStep = cExecStep52
Case 53
   Set cExecStep53 = New cRunStep
   Set InitExecStep = cExecStep53
Case 54
   Set cExecStep54 = New cRunStep
   Set InitExecStep = cExecStep54
Case 55
   Set cExecStep55 = New cRunStep
   Set InitExecStep = cExecStep55
Case 56
   Set cExecStep56 = New cRunStep
   Set InitExecStep = cExecStep56
Case 57
   Set cExecStep57 = New cRunStep
```

```
    Set InitExecStep = cExecStep57
  Case 58
    Set cExecStep58 = New cRunStep
    Set InitExecStep = cExecStep58
  Case 59
    Set cExecStep59 = New cRunStep
    Set InitExecStep = cExecStep59
  Case 60
    Set cExecStep60 = New cRunStep
    Set InitExecStep = cExecStep60
  Case 61
    Set cExecStep61 = New cRunStep
    Set InitExecStep = cExecStep61
  Case 62
    Set cExecStep62 = New cRunStep
    Set InitExecStep = cExecStep62
  Case 63
    Set cExecStep63 = New cRunStep
    Set InitExecStep = cExecStep63
  Case 64
    Set cExecStep64 = New cRunStep
    Set InitExecStep = cExecStep64
  Case 65
    Set cExecStep65 = New cRunStep
    Set InitExecStep = cExecStep65
  Case 66
    Set cExecStep66 = New cRunStep
    Set InitExecStep = cExecStep66
  Case 67
    Set cExecStep67 = New cRunStep
    Set InitExecStep = cExecStep67
  Case 68
    Set cExecStep68 = New cRunStep
    Set InitExecStep = cExecStep68
  Case 69
    Set cExecStep69 = New cRunStep
    Set InitExecStep = cExecStep69
  Case 70
    Set cExecStep70 = New cRunStep
    Set InitExecStep = cExecStep70
  Case 71
    Set cExecStep71 = New cRunStep
    Set InitExecStep = cExecStep71
  Case 72
    Set cExecStep72 = New cRunStep
    Set InitExecStep = cExecStep72
  Case 73
    Set cExecStep73 = New cRunStep
    Set InitExecStep = cExecStep73
  Case 74
    Set cExecStep74 = New cRunStep
    Set InitExecStep = cExecStep74
  Case 75
    Set cExecStep75 = New cRunStep
    Set InitExecStep = cExecStep75
  Case 76
    Set cExecStep76 = New cRunStep
    Set InitExecStep = cExecStep76
  Case 77
    Set cExecStep77 = New cRunStep
    Set InitExecStep = cExecStep77
  Case 78
    Set cExecStep78 = New cRunStep
    Set InitExecStep = cExecStep78
  Case 79
    Set cExecStep79 = New cRunStep
    Set InitExecStep = cExecStep79
  Case 80
    Set cExecStep80 = New cRunStep
    Set InitExecStep = cExecStep80
  Case 81
    Set cExecStep81 = New cRunStep
    Set InitExecStep = cExecStep81
  Case 82
    Set cExecStep82 = New cRunStep
    Set InitExecStep = cExecStep82
  Case 83
    Set cExecStep83 = New cRunStep
    Set InitExecStep = cExecStep83
  Case 84
    Set cExecStep84 = New cRunStep
    Set InitExecStep = cExecStep84
  Case 85
    Set cExecStep85 = New cRunStep
    Set InitExecStep = cExecStep85
  Case 86
    Set cExecStep86 = New cRunStep
    Set InitExecStep = cExecStep86
  Case 87
    Set cExecStep87 = New cRunStep
    Set InitExecStep = cExecStep87
  Case 88
    Set cExecStep88 = New cRunStep
    Set InitExecStep = cExecStep88
  Case 89
    Set cExecStep89 = New cRunStep
    Set InitExecStep = cExecStep89
  Case 90
    Set cExecStep90 = New cRunStep
    Set InitExecStep = cExecStep90
  Case 91
    Set cExecStep91 = New cRunStep
    Set InitExecStep = cExecStep91
  Case 92
    Set cExecStep92 = New cRunStep
    Set InitExecStep = cExecStep92
  Case 93
    Set cExecStep93 = New cRunStep
    Set InitExecStep = cExecStep93
  Case 94
    Set cExecStep94 = New cRunStep
    Set InitExecStep = cExecStep94
  Case 95
    Set cExecStep95 = New cRunStep
    Set InitExecStep = cExecStep95
  Case 96
    Set cExecStep96 = New cRunStep
    Set InitExecStep = cExecStep96
  Case 97
    Set cExecStep97 = New cRunStep
    Set InitExecStep = cExecStep97
  Case 98
    Set cExecStep98 = New cRunStep
    Set InitExecStep = cExecStep98
  Case 99
    Set cExecStep99 = New cRunStep
    Set InitExecStep = cExecStep99
  Case Else
    Set InitExecStep = Nothing
End Select

BugMessage "Sending cExecStep" & (lngIndex + 1) & "!"

If Not InitExecStep Is Nothing Then
  InitExecStep.Index = lngIndex

  ' Remove this element from the collection of free objects
  Call RemoveFreeProcess(lngIndex)
End If
```

```
   Exit Function

InitExecStepErr:
   ' Log the error code raised by Visual Basic
   Call LogErrors(Errors)
   Set InitExecStep = Nothing

End Function
Public Sub Run()
   ' Calls procedures to build a list of all the steps that
   ' need to be executed and to execute them
   ' Determines whether the run has started/terminated and
   ' raises the Run Start and Complete events.
   Dim cTempStep As cStep

   On Error GoTo RunErr

   If StringEmpty(mstrRootKey) Then
      Call ShowError(errExecuteBranchFailed)
      On Error GoTo 0
      Err.Raise vbObjectError + errExecuteBranchFailed,
mstrModuleName & "Run", _
            LoadResString(errExecuteBranchFailed)
   Else
      ' Execute the first branch
      WriteToWspLog (mintRunStart)
      RaiseEvent RunStart(Determine64BitTime(),
mcWspLog.FileName)

      If mcNavSteps.HasChild(StepKey:=mstrRootKey) Then
         Set cTempStep =
mcNavSteps.ChildStep(StepKey:=mstrRootKey)
         mstrCurBranchRoot = MakeKeyValid(cTempStep.StepId,
cTempStep.StepType)

         Call CreateDummyInstance(mstrCurBranchRoot)

         ' Run all pending steps in the branch
         If Not RunBranch(mstrCurBranchRoot) Then
            ' Execute a new branch if there aren't any
            ' steps to run
            Call RunNewBranch
         End If
      Else
         WriteToWspLog (mintRunComplete)
         ' No children to execute - the run is complete
         RaiseEvent RunComplete(Determine64BitTime())
      End If
   End If

   Exit Sub

RunErr:
   ' Log the error code raised by Visual Basic
   Call LogErrors(Errors)
   Call ShowError(errExecuteBranchFailed,
OptArgs:=mstrCurBranchRoot)
   Call ResetForm

End Sub
Private Sub RunNewBranch()
   ' We will build a tree of all instances that occur and
   ' the count of the sub-steps that are running will be
   ' stored at each node in the tree (maintained internally
   ' as an array). Since there can be multiple iterations
   ' of the top level nodes running at the same time, we
   ' create a dummy node at the root that keeps a record of
   ' the instances of the top level node.

   ' Determines whether the run has started/terminated and
   ' raises the Run Start and Complete events.
   Dim cNextStep As cStep
   Dim bRunComplete As Boolean

   On Error GoTo RunNewBranchErr

   bRunComplete = False

   Do
      If StringEmpty(mstrCurBranchRoot) Then
         Exit Do
'        On Error GoTo 0
'        Err.Raise vbObjectError + errExecuteBranchFailed, mstrSource,
_
'           LoadResString(errExecuteBranchFailed)
      Else
         Set cNextStep =
mcNavSteps.NextStep(StepKey:=mstrCurBranchRoot)
         If cNextStep Is Nothing Then
            mstrCurBranchRoot = gstrEmptyString
            bRunComplete = True
            Exit Do
         Else
            ' Starting execution of a new branch - initialize the
            ' module-level variable
            mstrCurBranchRoot = MakeKeyValid(cNextStep.StepId,
cNextStep.StepType)
            Call CreateDummyInstance(mstrCurBranchRoot)
         End If
      End If
      Debug.Print "Running new branch: " & mstrCurBranchRoot

   ' Loop until we find a branch that has steps to execute
   Loop While Not RunBranch(mstrCurBranchRoot)

   If bRunComplete Then
      WriteToWspLog (mintRunComplete)
      ' Run is complete
      RaiseEvent RunComplete(Determine64BitTime())
   End If

   Exit Sub

RunNewBranchErr:
   ' Log the error code raised by Visual Basic
   Call LogErrors(Errors)
   Call ShowError(errExecuteBranchFailed,
OptArgs:=mstrCurBranchRoot)
   On Error GoTo 0
   mstrSource = mstrModuleName & "RunNewBranch"
   Err.Raise vbObjectError + errExecuteBranchFailed, mstrSource, _
      LoadResString(errExecuteBranchFailed)

End Sub
Private Function RunBranch(strRootNode As String) As Boolean
   ' This procedure is called to run all the necessary steps
   ' in a branch. It can also be called when a step terminates,
   ' in which case the terminated step is passed in as the
   ' optional parameter. When a step terminates, we need to
   ' either wait for some other steps to terminate before
   ' we execute more steps or run as many steps as necessary
   ' Returns True if there are steps currently executing
   ' in the branch, else returns False
   Dim cRunning As cInstance

   On Error GoTo RunBranchErr

   If Not StringEmpty(strRootNode) Then
      ' Call a procedure to execute all the enabled steps
      ' in the branch - will return the step node that is
```

```
        ' being executed - nothing means 'No more steps to
        ' execute in the branch'.
        Do
            Set cRunning = RunPendingStepInBranch(strRootNode,
cRunning)

        Loop While Not cRunning Is Nothing

        RunBranch = mcDummyRootInstance.IsRunning
    End If

    Exit Function

RunBranchErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    On Error GoTo 0
    mstrSource = mstrModuleName & "RunBranch"
    Err.Raise vbObjectError + errExecuteBranchFailed, _
            mstrSource, LoadResString(errExecuteBranchFailed)

End Function
Private Sub TimeUpdateForProcess(StepRecord As cStep, _
        ByVal InstanceId As Long, _
        Optional ByVal StartTime As Currency = 0, _
        Optional ByVal EndTime As Currency = 0, _
        Optional ByVal ElapsedTime As Long = 0, _
        Optional Command As String)
    ' We do not maintain start and end timestamps for the constraint
    ' of a step. Hence we check if the process that just started/
    ' terminated is the worker step that is being executed. If so,
    ' we update the start/end time and status on the instance record.

    Dim cInstanceRec As cInstance
    Dim sItVal As String

    On Error GoTo TimeUpdateForProcessErr

    Set cInstanceRec = mcInstances.QueryInstance(InstanceId)

    If StartTime = 0 Then
        RaiseEvent ProcessComplete(StepRecord, EndTime, InstanceId,
ElapsedTime)
    Else
        sItVal = GetInstanceItValue(cInstanceRec)
        RaiseEvent ProcessStart(StepRecord, Command, StartTime,
InstanceId, _
                cInstanceRec.ParentInstanceId, sItVal)
    End If

    Call cInstanceRec.UpdateStartTime(StepRecord.StepId, StartTime,
EndTime, ElapsedTime)

    Exit Sub

TimeUpdateForProcessErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    WriteError errUpdateDisplayFailed, mstrModuleName &
"TimeUpdateForProcess"

End Sub
Private Sub TimeStartUpdateForStep(StepRecord As cStep, _
        ByVal InstanceId As Long, _
        ByVal StartTime As Currency)

    ' Called when a step starts execution. Checks if this is the
    ' first enabled child of the manager step. If so, updates
    ' the start time and status on the manager.
    ' Also raises the Step Start event for the completed step.

    Dim cStartInst As cInstance
    Dim cInstanceRec As cInstance
    Dim LogLabels As New cVectorStr
    Dim iItIndex As Long
    Dim sLogLabel As String
    Dim sPath As String
    Dim sIt As String
    Dim sItVal As String

    On Error GoTo TimeStartUpdateForStepErr

    Set cStartInst = mcInstances.QueryInstance(InstanceId)

    ' Determine the step path and iterator values for the step and raise a
step start event
    Set cInstanceRec = cStartInst
    Do While cInstanceRec.Key <> mstrDummyRootKey
        If Not StringEmpty(sPath) Then
            sPath = sPath & gstrFileSeparator
        End If
        sPath = sPath & gstrSQ & cInstanceRec.Step.StepLabel & gstrSQ
        Set cInstanceRec =
mcInstances.QueryInstance(cInstanceRec.ParentInstanceId)
    Loop

    For iItIndex = cStartInst.Iterators.Count - 1 To 0 Step -1
        If Not StringEmpty(sIt) Then
            sIt = sIt & gstrFileSeparator
        End If
        sIt = sIt & gstrSQ & cStartInst.Iterators(iItIndex).Value & gstrSQ
    Next iItIndex

    sItVal = GetInstanceItValue(cStartInst)
    RaiseEvent StepStart(StepRecord, StartTime, InstanceId,
cStartInst.ParentInstanceId, _
            sPath, sIt, sItVal)

    iItIndex = 0
    Set cInstanceRec = cStartInst
    ' Raise a StepStart event for the manager step, if this is it's first sub-
step being executed
    Do While cInstanceRec.Key <> mstrDummyRootKey

        sLogLabel = gstrSQ & cInstanceRec.Step.StepLabel & gstrSQ
        If iItIndex < cStartInst.Iterators.Count Then
            If cStartInst.Iterators(iItIndex).StepId =
cInstanceRec.Step.StepId Then
                sLogLabel = sLogLabel & msIt & gstrSQ &
cStartInst.Iterators(iItIndex).IteratorName & gstrSQ & _
                    msItValue & gstrSQ &
cStartInst.Iterators(iItIndex).Value & gstrSQ
                iItIndex = iItIndex + 1
            End If
        End If
        LogLabels.Add sLogLabel

        If cInstanceRec.Key <> cStartInst.Key And
cInstanceRec.StartTime = 0 Then
            cInstanceRec.StartTime = StartTime
            cInstanceRec.Status = gintRunning
            sItVal = GetInstanceItValue(cInstanceRec)
            ' The step path and iterator values are not needed for manager
steps, since
            ' they are primarily used by the run status form
            RaiseEvent StepStart(cInstanceRec.Step, StartTime,
cInstanceRec.InstanceId, _
                cInstanceRec.ParentInstanceId, gstrEmptyString,
gstrEmptyString, _
                sItVal)
```

```
      End If

      Set cInstanceRec =
mcInstances.QueryInstance(cInstanceRec.ParentInstanceId)
   Loop

   Call WriteToWspLog(mintStepStart, LogLabels, StartTime)
   Set LogLabels = Nothing

   Exit Sub

TimeStartUpdateForStepErr:
   ' Log the error code raised by Visual Basic
   Call LogErrors(Errors)
   WriteError errUpdateDisplayFailed, mstrModuleName &
"TimeStartUpdateForStep"

End Sub
Private Sub WriteToWspLog(iLogEvent As WspLogEvents, Optional
StepDtls As cVectorStr, _
      Optional dtStamp As Currency = gdtmEmpty)

   ' Writes to the workspace log that is generated for the run. The last
three
   ' parameters are valid only for Step Start and Step Complete events.
   Static bError As Boolean
   Dim sLabel As String
   Dim lIndex As Long
   Dim bHdr As Boolean
   Dim cTempConn As cConnection

   On Error GoTo WriteToWspLogErr

   Select Case iLogEvent
      Case mintRunStart
         Set mcWspLog = New cFileSM
         mcWspLog.FileName = GetDefaultDir(WspId, mcParameters)
& gstrFileSeparator & _
            Trim(Str(RunId)) & gstrFileSeparator & "SMLog-" &
Format(Now, FMT_WSP_LOG_FILE) & gstrLogFileSuffix
         mcWspLog.WriteLine
(JulianDateToString(Determine64BitTime()) & " Start Run: " & vbTab
& gstrSQ & GetWorkspaceDetails(WorkspaceId:=WspId)) & gstrSQ

         ' Write all current parameter values to the log
         bHdr = False
         For lIndex = 0 To mcParameters.ParameterCount - 1
            If mcParameters(lIndex).ParameterType <>
gintParameterApplication Then
               If Not bHdr Then
                  mcWspLog.WriteField
JulianDateToString(Determine64BitTime()) & " Parameters: "
                  bHdr = True
               Else
                  mcWspLog.WriteField vbTab & vbTab & vbTab
               End If
               mcWspLog.WriteLine vbTab & gstrSQ &
mcParameters(lIndex).ParameterName & gstrSQ & vbTab & vbTab &
gstrSQ & mcParameters(lIndex).ParameterValue & gstrSQ
            End If
         Next lIndex

         ' Write all connection properties to the log
         For lIndex = 0 To RunConnections.Count - 1
            Set cTempConn = RunConnections(lIndex)
            If lIndex = 0 Then
               mcWspLog.WriteField
JulianDateToString(Determine64BitTime()) & " Connections: "
            Else
               mcWspLog.WriteField vbTab & vbTab & vbTab
            End If
            mcWspLog.WriteLine vbTab & gstrSQ &
cTempConn.ConnectionName & gstrSQ & _
               vbTab & vbTab & gstrSQ &
cTempConn.ConnectionValue & gstrSQ & _
               vbTab & "No Count: " & gstrSQ &
cTempConn.NoCountDisplay & gstrSQ & gstrBlank & _
               "No Execute: " & gstrSQ & cTempConn.NoExecute &
gstrSQ & gstrBlank & _
               "Parse Query Only: " & gstrSQ &
cTempConn.ParseQueryOnly & gstrSQ & gstrBlank & _
               "Quoted Identifiers: " & gstrSQ &
cTempConn.QuotedIdentifiers & gstrSQ & gstrBlank & _
               "ANSI Nulls: " & gstrSQ & cTempConn.AnsiNulls &
gstrSQ & gstrBlank & _
               "Show Query Plan: " & gstrSQ &
cTempConn.ShowQueryPlan & gstrSQ & gstrBlank & _
               "Show Stats Time: " & gstrSQ &
cTempConn.ShowStatsTime & gstrSQ & gstrBlank & _
               "Show Stats IO: " & gstrSQ & cTempConn.ShowStatsIO
& gstrSQ & gstrBlank & _
               "Row Count" & gstrSQ & cTempConn.RowCount &
gstrSQ & gstrBlank & _
               "Query Timeout" & gstrSQ &
cTempConn.QueryTimeOut & gstrSQ
         Next lIndex

      Case mintRunComplete
         BugAssert Not mcWspLog Is Nothing
         mcWspLog.WriteLine
(JulianDateToString(Determine64BitTime()) & " Comp. Run: " &
vbTab & gstrSQ & GetWorkspaceDetails(WorkspaceId:=WspId)) &
gstrSQ
         Set mcWspLog = Nothing

      Case mintStepStart
         For lIndex = StepDtls.Count - 1 To 0 Step -1
            sLabel = StepDtls(lIndex)
            If lIndex = StepDtls.Count - 1 Then
               mcWspLog.WriteLine JulianDateToString(dtStamp) &
Start Step: " & vbTab & sLabel
            Else
               mcWspLog.WriteLine vbTab & vbTab & vbTab & vbTab
& sLabel
            End If
         Next lIndex

      Case mintStepComplete
         For lIndex = StepDtls.Count - 1 To 0 Step -1
            sLabel = StepDtls(lIndex)
            If lIndex = StepDtls.Count - 1 Then
               mcWspLog.WriteLine JulianDateToString(dtStamp) &
Comp. Step: " & vbTab & sLabel
            Else
               mcWspLog.WriteLine vbTab & vbTab & vbTab & vbTab
& sLabel
            End If
         Next lIndex

   End Select

   Exit Sub

WriteToWspLogErr:
   If Not bError Then
      bError = True
   End If

End Sub
```

```
'Private Sub WriteToWspLog(iLogEvent As WspLogEvents, Optional
StepDtls As cVectorStr, _
'       Optional dtStamp As Date = gdtmEmpty)
'
'   This function uses the LogWriter dll - memory corruption problems
since the vb exe
'   and the vc Execute Dll both use the same dll to write.
'    ' Writes to the workspace log that is generated for the run. The last
three
'    ' parameters are valid only for StepStart and StepComplete events.
'    Static bError As Boolean
'    Static sFile As String
'    Dim sLabel As String
'    Dim lIndex As Long
'    Dim bHdr As Boolean
'
'    On Error GoTo WriteToWspLogErr
'
'    Select Case iLogEvent
'       Case mintRunStart
'          Set mcWspLog = New LOGWRITERLib.SMLog
'          sFile = App.Path & "\" & "SMLog-" & Format(Now,
FMT_WSP_LOG_FILE) & gstrLogFileSuffix
'          mcWspLog.FileName = sFile
'          mcWspLog.Init
'          mcWspLog.WriteLine (Format(Now,
FMT_WSP_LOG_DATE) & " Start Run: " & vbTab & gstrSQ &
GetWorkspaceDetails(WorkspaceId:=WspId)) & gstrSQ
'
'          ' Write all current parameter values to the log
'          bHdr = False
'          For lIndex = 0 To mcParameters.ParameterCount - 1
'             If mcParameters(lIndex).ParameterType <>
gintParameterApplication Then
'                If Not bHdr Then
'                   'mcWspLog.WriteLine Format(Now,
FMT_WSP_LOG_DATE) & " Parameters: " & vbTab & gstrSQ &
mcParameters(lIndex).ParameterName & gstrSQ & vbTab & vbTab &
gstrSQ & mcParameters(lIndex).ParameterValue & gstrSQ
'                   bHdr = True
'                Else
'                   'mcWspLog.WriteLine vbTab & vbTab & vbTab &
vbTab & gstrSQ & mcParameters(lIndex).ParameterName & gstrSQ &
vbTab & vbTab & gstrSQ & mcParameters(lIndex).ParameterValue &
gstrSQ
'                End If
'             End If
'          Next lIndex
'
'       Case mintRunComplete
'          BugAssert Not mcWspLog Is Nothing
'          mcWspLog.WriteLine (Format(Now,
FMT_WSP_LOG_DATE) & " Comp. Run: " & vbTab & gstrSQ &
GetWorkspaceDetails(WorkspaceId:=WspId)) & gstrSQ
'          Set mcWspLog = Nothing
'
'       Case mintStepStart
'          For lIndex = StepDtls.Count - 1 To 0 Step -1
'             sLabel = StepDtls(lIndex)
'             If lIndex = StepDtls.Count - 1 Then
'                mcWspLog.WriteLine Format(dtStamp,
FMT_WSP_LOG_DATE) & " Start Step: " & vbTab & sLabel
'             Else
'                mcWspLog.WriteLine vbTab & vbTab & vbTab & vbTab
& sLabel
'             End If
'          Next lIndex
'
'       Case mintStepComplete
'          For lIndex = StepDtls.Count - 1 To 0 Step -1
'             sLabel = StepDtls(lIndex)
'             If lIndex = StepDtls.Count - 1 Then
'                mcWspLog.WriteLine Format(dtStamp,
FMT_WSP_LOG_DATE) & " Comp. Step: " & vbTab & sLabel
'             Else
'                mcWspLog.WriteLine vbTab & vbTab & vbTab & vbTab
& sLabel
'             End If
'          Next lIndex
'
'    End Select
'
'    Exit Sub
'
'WriteToWspLogErr:
'    If Not bError Then
'       bError = True
'    End If
'
'End Sub
'
Public Property Get WspPreExecution() As Variant
   WspPreExecution = mcvntWspPreCons
End Property
Public Property Let WspPreExecution(ByVal vdata As Variant)
   mcvntWspPreCons = vdata
End Property

Public Property Get WspPostExecution() As Variant
   WspPostExecution = mcvntWspPostCons
End Property
Public Property Let WspPostExecution(ByVal vdata As Variant)
   mcvntWspPostCons = vdata
End Property

Private Sub ExecuteStep(cCurStep As cInstance)
   ' Initializes a cRunStep object with all the properties
   ' corresponding to the step to be executed and calls it's
   ' execute method to execute the step

   Dim cExecStep As cRunStep

   On Error GoTo ExecuteStepErr
   mstrSource = mstrModuleName & "ExecuteStep"

   ' Confirm that the step is a worker
   If cCurStep.Step.StepType <> gintWorkerStep Then
      On Error GoTo 0
      Err.Raise vbObjectError + errExecInstanceFailed, mstrSource, _
            LoadResString(errExecInstanceFailed)
   End If

   Set cExecStep = InitExecStep()
   ' Exceeded the number of processes that we can run simultaneously
   If cExecStep Is Nothing Then
      ' Raise an error
      On Error GoTo 0
      Err.Raise vbObjectError + errProgramError, mstrSource, _
         LoadResString(errProgramError)
   End If
   ' Initialize the instance id - not needed for step execution
   ' but necessary to identify later which instance completed
   cExecStep.InstanceId = cCurStep.InstanceId

   Set cExecStep.ExecuteStep = cCurStep.Step
   Set cExecStep.Iterators = cCurStep.Iterators
   Set cExecStep.Globals = mcRunSteps
   Set cExecStep.WspParameters = mcParameters
   Set cExecStep.WspConnections = RunConnections
   Set cExecStep.WspConnDtls = RunConnDtls
```

```
    ' Initialize all the pre and post-execution constraints that
    ' have been defined globally for the workspace
    cExecStep.WspPreCons = mcvntWspPreCons
    cExecStep.WspPostCons = mcvntWspPostCons

    ' Initialize all the pre and post-execution constraints for
    ' the step being executed
    cExecStep.PreCons = DetermineConstraints(cCurStep, gintPreStep)
    cExecStep.PostCons = DetermineConstraints(cCurStep, gintPostStep)

    cExecStep.RunId = RunId
    cExecStep.CreateInputFiles = CreateInputFiles

    ' Call the execute method to execute the step
    cExecStep.Execute

    Set cExecStep = Nothing

    Exit Sub

ExecuteStepErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    On Error GoTo 0
    Call ExecutionFailed(cExecStep)

End Sub

Public Property Set Steps(cRunSteps As cArrSteps)

    Set mcRunSteps = cRunSteps
    Set mcNavSteps.StepRecords = cRunSteps

End Property
Public Property Set Parameters(cParameters As cArrParameters)
    ' A reference to the parameter array - we use it to
    ' substitute parameter values in the step text

    Set mcParameters = cParameters

End Property
Public Property Get Steps() As cArrSteps

    Set Steps = mcRunSteps

End Property
Public Property Get Constraints() As cArrConstraints

    Set Constraints = mcRunConstraints

End Property
Public Property Set Constraints(vdata As cArrConstraints)

    Set mcRunConstraints = vdata

End Property


Private Sub cExecStep1_ProcessComplete(cStepRecord As cStep, _
        dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

    Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub


Private Sub cExecStep1_ProcessStart(cStepRecord As cStep, _
        strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

    Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub


Private Sub cExecStep1_StepComplete(cStepRecord As cStep, _
        dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

    Call StepTerminated(cStepRecord, dtmEndTime, cExecStep1.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep1_StepStart(cStepRecord As cStep, _
        dtmStartTime As Currency, InstanceId As Long)

    Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep9_ProcessComplete(cStepRecord As cStep, _
        dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

    Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub


Private Sub cExecStep9_ProcessStart(cStepRecord As cStep, _
        strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

    Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub


Private Sub cExecStep9_StepComplete(cStepRecord As cStep, _
        dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

    Call StepTerminated(cStepRecord, dtmEndTime, cExecStep9.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep9_StepStart(cStepRecord As cStep, _
        dtmStartTime As Currency, InstanceId As Long)

    Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep10_ProcessComplete(cStepRecord As cStep, _
        dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

    Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)
```


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```
End Sub

Private Sub cExecStep10_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep10_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep10.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep10_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep11_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep11_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep11_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep11.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep11_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub
Private Sub cExecStep12_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep12_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep12_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep12.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep12_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub
Private Sub cExecStep13_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep13_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep13_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep13.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep13_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub
Private Sub cExecStep14_ProcessComplete(cStepRecord As cStep, _
```

```
    dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub


Private Sub cExecStep14_ProcessStart(cStepRecord As cStep, _
    strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub


Private Sub cExecStep14_StepComplete(cStepRecord As cStep, _
    dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep14.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep14_StepStart(cStepRecord As cStep, _
    dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub
Private Sub cExecStep15_ProcessComplete(cStepRecord As cStep, _
    dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub


Private Sub cExecStep15_ProcessStart(cStepRecord As cStep, _
    strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub


Private Sub cExecStep15_StepComplete(cStepRecord As cStep, _
    dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep15.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep15_StepStart(cStepRecord As cStep, _
    dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub
Private Sub cExecStep16_ProcessComplete(cStepRecord As cStep, _
    dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub


Private Sub cExecStep16_ProcessStart(cStepRecord As cStep, _
    strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub


Private Sub cExecStep16_StepComplete(cStepRecord As cStep, _
    dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep16.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep16_StepStart(cStepRecord As cStep, _
    dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub
Private Sub cExecStep17_ProcessComplete(cStepRecord As cStep, _
    dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub


Private Sub cExecStep17_ProcessStart(cStepRecord As cStep, _
    strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub


Private Sub cExecStep17_StepComplete(cStepRecord As cStep, _
    dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep17.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep17_StepStart(cStepRecord As cStep, _
    dtmStartTime As Currency, InstanceId As Long)
```

```
   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep18_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub


Private Sub cExecStep18_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub


Private Sub cExecStep18_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep18.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep18_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep19_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub


Private Sub cExecStep19_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub


Private Sub cExecStep19_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep19.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep19_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep20_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep20_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep20_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep20.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep20_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep21_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep21_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep21_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep21.Index,
InstanceId, Status)

End Sub
```


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```
Private Sub cExecStep21_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep22_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep22_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep22_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep22.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep22_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep23_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep23_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep23_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep23.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep23_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep24_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep24_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep24_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep24.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep24_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep25_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep25_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep25_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep25.Index,
InstanceId, Status)

End Sub
```


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```
Private Sub cExecStep25_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep26_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep26_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep26_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep26.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep26_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep27_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep27_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep27_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep27.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep27_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep28_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep28_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep28_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep28.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep28_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep29_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep29_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep29_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep29.Index,
InstanceId, Status)

End Sub
```

```
Private Sub cExecStep29_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep30_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep30_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep30_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep30.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep30_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep31_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep31_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep31_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep31.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep31_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep32_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep32_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep32_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep32.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep32_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep33_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep33_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep33_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep33.Index,
InstanceId, Status)

End Sub
```


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```
Private Sub cExecStep33_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep34_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep34_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep34_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep34.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep34_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep35_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep35_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep35_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep35.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep35_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep36_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep36_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep36_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep36.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep36_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep37_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep37_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep37_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep37.Index,
InstanceId, Status)

End Sub
```


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```
Private Sub cExecStep37_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep38_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep38_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep38_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep38.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep38_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep39_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep39_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep39_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep39.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep39_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep40_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep40_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep40_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep40.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep40_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep41_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep41_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep41_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep41.Index,
InstanceId, Status)

End Sub
```


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```
Private Sub cExecStep41_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep42_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep42_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep42_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep42.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep42_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep43_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep43_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep43_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep43.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep43_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep44_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep44_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep44_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep44.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep44_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep45_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep45_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep45_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep45.Index,
InstanceId, Status)

End Sub
```


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```
Private Sub cExecStep45_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep46_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep46_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep46_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep46.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep46_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep47_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep47_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep47_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep47.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep47_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep48_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep48_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep48_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep48.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep48_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep49_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep49_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep49_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep49.Index,
InstanceId, Status)

End Sub
```


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```
Private Sub cExecStep49_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep50_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep50_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep50_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep50.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep50_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep51_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep51_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep51_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep51.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep51_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep52_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep52_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep52_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep52.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep52_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep53_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep53_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep53_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep53.Index,
InstanceId, Status)

End Sub
```


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```
Private Sub cExecStep53_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep54_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep54_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep54_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep54.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep54_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep55_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep55_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep55_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep55.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep55_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep56_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep56_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep56_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep56.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep56_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep57_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep57_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep57_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep57.Index,
InstanceId, Status)

End Sub
```


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```
Private Sub cExecStep57_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep58_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep58_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep58_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep58.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep58_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep59_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep59_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep59_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep59.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep59_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep60_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep60_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep60_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep60.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep60_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep61_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep61_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep61_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep61.Index,
InstanceId, Status)

End Sub
```


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```
Private Sub cExecStep61_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep62_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep62_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep62_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep62.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep62_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep63_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep63_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep63_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep63.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep63_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep64_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep64_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep64_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep64.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep64_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep65_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep65_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep65_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep65.Index,
InstanceId, Status)

End Sub
```


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```
Private Sub cExecStep65_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep66_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep66_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep66_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep66.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep66_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep67_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep67_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep67_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep67.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep67_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep68_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep68_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep68_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep68.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep68_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep69_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep69_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep69_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep69.Index,
InstanceId, Status)

End Sub
```


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```
Private Sub cExecStep69_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep70_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep70_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep70_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep70.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep70_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep71_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep71_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep71_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep71.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep71_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep72_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep72_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep72_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep72.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep72_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep73_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep73_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep73_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep73.Index,
InstanceId, Status)

End Sub
```


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```
Private Sub cExecStep73_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep74_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep74_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep74_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep74.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep74_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep75_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep75_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep75_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep75.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep75_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep76_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep76_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep76_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep76.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep76_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep77_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep77_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep77_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep77.Index,
InstanceId, Status)

End Sub
```


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```
Private Sub cExecStep77_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep78_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep78_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep78_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep78.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep78_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep79_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep79_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep79_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep79.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep79_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep80_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep80_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep80_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep80.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep80_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep81_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep81_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep81_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep81.Index,
InstanceId, Status)

End Sub
```


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```
Private Sub cExecStep81_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep82_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep82_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep82_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep82.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep82_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep83_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep83_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep83_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep83.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep83_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep84_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep84_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep84_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep84.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep84_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep85_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep85_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep85_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep85.Index,
InstanceId, Status)

End Sub
```


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```
Private Sub cExecStep85_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep86_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep86_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep86_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep86.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep86_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep87_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep87_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep87_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep87.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep87_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep88_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep88_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep88_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep88.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep88_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep89_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep89_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep89_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep89.Index,
InstanceId, Status)

End Sub
```


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```
Private Sub cExecStep89_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep90_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep90_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep90_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep90.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep90_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep91_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep91_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep91_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep91.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep91_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep92_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep92_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep92_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep92.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep92_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep93_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep93_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep93_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep93.Index,
InstanceId, Status)

End Sub
```

```
Private Sub cExecStep93_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep94_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep94_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep94_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep94.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep94_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep95_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep95_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep95_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep95.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep95_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep96_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep96_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep96_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep96.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep96_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep97_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep97_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep97_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep97.Index,
InstanceId, Status)

End Sub
```


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```
Private Sub cExecStep97_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep98_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep98_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep98_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep98.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep98_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep99_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep99_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep99_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep99.Index,
InstanceId, Status)

End Sub

Private Sub cExecStep99_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep2_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep2_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub


Private Sub cExecStep2_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep2.Index,
_
         InstanceId, Status)

End Sub

Private Sub cExecStep2_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub


Private Sub cExecStep3_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep3_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub


Private Sub cExecStep3_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)
```

```
   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep3.Index,
_
        InstanceId, Status)

End Sub

Private Sub cExecStep3_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub


Private Sub cExecStep4_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep4_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep4_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep4.Index,
_
        InstanceId, Status)

End Sub


Private Sub cExecStep4_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep5_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep5_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep5_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep5.Index,
_
        InstanceId, Status)

End Sub

Private Sub cExecStep5_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep6_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep6_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep6_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep6.Index,
_
        InstanceId, Status)

End Sub

Private Sub cExecStep6_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep7_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep7_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)
```

```
End Sub

Private Sub cExecStep7_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep7.Index,
_
         InstanceId, Status)

End Sub

Private Sub cExecStep7_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub cExecStep8_ProcessComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
EndTime:=dtmEndTime, ElapsedTime:=lElapsed)

End Sub

Private Sub cExecStep8_ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long)

   Call TimeUpdateForProcess(cStepRecord, lngInstanceId,
StartTime:=dtmStartTime, Command:=strCommand)

End Sub

Private Sub cExecStep8_StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)

   Call StepTerminated(cStepRecord, dtmEndTime, cExecStep8.Index,
_
         InstanceId, Status)

End Sub

Private Sub cExecStep8_StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)

   Call TimeStartUpdateForStep(cStepRecord, InstanceId,
dtmStartTime)

End Sub

Private Sub Class_Initialize()

   Dim lngCount As Long
   Dim lngTemp As Long

   On Error GoTo InitializeErr

   Set mcFreeSteps = New cVectorLng
   ' Initialize the array of free objects with all elements
   ' for now
   For lngCount = 0 To glngNumConcurrentProcesses - 1 Step 1
      mcFreeSteps.Add lngCount
   Next lngCount

   ' Initialize a byte array with the number of free processes. It will
   ' be used later to determine if any step is running
   ' Each element in the array can represent 8 steps, 1 for each bit
   ReDim mbarrFree(glngNumConcurrentProcesses \ gintBitsPerByte)

   ' Initialize each element in the byte array w/ all 1's
   ' (upto glngNumConcurrentProcesses)
   For lngCount = LBound(mbarrFree) To UBound(mbarrFree) Step 1
      lngTemp = IIf( _
            glngNumConcurrentProcesses - (gintBitsPerByte * lngCount)
> gintBitsPerByte, _
            gintBitsPerByte, _
            glngNumConcurrentProcesses - (gintBitsPerByte *
lngCount))

      mbarrFree(lngCount) = (2 ^ lngTemp) - 1
   Next lngCount

   Set mcInstances = New cInstances
   Set mcFailures = New cFailedSteps
   Set mcNavSteps = New cStepTree
   Set mcTermSteps = New cTermSteps

   ' Initialize the Abort flag to False
   mblnAbort = False
   mblnAsk = False

   Exit Sub

InitializeErr:
   ' Log the error code raised by Visual Basic
   Call LogErrors(Errors)
   On Error GoTo 0
   Err.Raise vbObjectError + errInitializeFailed, mstrModuleName &
"Initialize", _
         LoadResString(errInitializeFailed)

End Sub
Private Sub Class_Terminate()

   On Error GoTo Class_TerminateErr

   mcFreeSteps.Clear
   Set mcFreeSteps = Nothing
   ReDim mbarrFree(0)

   mcInstances.Clear
   Set mcInstances = Nothing

   Set mcFailures = Nothing
   Set mcNavSteps = Nothing
   Set mcTermSteps = Nothing

   Exit Sub

Class_TerminateErr:
   Call LogErrors(Errors)

End Sub

Private Sub mcTermSteps_TermStepExists(cStepDetails As cTermStep)

   Call RunNextStep(cStepDetails.TimeComplete, cStepDetails.Index, _
         cStepDetails.InstanceId, cStepDetails.ExecutionStatus)

End Sub
```

cRunItDetails.cls

```
VERSION 1.0 CLASS
```

```
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cRunItDetails"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:       cRunItDetails.cls
'            Microsoft TPC-H Kit Ver. 1.00
'            Copyright Microsoft, 1999
'            All Rights Reserved
'
'
'  PURPOSE:     This module encapsulates the properties of iterator
values
'            that are used by the step being executed at runtime.
'  Contact:     Reshma Tharamal (reshmat@microsoft.com)
'

Option Explicit

' Used to indicate the source module name when errors
' are raised by this class
Private Const mstrModuleName As String = "cRunItDetails."
Private mstrSource As String

Private mstrIteratorName As String
Private mintType As ValueType
Private mlngSequence As Long
Private mlngFrom As Long
Private mlngTo As Long
Private mlngStep As Long
Private mstrValue As String

Public Property Get RangeTo() As Long

   RangeTo = mlngTo

End Property
Public Property Let RangeTo(ByVal vdata As Long)

   mlngTo = vdata

End Property

Public Property Get RangeFrom() As Long

   RangeFrom = mlngFrom

End Property
Public Property Get Sequence() As Long

   Sequence = mlngSequence

End Property

Public Property Get RangeStep() As Long

   RangeStep = mlngStep

End Property
Public Property Let RangeStep(vdata As Long)

   mlngStep = vdata

End Property

Public Property Let RangeFrom(ByVal vdata As Long)

   mlngFrom = vdata

End Property
Public Property Let Sequence(ByVal vdata As Long)

   mlngSequence = vdata

End Property

Public Property Get IteratorType() As ValueType

   IteratorType = mintType

End Property
Public Property Let IteratorType(ByVal vdata As ValueType)

   On Error GoTo TypeErr
   mstrSource = mstrModuleName & "Type"

   ' These constants have been defined in the enumeration,
   ' Type, which is exposed
   Select Case vdata
      Case gintFrom, gintTo, gintStep, gintValue
         mintType = vdata

      Case Else
         On Error GoTo 0
         Err.Raise vbObjectError + errTypeInvalid, _
            mstrSource, LoadResString(errTypeInvalid)
   End Select

   Exit Property

TypeErr:
   LogErrors Errors
   mstrSource = mstrModuleName & "Type"
   On Error GoTo 0
   Err.Raise vbObjectError + errTypeInvalid, _
      mstrSource, LoadResString(errTypeInvalid)

End Property
Private Sub IsList()

   If mintType <> gintValue Then
      On Error GoTo 0
      Err.Raise vbObjectError + errInvalidProperty, mstrSource, _
            LoadResString(errInvalidProperty)
   End If

End Sub
Private Sub IsRange()

   If mintType = gintValue Then
      On Error GoTo 0
      Err.Raise vbObjectError + errInvalidProperty, mstrSource, _
            LoadResString(errInvalidProperty)
   End If

End Sub

Public Property Get Value() As String

   Value = mstrValue

End Property
Public Property Let Value(vdata As String)

   mstrValue = vdata

End Property
```

```
Public Property Get IteratorName() As String

   IteratorName = mstrIteratorName

End Property
Public Property Let IteratorName(ByVal vdata As String)

   mstrIteratorName = vdata

End Property
```

cRunItNode.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cRunItNode"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
' An iterator class containing the properties that are used
' by the stpe being executed.
' These iterators might actually come from steps that are at
' a higher level than the step actually being executed (viz.
' direct ascendants of the step at any level).

Option Explicit

Public IteratorName As String
Public Value As String
Public StepId As Long
```

cRunOnly.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cRunOnly"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
Option Explicit

Public Event Done()
Private WithEvents mcRunWsp As cRunWorkspace
Attribute mcRunWsp.VB_VarHelpID = -1

Public WspName As String
Public WorkspaceId As Long
Public WspLog As String

Public Sub RunWsp()

   On Error GoTo RunWspErr

   Set mcRunWsp = New cRunWorkspace
   Set mcRunWsp.LoadDb = dbsAttTool
   mcRunWsp.WorkspaceId = WorkspaceId
   mcRunWsp.CreateInputFiles = True
   mcRunWsp.RunWorkspace

   Exit Sub

RunWspErr:
   ' Log the VB error code
   LogErrors Errors

End Sub

Private Sub mcRunWsp_RunComplete(dtmEndTime As Currency)

   MsgBox "Completed executing workspace: " & gstrSQ & WspName
& gstrSQ & " at " & _
         JulianDateToString(dtmEndTime) & "." & vbCrLf & vbCrLf &
_
         "The log file for the run is: " & gstrSQ & WspLog & gstrSQ &
"."
   RaiseEvent Done

End Sub

Private Sub mcRunWsp_RunStart(dtmStartTime As Currency,
strWspLog As String, lRunId As Long)
   WspLog = strWspLog
End Sub
```

cRunStep.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cRunStep"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:       cRunStep.cls
'              Microsoft TPC-H Kit Ver. 1.00
'              Copyright Microsoft, 1999
'              All Rights Reserved
'
'
'  PURPOSE:    This class executes the step that is assigned to the
'              ExecuteStep property. It executes the pre-execution
constraints
'              in sequence and then the step itself. At the end it executes
'              the post-execution constraints. Since these steps should always
'              be executed in sequence, each step is only fired on the
'              completion of the previous step.
'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

' Used to indicate the source module name when errors
' are raised by this class
Private Const mstrModuleName As String = "cRunStep."
Private mstrSource As String

' Local variable(s) to hold property value(s)
Private mcStep As cStep
Private mcGlobals As cArrSteps
Private mcvntWspPreCons As Variant
Private mcvntWspPostCons As Variant
Private mcvntPreCons As Variant
Private mcvntPostCons As Variant
Private mcIterators As cRunColIt
Private mlngInstanceId As Long ' Identifier for the current instance
Private mlngIndex As Long ' Index value for the current instance
Private mstrCommand As String ' The command string
Private msRunStepDtl As String ' Step text/file name that will go into
the run_step_details table
```

```
Private mblnAbort As Boolean   ' Set to True when the user aborts the
run
Private msOutputFile As String
Private msErrorFile As String
Private miStatus As InstanceStatus
Private mcVBErr As cVBErrorsSM
Public WspParameters As cArrParameters
Public WspConnections As cConnections
Public WspConnDtls As cConnDtls

Private WithEvents mcTermProcess As cTermProcess
Attribute mcTermProcess.VB_VarHelpID = -1
Public RunId As Long
Public CreateInputFiles As Boolean
Private msOutputDir As String

' Object that will execute the step
Private WithEvents mcExecObj As EXECUTEDLLLib.Execute
Attribute mcExecObj.VB_VarHelpID = -1

' Holds the step that is currently being executed (constraint or
' worker step)
Private mcExecStep As cStep

Private Const msCompareExe As String = "\diff.exe"

Private Enum NextNodeType
   mintWspPreConstraint = 1
   mintPreConstraint
   mintStep
   mintWspPostConstraint
   mintPostConstraint
End Enum

' Public events to notify the calling function of the
' start and end time for each step
Public Event StepStart(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long)
Public Event StepComplete(cStepRecord As cStep, _
      dtmEndTime As Currency, InstanceId As Long, Status As
InstanceStatus)
Public Event ProcessStart(cStepRecord As cStep, _
      strCommand As String, dtmStartTime As Currency, _
      InstanceId As Long)
Public Event ProcessComplete(cStepRecord As cStep, _
      dtmStartTime As Currency, InstanceId As Long, lElapsed As
Long)

Private Function AppendDiffErrors(sDiffFile As String)
   ' The file containing the errors generated by the diff utility is passed
in
   ' These errors are appended to the error file for the step

   Dim sTemp As String
   Dim InputFile As Integer

   If Not StringEmpty(sDiffFile) Then

      InputFile = FreeFile
      Open sDiffFile For Input Access Read As InputFile

      Do While Not EOF(InputFile)        ' Loop until end of file.
         Line Input #InputFile, sTemp    ' Read line into variable.
         mcVBErr.LogMessage sTemp
      Loop

      Close InputFile
   End If

End Function

Private Sub CreateStepTextFile()
   ' Creates a file containing the step text being executed
   On Error GoTo CreateStepTextFileErr

   Dim sInputFile As String

   If mcExecStep.ExecutionMechanism = gintExecuteShell Then
      sInputFile = GetOutputFile(gsCmdFileSuffix)
   Else
      sInputFile = GetOutputFile(gsSqlFileSuffix)
   End If

   ' Generate a file containing the step text being executed
   If Not StringEmpty(mcExecStep.StepTextFile) Or
mcExecStep.ExecutionMechanism = gintExecuteShell Then
      FileCopy mstrCommand, sInputFile
   Else
      Call WriteCommandToFile(mstrCommand, sInputFile)
   End If

   Exit Sub

CreateStepTextFileErr:

   mcVBErr.LogVBErrors

End Sub
Private Function GetOutputFile(strFileExt As String) As String
   ' This function generates the output file name for the step currently
being executed
   ' The value of the built-in parameter 'DefaultDir' is appended with the
run identifier
   ' for the file location
   ' The step label is used for the file name and a combination of all
iterator values
   ' for the step is used to make the output files unique for each instance
   Dim sFile As String
   Dim sIt As String
   Dim lIt As Long

   On Error GoTo GetOutputFileErr

   sFile = SubstituteParametersIfPossible(mcExecStep.StepLabel)

   sFile = TranslateStepLabel(sFile)

   If mcExecStep Is mcStep Then
      ' Use iterators that have been defined for the worker or any of it's
managers
      ' to make the error/log file unique for this instance
      For lIt = mcIterators.Count - 1 To 0 Step -1
         sIt = sIt & gsExtSeparator & mcIterators(lIt).Value
      Next lIt
   End If
   sIt = sIt & strFileExt

   ' Ensure that the length of the complete path does not exceed 255
characters
   If Len(msOutputDir) + Len(sFile) + Len(sIt) > MAX_PATH Then
      sFile = Mid(sFile, 1, MAX_PATH - Len(sIt) - Len(msOutputDir))
   End If
   GetOutputFile = msOutputDir & sFile & sIt
   Exit Function

GetOutputFileErr:

   ' Does not make sense to log error to the error file yet. Write to the
project
   ' log and return the step label as default
```

```
   GetOutputFile = mcExecStep.StepLabel & gsExtSeparator &
strFileExt

End Function


Private Sub HandleExecutionError()

   On Error GoTo HandleExecutionError

   ' Log the error code raised by Visual Basic
   miStatus = gintFailed
   mcVBErr.LogVBErrors
   Call mcVBErr.WriteError(errExecuteStepFailed, _
         OptArgs:="Continuation criteria for the step is: " &
gsContCriteria(mcStep.ContinuationCriteria))

HandleExecutionError:

   ' Logging failed - return

End Sub

Public Property Get Index() As Long

   Index = mlngIndex

End Property
Public Property Let Index(ByVal vdata As Long)

   mlngIndex = vdata

End Property
Private Function InitializeExecStatus() As InstanceStatus
   Dim sCompareFile As String

   On Error GoTo InitializeExecStatusErr

   InitializeExecStatus = mcExecObj.StepStatus

   If InitializeExecStatus = gintComplete Then
      If Not StringEmpty(mcExecStep.FailureDetails) Then
         ' Compare output to determine whether the step failed
         sCompareFile = GetShortName(SubstituteParameters( _
               mcExecStep.FailureDetails, mcExecStep.WorkspaceId,
mcIterators, _
               WspParameters))
         InitializeExecStatus = IIf(CompareOutput(sCompareFile,
msOutputFile), gintComplete, gintFailed)
      End If
   End If

   Exit Function

InitializeExecStatusErr:
   mcVBErr.LogVBErrors
'   Call LogErrors(Errors)
   InitializeExecStatus = mcExecObj.StepStatus

End Function
Private Function CompareOutput(sCompareFile As String, sOutputFile
As String) As Boolean

   Dim sCmpOutput As String
   Dim sDiffOutput As String

   On Error GoTo CompareOutputErr

   ' Create temporary files to store the file compare output and
   ' the errors generated by the compare function
   sCmpOutput = CreateTempFile()
   sDiffOutput = CreateTempFile()

   ' Run the compare utility and redirect it's output and errors
   SyncShell ("cmd /c " & _
         GetShortName(App.Path & msCompareExe) & gstrBlank & _
         sCompareFile & gstrBlank & sOutputFile & _
         " > " & sCmpOutput & " 2> " & sDiffOutput)

   If FileLen(sDiffOutput) > 0 Then
      ' The compare generated errors - append error msgs to the error file
      Call AppendDiffErrors(sDiffOutput)
      CompareOutput = False
   Else
      CompareOutput = (FileLen(sCmpOutput) = 0)
   End If

   If Not CompareOutput Then
      mcVBErr.WriteError errDiffFailed
   End If

   ' Delete the temporary files used to store the output of the compare
and
   ' the errors generated by the compare
   Kill sDiffOutput
   Kill sCmpOutput

   Exit Function

CompareOutputErr:
   mcVBErr.LogVBErrors
   CompareOutput = False

End Function
Public Property Get InstanceId() As Long

   InstanceId = mlngInstanceId

End Property
Public Property Let InstanceId(ByVal vdata As Long)

   mlngInstanceId = vdata

End Property

Private Function ExecuteConstraint(vntConstraints As Variant, _
      ByRef intLoopIndex As Integer) As Boolean

   ' Returns True if there is a constraint in the passed in
   ' array that remains to be executed

   If IsArray(vntConstraints) And Not IsEmpty(vntConstraints) Then
      ExecuteConstraint = (LBound(vntConstraints) <= intLoopIndex)
And (intLoopIndex <= UBound(vntConstraints))
   Else
      ExecuteConstraint = False
   End If

End Function
Private Function NextStep() As cStep

   ' Determines which is the next step to be executed - it could
   ' be either a pre-execution step, the worker step itself
   ' or a post-execution step

   Dim cConsRec As cConstraint
   Dim cNextStepRec As cStep
   Dim vntStepConstraints As Variant

   ' Static variable to remember exactly where we are in the
```

```
    ' processing
    Static intIndex As Integer
    Static intNextStepType As NextNodeType

    On Error GoTo NextStepErr

    If mblnAbort = True Then
        ' The user has aborted the run - do not run any more
        ' processes for the step
        Set NextStep = Nothing
        Exit Function
    End If

    If intNextStepType = 0 Then
        ' First time through this function - set the Index and
        ' node type to initial values
        intNextStepType = mintWspPreConstraint
        intIndex = 0
        RaiseEvent StepStart(mcStep, Determine64BitTime(),
mlngInstanceId)
    End If

    Do
        Select Case intNextStepType
            Case mintWspPreConstraint
                vntStepConstraints = mcvntWspPreCons

            Case mintPreConstraint
                vntStepConstraints = mcvntPreCons

            Case mintStep
                ' CONS:
                If mcStep.StepType = gintWorkerStep Then
                    Set cNextStepRec = mcStep
                End If

            Case mintWspPostConstraint
                vntStepConstraints = mcvntWspPostCons

            Case mintPostConstraint
                vntStepConstraints = mcvntPostCons

        End Select

        If intNextStepType <> mintStep Then
            ' Check if there is a constraint to be executed
            If ExecuteConstraint(vntStepConstraints, intIndex) Then
                ' Get the corresponding step record to be executed
                ' Query the global step record for the current
                ' constraint
                Set cConsRec = vntStepConstraints(intIndex)

                Set cNextStepRec =
mcGlobals.QueryStep(cConsRec.GlobalStepId)
                intIndex = intIndex + 1
            Else
                If intNextStepType = mintPostConstraint Then
                    ' No more stuff to be executed for the step
                    ' Raise a Done event
                    Set cNextStepRec = Nothing

                    ' Set the next step type to an invalid value
                    intNextStepType = -1
                Else
                    Call NextType(intNextStepType, intIndex)
                End If
            End If
        Else
            ' Increment the step type so we look at the post-
            ' execution steps the next time through
                Call NextType(intNextStepType, intIndex)
            End If

        Loop Until (Not cNextStepRec Is Nothing) Or _
            intNextStepType = -1

        Set NextStep = cNextStepRec

        Exit Function

NextStepErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    On Error GoTo 0
    mstrSource = mstrModuleName & "NextStep"
    Err.Raise vbObjectError + errNextStepFailed, mstrSource, _
        LoadResString(errNextStepFailed)

End Function
Public Sub Execute()
    ' This procedure is the method that executes the step that
    ' is assigned to the ExecuteStep property. It call a procedure
    ' to determine the next step to be executed.
    ' Then it initializes all the properties of the cExecuteSM object
    ' and calls it's run method to execute it.
    Dim cConn As cConnection
    Dim cRunConnDtl As cConnDtl

    On Error GoTo ExecuteErr

    ' If this procedure is called after a step has completed,
    ' we would have to check if we created any temporary files
    ' while executing that step
    If Not mcExecStep Is Nothing Then
        If Not StringEmpty(mcExecStep.StepTextFile) Or
mcExecStep.ExecutionMechanism = gintExecuteShell Then
            ' Remove the temporary file that we created while
            ' running this command
            Kill mstrCommand
        End If

        Call StepCompleted

        ' The VB errors class stores a reference to the Execute class since it
uses
        ' a method of the class to write errors to the error log. Hence,
        ' release all references to the Execute object before destroying it.
        Set mcVBErr.ErrorFile = Nothing
        Set mcExecObj = Nothing

        ' Delete empty output and error files (generated by shell
commands)
        ' (Can be done only after cleaning up cExecObj)
        Call DeleteEmptyOutputFiles
    Else
        ' First time through - initialize the location of output files
        msOutputDir = GetDefaultDir(mcStep.WorkspaceId,
WspParameters)
        msOutputDir = msOutputDir & gstrFileSeparator &
Trim(Str(RunId)) & gstrFileSeparator
        ' Dummy file since the function expects a file name
        MakePathValid (msOutputDir & "a.txt")
    End If

    ' Call a procedure to determine the next step to be executed
    ' - could be a constraint or the step itself
    ' Initialize a module-level variable to the step being
    ' executed
    Set mcExecStep = NextStep
    If mcExecStep Is Nothing Then
```


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```
      RaiseEvent StepComplete(mcStep, Determine64BitTime(),
mlngInstanceId, miStatus)
      ' No more stuff to execute
      Exit Sub
   End If

   Dim sStartDir As String

   Set mcExecObj = New EXECUTEDLLLib.Execute

   ' The VB errors class uses the WriteError method of the Execute class
to write
   ' all VB errors to the error file for the step (this prevents a clash when
the
   ' VB errors and Execution errors have to be written to the same log).
Hence, store
   ' a reference to the Execute object in mcVBErr
   msErrorFile = GetOutputFile(gsErrorFileSuffix)
   mcExecObj.ErrorFile = msErrorFile
   Call DeleteFile(msErrorFile, bCheckIfEmpty:=False)
   Set mcVBErr.ErrorFile = mcExecObj

   If mcExecStep.ExecutionMechanism = gintExecuteShell Then
      sStartDir = Trim$(GetShortName(SubstituteParameters( _
               mcExecStep.StartDir, mcExecStep.WorkspaceId,
mcIterators, WspParameters:=WspParameters)))
      ' Dummy connection object
      Set cConn = New cConnection
      Set cRunConnDtl = New cConnDtl
   Else
      ' Find the connection string value and substitute parameter values
in it
      Set cRunConnDtl =
WspConnDtls.GetConnectionDtl(mcExecStep.WorkspaceId,
mcExecStep.StartDir)
      Set cConn =
WspConnections.GetConnection(mcExecStep.WorkspaceId,
cRunConnDtl.ConnectionString)
      sStartDir = Trim$(SubstituteParameters(cConn.ConnectionValue,
_
            mcExecStep.WorkspaceId, mcIterators,
WspParameters:=WspParameters))
   End If

   msOutputFile = GetOutputFile(gsOutputFileSuffix)
   Call DeleteFile(msOutputFile, bCheckIfEmpty:=False)
   mcExecObj.OutputFile = msOutputFile
'   mcExecObj.LogFile = GetShortName(SubstituteParameters( _
'         mcExecStep.LogFile, mcExecStep.WorkspaceId, mcIterators,
WspParameters:=WspParameters))
   If mcExecStep.ExecutionMechanism = gintExecuteODBC And _
         cRunConnDtl.ConnType = ConnTypeDynamic Then
      Call mcExecObj.DoExecute(BuildCommandString(), sStartDir,
mcExecStep.ExecutionMechanism, _
            cConn.NoCountDisplay, cConn.NoExecute,
cConn.ParseQueryOnly, cConn.QuotedIdentifiers, _
            cConn.AnsiNulls, cConn.ShowQueryPlan,
cConn.ShowStatsTime, cConn.ShowStatsIO, _
            cConn.RowCount, cConn.QueryTimeOut, gstrEmptyString)
   Else
      Call mcExecObj.DoExecute(BuildCommandString(), sStartDir,
mcExecStep.ExecutionMechanism, _
            cConn.NoCountDisplay, cConn.NoExecute,
cConn.ParseQueryOnly, cConn.QuotedIdentifiers, _
            cConn.AnsiNulls, cConn.ShowQueryPlan,
cConn.ShowStatsTime, cConn.ShowStatsIO, _
            cConn.RowCount, cConn.QueryTimeOut,
mcExecStep.StartDir)
   End If

   Exit Sub

ExecuteErr:
   Call HandleExecutionError

   ' We can assume that if we are in this function, a StepStart event has
been triggered already.
   RaiseEvent StepComplete(mcStep, Determine64BitTime(),
mlngInstanceId, miStatus)

End Sub
Private Function BuildCommandString() As String
   ' Process text to be executed - either from the text
   ' field or read it from a file.
   ' This function will always return the command text for ODBC
commands
   ' and a file name for Shell commands
   Dim sFile As String
   Dim sCommand As String
   Dim sTemp As String

   On Error GoTo BuildCommandStringErr

   If Not StringEmpty(mcExecStep.StepTextFile) Then
      ' Substitute parameter values and environment variables
      ' in the filename
      msRunStepDtl = SubstituteParameters(mcExecStep.StepTextFile,
_
            mcExecStep.WorkspaceId, mcIterators,
WspParameters:=WspParameters)

      sFile = GetShortName(msRunStepDtl)

      mstrCommand = SubstituteParametersInText(sFile,
mcExecStep.WorkspaceId)

      If mcExecStep.ExecutionMechanism = gintExecuteODBC Then
         ' Read the contents of the file and pass it to ODBC
         BuildCommandString =
ReadCommandFromFile(mstrCommand)
      Else
         BuildCommandString = mstrCommand
      End If
   Else
      ' Substitute parameter values and environment variables
      ' in the step text
      msRunStepDtl = SubstituteParameters(mcExecStep.StepText, _
            mcExecStep.WorkspaceId, mcIterators,
WspParameters:=WspParameters)
      mstrCommand = msRunStepDtl

      If mcExecStep.ExecutionMechanism = gintExecuteShell Then
         ' Write the command to a temp file (enables us to execute
multiple
         ' commands via the command interpreter)
         mstrCommand = WriteCommandToFile(msRunStepDtl)
         BuildCommandString = mstrCommand
      Else
         BuildCommandString = SQLFixup(msRunStepDtl)
      End If
   End If

   If CreateInputFiles Then
      Call CreateStepTextFile
   End If

   Exit Function

BuildCommandStringErr:
   ' Log the error code raised by the Execute procedure
```

```
'    Call LogErrors(Errors)
   mcVBErr.LogVBErrors

   On Error GoTo 0
   mstrSource = mstrModuleName & "Execute"
   Err.Raise vbObjectError + errExecuteStepFailed, mstrSource, _
      LoadResString(errExecuteStepFailed) & mstrCommand

End Function
Public Sub Abort()

   On Error GoTo AbortErr

   ' Setting the Abort flag to True will ensure that we
   ' don't execute any more processes for this step
   mblnAbort = True

   If Not mcExecObj Is Nothing Then
      mcExecObj.Abort
   Else
      ' We are not in the middle of execution yet
   End If

   Exit Sub

AbortErr:
   Call LogErrors(Errors)
   On Error GoTo 0
   Err.Raise vbObjectError + errProgramError, _
      mstrModuleName & "Abort", _
      LoadResString(errProgramError)

End Sub
Private Sub NextType(ByRef StepType As NextNodeType, _
      ByRef Position As Integer)

   StepType = StepType + 1
   Position = 0

End Sub
Private Sub StepCompleted()

   On Error GoTo StepCompletedErr

   If Not mcExecStep Is Nothing Then
      If mcExecStep Is mcStep Then
         miStatus = InitializeExecStatus
         If miStatus = gintFailed Then
            ' Create input files if the step failed execution and one hasn't
been created already
            If Not CreateInputFiles Then CreateStepTextFile
            Call mcVBErr.WriteError(errExecuteStepFailed, _
                  OptArgs:="Continuation criteria for the step is: " &
gsContCriteria(mcStep.ContinuationCriteria))
         End If
      End If
   End If

   Exit Sub

StepCompletedErr:
   ' Log the error code raised by Visual Basic
   miStatus = gintFailed
   mcVBErr.LogVBErrors
   Call mcVBErr.WriteError(errExecuteStepFailed, _
         OptArgs:="Continuation criteria for the step is: " &
gsContCriteria(mcStep.ContinuationCriteria))

End Sub
Private Sub DeleteEmptyOutputFiles()

   On Error GoTo DeleteEmptyOutputFilesErr

   ' Delete empty output and error files
   If Not mcExecStep Is Nothing Then
      Call DeleteFile(msErrorFile, bCheckIfEmpty:=True)
      Call DeleteFile(msOutputFile, bCheckIfEmpty:=True)
   End If

   Exit Sub

DeleteEmptyOutputFilesErr:
   ' Not a critical error - continue

End Sub
Private Function ReadCommandFromFile(strFileName As String) As
String

   ' Returns the contents of the passed in file

   Dim sCommand As String
   Dim sTemp As String
   Dim InputFile As Integer

   On Error GoTo ReadCommandFromFileErr

   If Not StringEmpty(strFileName) Then

      InputFile = FreeFile
      Open strFileName For Input Access Read As InputFile

      Line Input #InputFile, sCommand ' Read line into variable.

      Do While Not EOF(InputFile) ' Loop until end of file.
         Line Input #InputFile, sTemp ' Read line into variable.
         sCommand = sCommand & vbCrLf & sTemp
      Loop

      Close InputFile
   End If

   ReadCommandFromFile = sCommand

   Exit Function

ReadCommandFromFileErr:

   ' Log the error code raised by Visual Basic
   Call LogErrors(Errors)
   mstrSource = mstrModuleName & "ReadCommandFromFile"
   On Error GoTo 0
   Err.Raise vbObjectError + errSubValuesFailed, _
         gstrSource, _
         LoadResString(errSubValuesFailed)

End Function
Private Function SubstituteParametersIfPossible(strLabel As String)

   On Error GoTo SubstituteParametersIfPossibleErr

   SubstituteParametersIfPossible = SubstituteParameters(strLabel, _
         mcExecStep.WorkspaceId, mcIterators,
WspParameters:=WspParameters)
   Exit Function

SubstituteParametersIfPossibleErr:
   SubstituteParametersIfPossible = strLabel

End Function
Private Function SubstituteParametersInText(strFileName As String, _
```


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```
        lngWorkspace As Long) As String

    ' Reads each line in the passed in file, substitutes parameter
    ' values in the line and writes out the modified line to a
    ' temporary file that we create. The temporary file will be
    ' removed once the step completes execution.
    ' Returns the name of the newly created temporary file.

    Dim strTempFile As String
    Dim strTemp As String
    Dim strOutput As String
    Dim InputFile As Integer
    Dim OutputFile As Integer

    On Error GoTo SubstituteParametersInTextErr

    strTempFile = CreateTempFile()

    If Not StringEmpty(strFileName) Then

        InputFile = FreeFile
        Open strFileName For Input Access Read As InputFile

        OutputFile = FreeFile
        Open strTempFile For Output Access Write As OutputFile

        Do While Not EOF(InputFile) ' Loop until end of file.
            Line Input #InputFile, strTemp ' Read line into variable.
            strOutput = SubstituteParameters(strTemp, lngWorkspace,
mcIterators, WspParameters:=WspParameters)

            If mcExecStep.ExecutionMechanism = gintExecuteODBC Then
strOutput = SQLFixup(strOutput)

            Print #OutputFile, strOutput
            BugMessage strOutput
        Loop

    End If

    Close InputFile
    Close OutputFile

    SubstituteParametersInText = strTempFile

    Exit Function

SubstituteParametersInTextErr:

    ' Log the error code raised by Visual Basic
'   Call LogErrors(Errors)
    mcVBErr.LogVBErrors
    mstrSource = mstrModuleName & "SubstituteParametersInText"
    On Error GoTo 0
    Err.Raise vbObjectError + errSubValuesFailed, _
            gstrSource, _
            LoadResString(errSubValuesFailed)

End Function

Private Function WriteCommandToFile(sCommand As String, Optional
sFile As String = gstrEmptyString) As String

    ' Writes the command text to a temporary file
    ' Returns the name of the temporary file

    Dim OutputFile As Integer

    On Error GoTo WriteCommandToFileErr

    If StringEmpty(sFile) Then
        sFile = CreateTempFile()
    End If

    OutputFile = FreeFile
    Open sFile For Output Access Write As OutputFile

    Print #OutputFile, sCommand

    Close OutputFile

    WriteCommandToFile = sFile

    Exit Function

WriteCommandToFileErr:

    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    mstrSource = mstrModuleName & "WriteCommandToFile"
    On Error GoTo 0
    Err.Raise vbObjectError + errSubValuesFailed, _
            gstrSource, _
            LoadResString(errSubValuesFailed)

End Function


Public Property Get WspPreCons() As Variant
    WspPreCons = mcvntWspPreCons
End Property
Public Property Let WspPreCons(ByVal vdata As Variant)
    mcvntWspPreCons = vdata
End Property

Public Property Get WspPostCons() As Variant
    WspPostCons = mcvntWspPostCons
End Property
Public Property Let WspPostCons(ByVal vdata As Variant)
    mcvntWspPostCons = vdata
End Property

Public Property Get PreCons() As Variant
    PreCons = mcvntPreCons
End Property
Public Property Let PreCons(ByVal vdata As Variant)
    mcvntPreCons = vdata
End Property

Public Property Get PostCons() As Variant
    PostCons = mcvntPostCons
End Property
Public Property Let PostCons(ByVal vdata As Variant)
    mcvntPostCons = vdata
End Property

Public Property Set Globals(cRunSteps As cArrSteps)

    Set mcGlobals = cRunSteps

End Property
Public Property Set ExecuteStep(cRunStep As cStep)

    Set mcStep = cRunStep

End Property
Public Property Get Globals() As cArrSteps

    Set Globals = mcGlobals
```

```
End Property
Public Property Get ExecuteStep() As cStep

   Set ExecuteStep = mcStep

End Property
Public Property Set Iterators(vdata As cRunColIt)

   Set mcIterators = vdata

End Property
Private Sub Class_Initialize()

   ' Initialize the Abort flag to False
   mblnAbort = False
   Set mcVBErr = New cVBErrorsSM
   Set mcTermProcess = New cTermProcess

End Sub

Private Sub Class_Terminate()

   On Error GoTo Class_TerminateErr

   Set mcExecObj = Nothing
   Set mcVBErr = Nothing
   Set mcTermProcess = Nothing

   Exit Sub

Class_TerminateErr:
   Call LogErrors(Errors)

End Sub

Private Sub mcExecObj_Start(ByVal StartTime As Currency)
   ' Raise an event indicating that the step has begun execution
   RaiseEvent ProcessStart(mcExecStep, msRunStepDtl, StartTime,
mlngInstanceId)
End Sub

Private Sub mcExecObj_Complete(ByVal EndTime As Currency,
ByVal Elapsed As Long)

   On Error GoTo mcExecObj_CompleteErr

   Debug.Print Elapsed
   RaiseEvent ProcessComplete(mcExecStep, EndTime,
mlngInstanceId, Elapsed)
   mcTermProcess.ProcessTerminated

   Exit Sub

mcExecObj_CompleteErr:
   Call LogErrors(Errors)

End Sub

Private Sub mcTermProcess_TermProcessExists()

   On Error GoTo TermProcessExistsErr

   ' Call a procedure to execute the next step, if any
   Call Execute

   Exit Sub

TermProcessExistsErr:
   ' Log the error code raised by the Execute procedure
   Call LogErrors(Errors)

End Sub
```

cRunWorkspace.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cRunWorkspace"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:       cRunWorkspace.cls
'              Microsoft TPC-H Kit Ver. 1.00
'              Copyright Microsoft, 1999
'              All Rights Reserved
'
'
'  PURPOSE:    This class loads all the information necessary to
'              execute a workspace and calls cRunInst to execute the
workspace.
'              It also propagates Step start and complete and
'              Run start and complete events.
'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

' Used to indicate the source module name when errors
' are raised by this module
Private Const mstrModuleName As String = "cRunWorkspace."
Private mstrSource As String

Private mcRunSteps As cArrSteps
Private mcRunParams As cArrParameters
Private mcRunConstraints As cArrConstraints
Private mcRunConnections As cConnections
Private mcRunConnDtls As cConnDtls
Private mcvntWspPreCons As Variant
Private mcvntWspPostCons As Variant
Private mdbsLoadDb As Database
Private mlngRunId As Long
Private mlngWorkspaceId As Long
Private mField As cStringSM
Public CreateInputFiles As Boolean

Private WithEvents mcRun As cRunInst
Attribute mcRun.VB_VarHelpID = -1

Public Event RunStart(dtmStartTime As Currency, strWspLog As
String, lRunId As Long)
Public Event RunComplete(dtmEndTime As Currency)
Public Event StepStart(cStepRecord As cStep, dtmStartTime As
Currency, lngInstanceId As Long, _
      sPath As String, sIts As String)
Public Event StepComplete(cStepRecord As cStep, dtmEndTime As
Currency, lngInstanceId As Long)
Public Event ProcessStart(cStepRecord As cStep, strCommand As
String, _
      dtmStartTime As Currency, lngInstanceId As Long)
Public Event ProcessComplete(cStepRecord As cStep, dtmEndTime As
Currency, lngInstanceId As Long)
Public Function InstancesForStep(lngStepId As Long, iStatus As
InstanceStatus) As cInstances
   ' Returns an array of all the instances for a step

   If mcRun Is Nothing Then
      Set InstancesForStep = Nothing
   Else
```

```
        Set InstancesForStep = mcRun.InstancesForStep(lngStepId,
iStatus)
    End If

End Function
Private Sub InsertRunDetail(cStepRecord As cStep, _
        strCommand As String, dtmStartTime As Currency, _
        lngInstanceId As Long, lParentInstanceId As Long, sItValue As
String)
    ' Inserts a new run detail record into the database

    Dim strInsert As String
    Dim qy As QueryDef

    On Error GoTo InsertRunDetailErr
    mstrSource = mstrModuleName & "InsertRunDetail"

    strInsert = "insert into run_step_details " & _
            "( run_id, step_id, version_no, instance_id, parent_instance_id, "
& _
            " command, start_time, iterator_value ) " & _
            " values ( "

#If USE_JET Then

    strInsert = strInsert & " [r_id], [s_id], [ver_no], [i_id], [p_i_id], " & _
            " [com], [s_date], [it_val] )"

    Set qy = mdbsLoadDb.CreateQueryDef( _
            gstrEmptyString, strInsert)

    ' Call a procedure to assign the Querydef parameters
    Call AssignParameters(qy, StartTime:=dtmStartTime, _
            StepId:=cStepRecord.StepId, _
            Version:=cStepRecord.VersionNo, _
            InstanceId:=lngInstanceId, _
            Command:=strCommand)

    qy.Execute dbFailOnError
    qy.Close

#Else

    strInsert = strInsert & Str(mlngRunId) _
        & ", " & Str(cStepRecord.StepId) _
        & ", " & mField.MakeStringFieldValid(cStepRecord.VersionNo) _
        & ", " & Str(lngInstanceId) _
        & ", " & Str(lParentInstanceId) _
        & ", " & mField.MakeStringFieldValid(strCommand) _
        & ", " & Str(dtmStartTime) _
        & ", " & mField.MakeStringFieldValid(sItValue)

    strInsert = strInsert & " ) "

    mdbsLoadDb.Execute strInsert, dbFailOnError

#End If

    Exit Sub

InsertRunDetailErr:
    LogErrors Errors
    mstrSource = mstrModuleName & "InsertRunDetail"
    On Error GoTo 0
    Err.Raise vbObjectError + errUpdateRunDataFailed, _
            mstrSource, _
            LoadResString(errUpdateRunDataFailed)

End Sub
Private Sub UpdateRunDetail(cStepRecord As cStep, _
        dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)
    ' Updates the run detail record in the database

    Dim strUpdate As String
    Dim qy As QueryDef

    On Error GoTo UpdateRunDetailErr

    strUpdate = "update run_step_details " & _
            " set end_time = [e_date], elapsed_time = [elapsed] " & _
            " where run_id = [r_id] " & _
            " and step_id = [s_id] " & _
            " and version_no = [ver_no] " & _
            " and instance_id = [i_id] "

    Set qy = mdbsLoadDb.CreateQueryDef( _
            gstrEmptyString, strUpdate)

    ' Call a procedure to assign the Querydef parameters
    Call AssignParameters(qy, EndTime:=dtmEndTime, _
            StepId:=cStepRecord.StepId, _
            Version:=cStepRecord.VersionNo, _
            InstanceId:=lngInstanceId, Elapsed:=lElapsed)

    qy.Execute dbFailOnError
    qy.Close

    Exit Sub

UpdateRunDetailErr:
    LogErrors Errors
    mstrSource = mstrModuleName & "UpdateRunDetail"
    On Error GoTo 0
    Err.Raise vbObjectError + errUpdateRunDataFailed, _
            mstrSource, _
            LoadResString(errUpdateRunDataFailed)

End Sub
Private Function InsertRunHeader(dtmStartTime As Currency) As Long
    ' Inserts a new run header record into the database
    ' and returns the id for the run

    Dim strInsert As String
    Dim qy As QueryDef

    On Error GoTo InsertRunHeaderErr

    strInsert = "insert into run_header " & _
        "( run_id, workspace_id, start_time ) " & _
        " values ( " & _
        " [r_id], [w_id], [s_date] )"

    Set qy = mdbsLoadDb.CreateQueryDef( _
            gstrEmptyString, strInsert)

    ' Call a procedure to execute the Querydef object
    Call AssignParameters(qy, StartTime:=dtmStartTime)

    qy.Execute dbFailOnError
    qy.Close

    InsertRunHeader = mlngRunId
    Exit Function

InsertRunHeaderErr:
    LogErrors Errors
    mstrSource = mstrModuleName & "InsertRunHeader"
    On Error GoTo 0
    Err.Raise vbObjectError + errUpdateRunDataFailed, _
```


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```
        mstrSource, _
        LoadResString(errUpdateRunDataFailed)

End Function
Private Sub InsertRunParameters(dtmStartTime As Currency)
   ' Inserts a new run header record into the database
   ' and returns the id for the run

   Dim strInsert As String
   Dim qy As QueryDef
   Dim cParamRec As cParameter
   Dim lngIndex As Long

   On Error GoTo InsertRunParametersErr

   strInsert = "insert into run_parameters " & _
      "( run_id, parameter_name, parameter_value ) " & _
      " values ( " & _
      " [r_id], [p_name], [p_value] )"

   Set qy = mdbsLoadDb.CreateQueryDef( _
         gstrEmptyString, strInsert)
   qy.Parameters("r_id").Value = mlngRunId

   For lngIndex = 0 To mcRunParams.ParameterCount - 1
      Set cParamRec = mcRunParams(lngIndex)

      qy.Parameters("p_name").Value = cParamRec.ParameterName
      qy.Parameters("p_value").Value = cParamRec.ParameterValue
      qy.Execute dbFailOnError

   Next lngIndex

   qy.Close

   Exit Sub

InsertRunParametersErr:
   LogErrors Errors
   mstrSource = mstrModuleName & "InsertRunParameters"
   On Error GoTo 0
   Err.Raise vbObjectError + errUpdateRunDataFailed, _
         mstrSource, _
         LoadResString(errUpdateRunDataFailed)

End Sub
Private Sub AssignParameters(qyExec As DAO.QueryDef, _
      Optional StartTime As Currency = 0, _
      Optional EndTime As Currency = 0, _
      Optional StepId As Long = 0, _
      Optional Version As String = gstrEmptyString, _
      Optional InstanceId As Long = 0, _
      Optional ParentInstanceId As Long = 0, _
      Optional Command As String = gstrEmptyString, _
      Optional Elapsed As Long = 0, _
      Optional ItValue As String = gstrEmptyString)
   ' Assigns values to the parameters in the querydef object

   Dim prmParam As DAO.Parameter

   On Error GoTo AssignParametersErr
   mstrSource = mstrModuleName & "AssignParameters"

   For Each prmParam In qyExec.Parameters
      Select Case prmParam.Name
         Case "[w_id]"
            prmParam.Value = mlngWorkspaceId

         Case "[r_id]"
            prmParam.Value = mlngRunId

         Case "[s_id]"
            BugAssert StepId <> 0
            prmParam.Value = StepId

         Case "[ver_no]"
            BugAssert Not StringEmpty(Version)
            prmParam.Value = Version

         Case "[i_id]"
            BugAssert InstanceId <> 0
            prmParam.Value = InstanceId

         Case "[p_i_id]"
            prmParam.Value = ParentInstanceId

         Case "[com]"
            BugAssert Not StringEmpty(Command)
            prmParam.Value = Command

         Case "[s_date]"
            BugAssert StartTime <> 0
            prmParam.Value = StartTime

         Case "[e_date]"
            BugAssert EndTime <> 0
            prmParam.Value = EndTime

         Case "[elapsed]"
            prmParam.Value = Elapsed

         Case "[it_val]"
            prmParam.Value = ItValue

         Case Else
            ' Write the parameter name that is faulty
            WriteError errInvalidParameter, mstrSource, _
                  prmParam.Name
            On Error GoTo 0
            Err.Raise errInvalidParameter, mstrSource, _
                  LoadResString(errInvalidParameter)
      End Select
   Next prmParam

   Exit Sub

AssignParametersErr:

   mstrSource = mstrModuleName & "AssignParameters"
   Call LogErrors(Errors)
   On Error GoTo 0
   Err.Raise vbObjectError + errAssignParametersFailed, _
         mstrSource, LoadResString(errAssignParametersFailed)

End Sub
Private Sub RunStartProcessing(dtmStartTime As Currency)

   On Error GoTo RunStartProcessingErr

   ' Insert the run header into the database
   Call InsertRunHeader(dtmStartTime)

   ' Insert the run parameters into the database
   Call InsertRunParameters(dtmStartTime)

   Exit Sub

RunStartProcessingErr:
   ' Log the error code raised by Visual Basic
   Call LogErrors(Errors)
```

```
    mstrSource = mstrModuleName & "RunStartProcessing"
    ShowError errUpdateRunDataFailed
    WriteError errUpdateRunDataFailed, mstrSource

End Sub
Private Sub ProcessStartProcessing(cStepRecord As cStep, _
        strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long, _
        lParentInstanceId As Long, sItValue As String)

    On Error GoTo ProcessStartProcessingErr

    ' Insert the run detail into the database
    Call InsertRunDetail(cStepRecord, strCommand, dtmStartTime,
lngInstanceId, _
            lParentInstanceId, sItValue)

    Exit Sub

ProcessStartProcessingErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    mstrSource = mstrModuleName & "ProcessStartProcessing"
    ShowError errUpdateRunDataFailed
    WriteError errUpdateRunDataFailed, mstrSource

End Sub
Private Sub StepStartProcessing(cStepRecord As cStep, dtmStartTime
As Currency, _
        lngInstanceId As Long, lParentInstanceId As Long, sItValue As
String)

    On Error GoTo StepStartProcessingErr

    ' Since ProcessStart events won't be triggered for manager steps
    If cStepRecord.StepType = gintManagerStep Then
        ' Insert the run detail into the database
        Call InsertRunDetail(cStepRecord, cStepRecord.StepLabel, _
                dtmStartTime, lngInstanceId, lParentInstanceId, sItValue)
    End If

    Exit Sub

StepStartProcessingErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    mstrSource = mstrModuleName & "StepStartProcessing"
    ShowError errUpdateRunDataFailed

End Sub
Private Sub ProcessCompleteProcessing(cStepRecord As cStep, _
        dtmStartTime As Currency, lngInstanceId As Long, lElapsed As
Long)

    On Error GoTo ProcessCompleteProcessingErr

    ' Insert the run detail into the database
    Call UpdateRunDetail(cStepRecord, dtmStartTime, lngInstanceId,
lElapsed)

    Exit Sub

ProcessCompleteProcessingErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    mstrSource = mstrModuleName & "ProcessCompleteProcessing"
    ShowError errUpdateRunDataFailed

End Sub
Private Sub StepCompleteProcessing(cStepRecord As cStep, _
        dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

    On Error GoTo StepCompleteProcessingErr

    ' Since ProcessComplete events won't be triggered for manager steps
    If cStepRecord.StepType = gintManagerStep Then
        ' Update the run detail in the database
        Call UpdateRunDetail(cStepRecord, dtmEndTime, lngInstanceId,
lElapsed)
    End If

    Exit Sub

StepCompleteProcessingErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    ShowError errUpdateRunDataFailed

End Sub
Private Sub RunCompleteProcessing(dtmEndTime As Currency)

    On Error GoTo RunCompleteProcessingErr

    ' Update the header record with the end time for the run
    Call UpdateRunHeader(dtmEndTime)

    Exit Sub

RunCompleteProcessingErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    ShowError errUpdateRunDataFailed

End Sub

Private Sub UpdateRunHeader(ByVal dtmEndTime As Currency)
    ' Updates the run header record with the end date

    Dim strUpdate As String
    Dim qy As QueryDef

    On Error GoTo UpdateRunHeaderErr

    strUpdate = "update run_header " & _
            " set end_time = [e_date] " & _
            " where run_id = [r_id] "

    Set qy = mdbsLoadDb.CreateQueryDef( _
            gstrEmptyString, strUpdate)

    ' Call a procedure to execute the Querydef object
    Call AssignParameters(qy, EndTime:=dtmEndTime)

    qy.Execute dbFailOnError
    qy.Close

    Exit Sub

UpdateRunHeaderErr:
    LogErrors Errors
    mstrSource = mstrModuleName & "UpdateRunHeader"
    On Error GoTo 0
    Err.Raise vbObjectError + errUpdateRunDataFailed, _
            mstrSource, _
            LoadResString(errUpdateRunDataFailed)

End Sub

Public Property Let WorkspaceId(ByVal vdata As Long)
```

```
    mlngWorkspaceId = vdata
End Property
Public Property Get WorkspaceId() As Long
    WorkspaceId = mlngWorkspaceId
End Property
Public Sub RunWorkspace()

    Dim cRunSeq As cSequence

    On Error GoTo RunWorkspaceErr

    ' Call a procedure to load the module-level structures
    ' with all the step and parameter data for the run
    If LoadRunData = False Then
        ' Error handled by the function already
        Exit Sub
    End If

    ' Retrieve the next run identifier using the sequence class
    Set cRunSeq = New cSequence
    Set cRunSeq.IdDatabase = dbsAttTool
    cRunSeq.IdentifierColumn = "run_id"
    mlngRunId = cRunSeq.Identifier
    Set cRunSeq = Nothing

    Call mcRunParams.InitBuiltInsForRun(mlngWorkspaceId,
mlngRunId)

    Set mcRun.Constraints = mcRunConstraints
    mcRun.WspPreExecution = mcvntWspPreCons
    mcRun.WspPostExecution = mcvntWspPostCons

    Set mcRun.Steps = mcRunSteps
    Set mcRun.Parameters = mcRunParams
    Set mcRun.RunConnections = mcRunConnections
    Set mcRun.RunConnDtls = mcRunConnDtls

    mcRun.WspId = mlngWorkspaceId
    mcRun.RootKey = LabelStep(mlngWorkspaceId)
    mcRun.RunId = mlngRunId
    mcRun.CreateInputFiles = CreateInputFiles

    mcRun.Run

    Exit Sub

RunWorkspaceErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)

End Sub
Public Property Get LoadDb() As Database

    Set LoadDb = mdbsLoadDb

End Property
Public Property Set LoadDb(vdata As Database)

    Set mdbsLoadDb = vdata

End Property
Private Function LoadRunData() As Boolean

    ' Loads the step, parameter and constraint arrays
    ' with all the data for the workspace. Returns False
    ' if a failure occurs

    Dim strWorkspaceName As String
    Dim recWspSteps As Recordset
    Dim qySteps As DAO.QueryDef
    Dim recWspParams As Recordset
    Dim qyParams As DAO.QueryDef
    Dim recWspConns As Recordset
    Dim qyConns As DAO.QueryDef
    Dim recWspConnDtls As Recordset
    Dim qyConnDtls As DAO.QueryDef

    On Error GoTo LoadRunDataErr

    Set mcRunSteps.StepDB = mdbsLoadDb
    Set mcRunParams.ParamDatabase = mdbsLoadDb
    Set mcRunConstraints.ConstraintDB = mdbsLoadDb
    Set mcRunConnections.ConnDb = mdbsLoadDb
    Set mcRunConnDtls.ConnDb = mdbsLoadDb

    ' Read all the step and parameter data for the workspace
    Call ReadWorkspaceData(mlngWorkspaceId, mcRunSteps, _
            mcRunParams, mcRunConstraints, mcRunConnections,
mcRunConnDtls, _
            recWspSteps, qySteps, recWspParams, qyParams,
recWspConns, qyConns, _
            recWspConnDtls, qyConnDtls)

    ' Load all the pre- and post-execution constraints that
    ' have been defined for the workspace
    mcvntWspPreCons = mcRunConstraints.ConstraintsForWsp( _
        mlngWorkspaceId, _
        gintPreStep, _
        blnSort:=True, _
        blnGlobalConstraintsOnly:=True)
    mcvntWspPostCons = mcRunConstraints.ConstraintsForWsp( _
        mlngWorkspaceId, _
        gintPostStep, _
        blnSort:=True, _
        blnGlobalConstraintsOnly:=True)

    On Error Resume Next
    recWspSteps.Close
    qySteps.Close
    recWspParams.Close
    qyParams.Close
    recWspConns.Close
    qyConns.Close

    LoadRunData = True

    Exit Function

LoadRunDataErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    ShowError errLoadRunDataFailed
    LoadRunData = False

End Function
Public Sub StopRun()

    On Error GoTo StopRunErr

    If mcRun Is Nothing Then
        ' We haven't been the run yet, so do nothing
    Else
        mcRun.StopRun
    End If

    Exit Sub

StopRunErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
```


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```
    ' Errors would have been displayed by the called process

End Sub
Public Sub AbortRun()

    On Error GoTo AbortRunErr

    If mcRun Is Nothing Then
        ' We haven't been the run yet, so do nothing
    Else
        mcRun.Abort
    End If

    Exit Sub

AbortRunErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    ' Errors would have been displayed by the called process

End Sub

Private Sub Class_Initialize()

    ' Create instances of the step, parameter and constraint arrays
    Set mcRunSteps = New cArrSteps
    Set mcRunParams = New cArrParameters
    Set mcRunConstraints = New cArrConstraints
    Set mcRunConnections = New cConnections
    Set mcRunConnDtls = New cConnDtls
    Set mcRun = New cRunInst
    Set mField = New cStringSM

End Sub
Private Sub Class_Terminate()

    On Error GoTo UnLoadRunDataErr

    ' Clears the step, parameter and constraint arrays
    Set mcRunSteps = Nothing
    Set mcRunParams = Nothing
    Set mcRunConstraints = Nothing
    Set mcRunConnections = Nothing
    Set mcRunConnDtls = Nothing

    Set mcRun = Nothing
    Set mdbsLoadDb = Nothing
    Set mField = Nothing

    Exit Sub

UnLoadRunDataErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    ' Not a critical error - continue
    Resume Next

End Sub

Private Sub mcRun_ProcessComplete(cStepRecord As cStep, _
        dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

    RaiseEvent ProcessComplete(cStepRecord, dtmEndTime,
lngInstanceId)
    Call ProcessCompleteProcessing(cStepRecord, dtmEndTime,
lngInstanceId, lElapsed)

End Sub

Private Sub mcRun_ProcessStart(cStepRecord As cStep, _
        strCommand As String, dtmStartTime As Currency, lngInstanceId
As Long, _
        lParentInstanceId As Long, sItValue As String)

    RaiseEvent ProcessStart(cStepRecord, strCommand, dtmStartTime,
lngInstanceId)
    Call ProcessStartProcessing(cStepRecord, strCommand,
dtmStartTime, lngInstanceId, _
            lParentInstanceId, sItValue)

End Sub

Private Sub mcRun_RunComplete(dtmEndTime As Currency)

    Debug.Print "Run ended at: " & CStr(dtmEndTime)
    Call RunCompleteProcessing(dtmEndTime)

    RaiseEvent RunComplete(dtmEndTime)

End Sub
Private Sub mcRun_RunStart(dtmStartTime As Currency, strWspLog
As String)

    RaiseEvent RunStart(dtmStartTime, strWspLog, mlngRunId)
    Debug.Print "Run started at: " & CStr(dtmStartTime)

    Call RunStartProcessing(dtmStartTime)

End Sub
Private Sub mcRun_StepComplete(cStepRecord As cStep, _
        dtmEndTime As Currency, lngInstanceId As Long, lElapsed As
Long)

    RaiseEvent StepComplete(cStepRecord, dtmEndTime, lngInstanceId)
'    BugMessage "Step: " & cStepRecord.StepLabel & " has completed!"

    Call StepCompleteProcessing(cStepRecord, dtmEndTime,
lngInstanceId, lElapsed)

End Sub
Private Sub mcRun_StepStart(cStepRecord As cStep, dtmStartTime As
Currency, _
        lngInstanceId As Long, lParentInstanceId As Long, sPath As
String, sIts As String, sItValue As String)

    RaiseEvent StepStart(cStepRecord, dtmStartTime, lngInstanceId,
sPath, sIts)
    'bugmessage "Step: " & cStepRecord.StepLabel & " has started."

    Call StepStartProcessing(cStepRecord, dtmStartTime, lngInstanceId,
lParentInstanceId, sItValue)

End Sub
```

cSequence.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cSequence"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:        cSequence.cls
'               Microsoft TPC-H Kit Ver. 1.00
'               Copyright Microsoft, 1999
'               All Rights Reserved
```

```
'
'
'  PURPOSE:     This class uses the att_identifiers table to generate
unique
'               identifiers.
'  Contact:     Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

Private mlngIdentifier As Long
Private mstrIdentifierColumn As String
Private mrecIdentifiers As Recordset
Private mdbsDatabase As Database

Private Const mstrEmptyString = ""

' Used to indicate the source module name when errors
' are raised by this class
Private mstrSource As String
Private Const mstrModuleName As String = "cSequence."

Private Sub CreateIdRecord()
   ' Creates a record with all identifiers having an initial value of 1

   Dim sSql As String
   Dim pId As DAO.Parameter
   Dim qyId As DAO.QueryDef

   sSql = "insert into att_identifiers (" & _
         " workspace_id, parameter_id, step_id, " & _
         " constraint_id, run_id, connection_id " & _
         ", " & FLD_ID_CONN_NAME & _
         " ) values ( " & _
         "[w_id], [p_id], [s_id], [c_id], [r_id], [conn_id], [conn_dtl_id] )"
   Set qyId = mdbsDatabase.CreateQueryDef(gstrEmptyString, sSql)
   For Each pId In qyId.Parameters
      pId.Value = glMinId
   Next pId
   qyId.Execute dbFailOnError
   qyId.Close

End Sub
Private Sub CreateIdRecordset()

   Dim strSql As String

   ' Initialize the recordset with all identifiers
   strSql = "select * from att_identifiers"
   Set mrecIdentifiers = mdbsDatabase.OpenRecordset(strSql,
dbOpenForwardOnly)

   If mrecIdentifiers.RecordCount = 0 Then
      CreateIdRecord
      Set mrecIdentifiers = mdbsDatabase.OpenRecordset(strSql,
dbOpenForwardOnly)
   End If

   BugAssert mrecIdentifiers.RecordCount <> 0

End Sub

Public Property Set IdDatabase(vdata As Database)

   Set mdbsDatabase = vdata

End Property

Public Property Let IdentifierColumn(vdata As String)

   Dim intIndex As Integer

   On Error GoTo IdentifierColumnErr

   ' Initialize the return value to an empty string
   mstrIdentifierColumn = mstrEmptyString
   Call CreateIdRecordset

   For intIndex = 0 To mrecIdentifiers.Fields.Count - 1

      If LCase(Trim(mrecIdentifiers.Fields(intIndex).Name)) = _
            LCase(Trim(vdata)) Then

         ' Valid column name
         mstrIdentifierColumn = vdata
         Exit Property
      End If

   Next intIndex

   BugAssert True, "Invalid column name!"

   Exit Property

IdentifierColumnErr:
   LogErrors Errors
   mstrSource = mstrModuleName & "IdentifierColumn"
   On Error GoTo 0
   Err.Raise vbObjectError + errIdentifierColumnFailed, _
         mstrSource, _
         LoadResString(errIdentifierColumnFailed)

End Property
Public Property Get Identifier() As Long
   Dim strSql As String

   On Error GoTo GetIdentifierErr

   BugAssert mstrIdentifierColumn <> mstrEmptyString

   ' Increment the identifier column by 1
   strSql = "update att_identifiers " & _
      " set " & mstrIdentifierColumn & _
      " = " & mstrIdentifierColumn & " + 1"
   mdbsDatabase.Execute strSql, dbFailOnError

   ' Refresh the recordset with identifier values
   Call CreateIdRecordset

   mlngIdentifier = mrecIdentifiers.Fields(mstrIdentifierColumn).Value

   Identifier = mlngIdentifier

   Exit Property

GetIdentifierErr:
   LogErrors Errors
   mstrSource = mstrModuleName & "Identifier"
   On Error GoTo 0
   Err.Raise vbObjectError + errGetIdentifierFailed, _
         mstrSource, _
         LoadResString(errGetIdentifierFailed)

End Property
Private Sub Class_Terminate()

   mrecIdentifiers.Close

End Sub
```

cStack.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cStack"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:       cStack.cls
'              Microsoft TPC-H Kit Ver. 1.00
'              Copyright Microsoft, 1999
'              All Rights Reserved
'
'
'  PURPOSE:    This class implements a stack of objects.
'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

' Used to indicate the source module name when errors
' are raised by this class
Private Const mstrModuleName As String = "cStack."
Private mstrSource As String

Private mcVector As cVector
Private mlngCount As Long
Public Property Get Item(ByVal Position As Long) As Object
Attribute Item.VB_UserMemId = 0

    Set Item = mcVector(Position)

End Property

Public Sub Push(objToPush As Object)

    mcVector.Add objToPush

End Sub
Public Sub Clear()

    mcVector.Clear

End Sub

Public Function Pop() As Object

    If mcVector.Count > 0 Then
        Set Pop = mcVector.Delete(mcVector.Count - 1)
    Else
        Set Pop = Nothing
    End If

End Function
Public Function Count() As Long

    Count = mcVector.Count

End Function


Private Sub Class_Initialize()

    Set mcVector = New cVector

End Sub


Private Sub Class_Terminate()

    Set mcVector = Nothing

End Sub
```

cStep.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cStep"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
Attribute VB_Ext_KEY = "SavedWithClassBuilder" ,"Yes"
Attribute VB_Ext_KEY = "Top_Level" ,"Yes"
'  FILE:       cStep.cls
'              Microsoft TPC-H Kit Ver. 1.00
'              Copyright Microsoft, 1999
'              All Rights Reserved
'
'
'  PURPOSE:    Encapsulates the properties and methods of a step.
'              Contains functions to insert, update and delete
'              att_steps records from the database.
'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

' Local variable(s) to hold property value(s)
Private mlngStepId As Long
Private mstrVersionNo As String
Private mstrStepLabel As String
Private mstrStepTextFile As String
Private mstrStepText As String
Private mstrStartDir As String
Private mlngWorkspaceId As Integer
Private mlngParentStepId As Integer
Private mstrParentVersionNo As String
Private mintSequenceNo As Integer
Private mintStepLevel As Integer
Private mblnEnabledFlag As Boolean
Private mstrDegreeParallelism As String
Private mintExecutionMechanism As Integer
Private mstrFailureDetails As String
Private mintContinuationCriteria As Integer
Private mblnGlobalFlag As Boolean
Private mblnArchivedFlag As Boolean
Private mstrOutputFile As String
'Private mstrLogFile As String
Private mstrErrorFile As String
Private mdbsDatabase As Database
Private mintStepType As Integer
Private mintOperation As Operation
Private mlngPosition As Long
Private mstrIteratorName As String
Private mcIterators As cNodeCollections
Private mbIsNewVersion As Boolean
Private msOldVersion As String

' The following constants are used throughout the project to
' indicate the different options selected by the user
' The options are presented to the user as control arrays of
' option buttons. These constants have to be in sync with the
' indexes of the option buttons.
' All the control arrays have an lbound of 1. The value 0 is
' used to indicate that the property being represented by the
' control array is not valid for the step
```

```
' Public enums are used since we cannot expose public constants
' in class modules. gintNoOption is applicable to all enums,
' but declared in the Execution method enum, since we cannot
' declare it more than once.

' Is here as a comment
' Has been defined in public.bas with the other object types
'Public Enum gintStepType
'    gintGlobalStep = 3
'    gintManagerStep
'    gintWorkerStep
'End Enum

' Execution Method options
Public Enum ExecutionMethod
   gintNoOption = 0
   gintExecuteODBC
   gintExecuteShell
End Enum

' Failure criteria options
Public Enum FailureCriteria
   gintFailureODBC = 1
   gintFailureTextCompare
End Enum

' Continuation criteria options
' Note: Update the initialization of gsContCriteria in Initialize() if the
' continuation criteria are modified
Public Enum ContinuationCriteria
   gintOnFailureAbort = 1
   gintOnFailureContinue
   gintOnFailureCompleteSiblings
   gintOnFailureAbortSiblings
   gintOnFailureSkipSiblings
   gintOnFailureAsk
End Enum

' The initial version #
Private Const mstrMinVersion As String = "0.0"

' End of constants for option button control arrays
' Used to indicate the source module name when errors
' are raised by this class
Private mstrSource As String
Private Const mstrModuleName As String = "cStep."

' The cSequence class is used to generate unique step identifiers
Private mStepSeq As cSequence

' The StringSM class is used to carry out string operations
Private mFieldValue As cStringSM
Private Sub NewVersion()

mbIsNewVersion = True
msOldVersion = mstrVersionNo

End Sub
Public Function IsNewVersion() As Boolean
   IsNewVersion = mbIsNewVersion
End Function

Public Function OldVersionNo() As String
   OldVersionNo = msOldVersion
End Function

Public Sub SaveIterators()
   ' This procedure checks if any changes have been made
   ' to the iterators for the step. If so, it calls the
   ' methods of the iterator class to commit the changes
   Dim cItRec As cIterator
   Dim lngIndex As Long

   On Error GoTo SaveIteratorsErr

   For lngIndex = 0 To mcIterators.Count - 1
      Set cItRec = mcIterators(lngIndex)

      Select Case cItRec.IndOperation
         Case QueryOp
            ' No changes were made to the queried Step.
            ' Do nothing

         Case InsertOp
            cItRec.Add mlngStepId, mstrVersionNo
            cItRec.IndOperation = QueryOp

         Case UpdateOp
            cItRec.Update mlngStepId, mstrVersionNo
            cItRec.IndOperation = QueryOp

         Case DeleteOp
            cItRec.Delete mlngStepId, mstrVersionNo
            ' Remove the record from the collection
            mcIterators.Delete lngIndex

      End Select
   Next lngIndex

   Exit Sub

SaveIteratorsErr:
   LogErrors Errors
   mstrSource = mstrModuleName & "SaveIterators"
   On Error GoTo 0
   Err.Raise vbObjectError + errSaveFailed, _
         mstrSource, _
         LoadResString(errSaveFailed)

End Sub
Public Property Get IndOperation() As Operation

   IndOperation = mintOperation

End Property
Public Property Let IndOperation(ByVal vdata As Operation)

   BugAssert vdata = QueryOp Or vdata = InsertOp Or vdata =
UpdateOp Or vdata = DeleteOp, "Invalid operation"
   mintOperation = vdata

End Property

Public Function Iterators() As Variant
   ' Returns a variant containing all the iterators that
   ' have been defined for the step

   Dim cStepIterators() As cIterator
   Dim cTempIt As cIterator
   Dim lngIndex As Long
   Dim lngItCount As Long

   On Error GoTo IteratorsErr

   lngItCount = 0
   For lngIndex = 0 To mcIterators.Count - 1
      ' Increase the array dimension and add the constraint
      ' to it
      Set cTempIt = mcIterators(lngIndex)
```

```
      If cTempIt.IndOperation <> DeleteOp Then
         ReDim Preserve cStepIterators(lngItCount)
         Set cStepIterators(lngItCount) = cTempIt
         lngItCount = lngItCount + 1
      End If

   Next lngIndex

   If lngItCount = 0 Then
      Iterators = Empty
   Else
      Iterators = cStepIterators()
   End If

   Call QuickSort(Iterators)

   Exit Function

IteratorsErr:
   LogErrors Errors
   On Error GoTo 0
   Err.Raise vbObjectError + errIteratorsFailed, _
         mstrModuleName & "Iterators", _
         LoadResString(errIteratorsFailed)

End Function
Public Function IteratorCount() As Long
   ' Returns a count of all the iterators for the step

   Dim lngItCount As Long
   Dim lngIndex As Long
   Dim cTempIt As cIterator

   On Error GoTo IteratorsErr

   lngItCount = 0
   For lngIndex = 0 To mcIterators.Count - 1

      If mcIterators(lngIndex).IndOperation <> DeleteOp Then
         lngItCount = lngItCount + 1
      End If

   Next lngIndex

   IteratorCount = lngItCount

   Exit Function

IteratorsErr:
   LogErrors Errors
   On Error GoTo 0
   Err.Raise vbObjectError + errIteratorsFailed, _
         mstrSource, _
         LoadResString(errIteratorsFailed)

End Function
Public Sub Validate()
   ' Each distinct object will have a Validate method which
   ' will check if the class properties are valid. This method
   ' will be used to check interdependant properties that
   ' cannot be validated by the let procedures.
   ' It should be called by the add and modify methods of the class

   ' Check if the step label has been specified
   If StringEmpty(mstrStepLabel) Then
      ShowError errStepLabelMandatory
      On Error GoTo 0
      Err.Raise vbObjectError + errValidateFailed, _
            "Validate", LoadResString(errValidateFailed)
   End If

   If Not IsStringEmpty(mstrStepText) And Not
IsStringEmpty(mstrStepTextFile) Then
      ShowError errStepTextOrFile
      On Error GoTo 0
      Err.Raise vbObjectError + errStepTextOrFile, _
         "Validate", LoadResString(errStepTextOrFile)
   End If

End Sub

Public Function IncVersionY() As String
   ' The version number for a step is stored in the x.y
   ' format where x is the parent component and y is the
   ' child component of the step. This function will increment
   ' the y component of the step by 1

   On Error GoTo IncVersionYErr

   ' Store the old version number for the step
   Call NewVersion

   mstrVersionNo = Trim$(Str$(GetX(mstrVersionNo))) &
gstrVerSeparator & _
         Trim$(Str(GetY(mstrVersionNo) + 1))
   IncVersionY = mstrVersionNo

   Exit Function

IncVersionYErr:
   ' Log the error code raised by Visual Basic
   Call LogErrors(Errors)
   gstrSource = mstrModuleName & "IncVersionY"
   On Error GoTo 0
   Err.Raise vbObjectError + errIncVersionYFailed, _
         gstrSource, _
         LoadResString(errIncVersionYFailed)

End Function
Public Function IncVersionX() As String
   ' The version number for a step is stored in the x.y
   ' format where x is the parent component and y is the
   ' child component of the step. This function will increment
   ' the y component of the step by 1 and reset the x component
   ' to 0

   On Error GoTo IncVersionXErr

   ' Store the old version number for the step
   Call NewVersion

   mstrVersionNo = Trim$(Str$(GetX(mstrVersionNo) + 1)) &
gstrVerSeparator & "0"
   IncVersionX = mstrVersionNo

   Exit Function

IncVersionXErr:
   ' Log the error code raised by Visual Basic
   Call LogErrors(Errors)
   gstrSource = mstrModuleName & "IncVersionX"
   On Error GoTo 0
   Err.Raise vbObjectError + errIncVersionXFailed, _
         gstrSource, _
         LoadResString(errIncVersionXFailed)

End Function


Private Function GetY(strVersion As String) As Long
```


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```
    ' The version number for a step is stored in the x.y
    ' format where x is the parent component and y is the
    ' child component of the step. Given an argument of type
    ' x.y, it returns y

    ' Truncate the fractional part to get the parent component
    ' of the version number (x.y)
    GetY = Val(Mid(strVersion, InStr(strVersion, gstrVerSeparator) + 1))

End Function
Private Function GetX(strVersion As String) As Long
    ' The version number for a step is stored in the x.y
    ' format where x is the parent component and y is the
    ' child component of the step. Given an argument of type
    ' x.y, it returns x

    ' Truncate the fractional part to get the parent component
    ' of the version number (x.y)
    GetX = Val(Left(strVersion, InStr(strVersion, gstrVerSeparator) - 1))

End Function

Public Function Clone(Optional cCloneStep As cStep) As cStep

    ' Creates a copy of a given step

    Dim lngIndex As Long
    Dim cItRec As cIterator
    Dim cItClone As cIterator

    On Error GoTo CloneErr

    If cCloneStep Is Nothing Then
        Set cCloneStep = New cStep
    End If

    ' Copy all the step properties to the newly created step
    ' Initialize the global flag first since subsequent
    ' validations might depend on it
    cCloneStep.GlobalFlag = mblnGlobalFlag
'    cCloneStep.GlobalRunMethod = mintGlobalRunMethod

    cCloneStep.StepType = mintStepType
    cCloneStep.StepId = mlngStepId
    cCloneStep.VersionNo = mstrVersionNo
    cCloneStep.StepLabel = mstrStepLabel
    cCloneStep.StepTextFile = mstrStepTextFile
    cCloneStep.StepText = mstrStepText
    cCloneStep.StartDir = mstrStartDir
    cCloneStep.WorkspaceId = mlngWorkspaceId
    cCloneStep.ParentStepId = mlngParentStepId
    cCloneStep.ParentVersionNo = mstrParentVersionNo
    cCloneStep.StepLevel = mintStepLevel
    cCloneStep.SequenceNo = mintSequenceNo
    cCloneStep.EnabledFlag = mblnEnabledFlag
    cCloneStep.DegreeParallelism = mstrDegreeParallelism
    cCloneStep.ExecutionMechanism = mintExecutionMechanism
    cCloneStep.FailureDetails = mstrFailureDetails
    cCloneStep.ContinuationCriteria = mintContinuationCriteria
    cCloneStep.ArchivedFlag = mblnArchivedFlag
    cCloneStep.OutputFile = mstrOutputFile
'    cCloneStep.LogFile = mstrLogFile
    cCloneStep.ErrorFile = mstrErrorFile
    cCloneStep.IteratorName = mstrIteratorName

    cCloneStep.IndOperation = mintOperation
    cCloneStep.Position = mlngPosition

    Set cCloneStep.NodeDB = mdbsDatabase

    ' Clone all the iterators for the step
    For lngIndex = 0 To mcIterators.Count - 1
        Set cItRec = mcIterators(lngIndex)
        Set cItClone = cItRec.Clone
        cCloneStep.LoadIterator cItClone
    Next lngIndex

    ' And set the return value to the newly created step
    Set Clone = cCloneStep

    Exit Function

CloneErr:
    LogErrors Errors
    mstrSource = mstrModuleName & "Clone"
    On Error GoTo 0
    Err.Raise vbObjectError + errCloneFailed, _
            mstrSource, LoadResString(errCloneFailed)

End Function
'End Sub
'
Public Property Let OutputFile(ByVal vdata As String)

    mstrOutputFile = vdata

End Property

Public Property Get OutputFile() As String

    OutputFile = mstrOutputFile

End Property

'Public Property Let LogFile(ByVal vdata As String)
'
'    mstrLogFile = vdata
'
'End Property
'
'Public Property Get LogFile() As String
'
'    LogFile = mstrLogFile
'
'End Property

Public Property Let ErrorFile(ByVal vdata As String)

    mstrErrorFile = vdata

End Property
Public Property Let IteratorName(ByVal vdata As String)

    mstrIteratorName = vdata

End Property

Public Property Get ErrorFile() As String

    ErrorFile = mstrErrorFile

End Property
Public Property Get IteratorName() As String

    IteratorName = mstrIteratorName

End Property

Public Property Set NodeDB(vdata As Database)
```

```
    Set mdbsDatabase = vdata
    Set mcIterators.NodeDB = vdata

End Property
Public Property Get NodeDB() As Database

    Set NodeDB = mdbsDatabase

End Property

Private Function IsStringEmpty(strToCheck As String) As Boolean

    IsStringEmpty = (strToCheck = gstrEmptyString)

End Function

Public Property Let EnabledFlag(ByVal vdata As Boolean)

    ' The enabled flag must be False for all global steps.
    ' This check must be made by the global step class. Only
    ' generic step validations will be carried out by this
    ' class
    mblnEnabledFlag = vdata

End Property

Public Property Let GlobalFlag(ByVal vdata As Boolean)

    mblnGlobalFlag = vdata

End Property
Public Property Get EnabledFlag() As Boolean

    EnabledFlag = mblnEnabledFlag

End Property

Public Property Let ArchivedFlag(ByVal vdata As Boolean)

    mblnArchivedFlag = vdata

End Property

Public Property Get ArchivedFlag() As Boolean

    ArchivedFlag = mblnArchivedFlag

End Property

Public Property Get GlobalFlag() As Boolean

    GlobalFlag = mblnGlobalFlag

End Property

Public Sub Add()
    ' Inserts a step record into the database - it initializes
    ' the necessary properties for the step and calls InsertStepRec
    ' to do the database work

    On Error GoTo AddErr

    ' A new record would have the deleted_flag turned off!
    mblnArchivedFlag = False

    Call InsertStepRec

    ' If a new version of a step has been created, reset the old version info,
since
    ' it's already been saved to the db
    If IsNewVersion() Then
        mbIsNewVersion = False
        msOldVersion = gstrEmptyString
    End If

    Exit Sub

AddErr:
    LogErrors Errors
    On Error GoTo 0
    Err.Raise vbObjectError + errAddStepFailed, _
            mstrModuleName & "Add", LoadResString(errAddStepFailed)
End Sub
Private Sub InsertStepRec()
    ' Inserts a step record into the database
    ' It first generates the insert statement using the different
    ' step properties and then executes it

    Dim strInsert As String
    Dim qy As DAO.QueryDef

    On Error GoTo InsertStepRecErr

    ' First check if the database object is valid
    Call CheckDB

    ' Check if the step record is valid
    Call Validate

    If IsNewVersion() Then
        Call UpdOldVersionsArchFlg
    End If

    ' Create a temporary querydef object
    strInsert = "insert into att_steps " & _
        "( workspace_id, step_id, version_no, " & _
        " step_label, step_file_name, step_text, start_directory, " & _
        " parent_step_id, parent_version_no, sequence_no, " & _
        " enabled_flag, step_level, " & _
        " degree_parallelism, execution_mechanism, " & _
        " failure_details, " & _
        " continuation_criteria, global_flag, " & _
        " archived_flag, " & _
        " output_file_name, error_file_name, " & _
        " iterator_name ) values ( "

    ' log_file_name,

#If USE_JET Then

    strInsert = strInsert & " [w_id], [s_id], [ver_no], " & _
        " [s_label], [s_file_name], [s_text], [s_start_dir], " & _
        " [p_step_id], [p_version_no], [seq_no], " & _
        " [enabled], [s_level], [deg_parallelism], " & _
        " [exec_mechanism], [fail_dtls], " & _
        " [cont_criteria], [global], [archived], " & _
        " [output_file], [error_file], " & _
        " [it_name] ) "

    ' [log_file],

    Set qy = mdbsDatabase.CreateQueryDef(gstrEmptyString, strInsert)

    ' Call a procedure to execute the Querydef object
    Call AssignParameters(qy)

    qy.Execute dbFailOnError
    qy.Close
#Else
```


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```
      strInsert = strInsert & Str(mlngWorkspaceId) & ", " &
Str(mlngStepId) & _
      ", " & mFieldValue.MakeStringFieldValid(mstrVersionNo)

   ' For fields that may be null, call a function to determine
   ' the string to be appended to the insert statement
   strInsert = strInsert & ", " &
mFieldValue.MakeStringFieldValid(mstrStepLabel)
   strInsert = strInsert & ", " &
mFieldValue.MakeStringFieldValid(mstrStepTextFile)
   strInsert = strInsert & ", " &
mFieldValue.MakeStringFieldValid(mstrStepText)
   strInsert = strInsert & ", " &
mFieldValue.MakeStringFieldValid(mstrStartDir)

   strInsert = strInsert & ", " & Str(mlngParentStepId) & _
      ", " & mFieldValue.MakeStringFieldValid(mstrParentVersionNo)
& _
      ", " & Str(mintSequenceNo) & _
      ", " & Str(mblnEnabledFlag) & ", " & Str(mintStepLevel)

   strInsert = strInsert & ", " &
mFieldValue.MakeStringFieldValid(mstrDegreeParallelism)
   strInsert = strInsert & ", " & Str(mintExecutionMechanism)

   strInsert = strInsert & ", " &
mFieldValue.MakeStringFieldValid(mstrFailureDetails) & _
      ", " & Str(mintContinuationCriteria) & _
      ", " & Str(mblnGlobalFlag) & _
      ", " & Str(mblnArchivedFlag)

   strInsert = strInsert & ", " &
mFieldValue.MakeStringFieldValid(mstrOutputFile)
'    strInsert = strInsert & ", " &
mFieldValue.MakeStringFieldValid(mstrLogFile)
   strInsert = strInsert & ", " &
mFieldValue.MakeStringFieldValid(mstrErrorFile)
   strInsert = strInsert & ", " &
mFieldValue.MakeStringFieldValid(mstrIteratorName)

   strInsert = strInsert & " ) "

   BugMessage strInsert
   mdbsDatabase.Execute strInsert, dbFailOnError

#End If

   Exit Sub

InsertStepRecErr:
   mstrSource = mstrModuleName & "InsertStepRec"
   LogErrors Errors
   On Error GoTo 0
   Err.Raise vbObjectError + errInsertStepFailed, _
         mstrSource, LoadResString(errInsertStepFailed)
End Sub
Private Sub UpdOldVersionsArchFlg()
   ' Updates the archived flag on all old version for the step to True

   Dim sUpdate As String
   Dim qy As DAO.QueryDef

   On Error GoTo UpdOldVersionsArchFlgErr
   mstrSource = mstrModuleName & "UpdOldVersionsArchFlg"

#If USE_JET Then

   sUpdate = "update att_steps " & _
      " set archived_flag = True "

   ' Append the Where clause
   sUpdate = sUpdate & " where step_id = [s_id] " & _
      " and version_no <> [ver_no]"

   Set qy = mdbsDatabase.CreateQueryDef(gstrEmptyString, sUpdate)

   ' Call a procedure to execute the Querydef object
   Call AssignParameters(qy)
   qy.Execute dbFailOnError

   If qy.RecordsAffected = 0 Then
      On Error GoTo 0
      Err.Raise vbObjectError + errModifyStepFailed, _
            mstrSource, LoadResString(errModifyStepFailed)
   End If

   qy.Close

#Else

   sUpdate = "update att_steps " & _
      " set archived_flag = True "

   sUpdate = sUpdate & " where step_id = " & Str(mlngStepId) & _
      " and version_no <> " &
mFieldValue.MakeStringFieldValid(mstrVersionNo)

   BugMessage sUpdate
   mdbsDatabase.Execute sUpdate, dbFailOnError
#End If

   Exit Sub

UpdOldVersionsArchFlgErr:
   mstrSource = mstrModuleName & "UpdOldVersionsArchFlg"
   LogErrors Errors
   On Error GoTo 0
   Err.Raise vbObjectError + errModifyStepFailed, _
         mstrSource, LoadResString(errModifyStepFailed)
End Sub
Public Sub InsertIterator(cItRecord As cIterator)
   ' Inserts the iterator record into the database

   Call cItRecord.Add(mlngStepId, mstrVersionNo)

End Sub
Public Sub UpdateIterator(cItRecord As cIterator)
   ' Updates the iterator record in the database

   Call cItRecord.Update(mlngStepId, mstrVersionNo)

End Sub
Public Sub UpdateIteratorVersion()
   ' Updates the iterator record in the database

   Dim lngIndex As Long
   Dim cTempIt As cIterator

   On Error GoTo UpdateIteratorVersionErr

   For lngIndex = 0 To mcIterators.Count - 1
      ' Increase the array dimension and add the constraint
      ' to it
      Set cTempIt = mcIterators(lngIndex)

      If cTempIt.IndOperation <> DeleteOp Then
         ' Set the operation to indicate an insert
         cTempIt.IndOperation = InsertOp
      End If
```

```
    Next lngIndex

    Exit Sub

UpdateIteratorVersionErr:
    mstrSource = mstrModuleName & "UpdateIteratorVersion"
    LogErrors Errors
    On Error GoTo 0
    Err.Raise vbObjectError + errUpdateFailed, _
          mstrSource, LoadResString(errUpdateFailed)

End Sub
Public Sub AddIterator(cItRecord As cIterator)
    ' Adds the iterator record to the collection of iterators
    ' for the step

    Call mcIterators.Add(cItRecord)

End Sub
Public Sub AddAllIterators()
    ' Sets the indicator variable for all iterators to insert

    Dim lngIndex As Long

    For lngIndex = 0 To mcIterators.Count - 1
        mcIterators(lngIndex).Validate
        mcIterators(lngIndex).IndOperation = InsertOp
    Next lngIndex

End Sub

Public Sub LoadIterator(cItRecord As cIterator)
    ' Adds the iterator record to the collection of iterators
    ' for the step

    Call mcIterators.Load(cItRecord)

End Sub
Public Sub UnloadIterators()
    ' Unloads all iterator records for the step

    Dim lngIndex As Long

    For lngIndex = mcIterators.Count - 1 To 0 Step -1
        ' Calls the collection method to unload the node
        ' from the array
        mcIterators.Unload lngIndex
    Next lngIndex

End Sub
Public Sub ModifyIterator(cItRecord As cIterator)
    ' Modifies the iterator record in the collection

    Call mcIterators.Modify(cItRecord)

End Sub
Public Sub DeleteIterator(cItRecord As cIterator)
    ' Deletes the iterator record from the database

    Call cItRecord.Delete(mlngStepId, mstrVersionNo)

End Sub
Public Sub RemoveIterator(cItRecord As cIterator)
    ' Marks the iterator record in the collection to
    ' indicate a delete

    Call mcIterators.Delete(cItRecord.Position)

End Sub

Private Sub AssignParameters(qyExec As DAO.QueryDef)
    ' Assigns values to the parameters in the querydef object
    ' The parameter names are cryptic to make them different
    ' from the actual field names. When the parameter names
    ' are the same as the field names, parameters in the
    ' where clause do not get created.

    Dim prmParam As DAO.Parameter

    On Error GoTo AssignParametersErr
    mstrSource = mstrModuleName & "AssignParameters"

    For Each prmParam In qyExec.Parameters
        Select Case prmParam.Name
            Case "[w_id]"
                prmParam.Value = mlngWorkspaceId
            Case "[s_id]"
                prmParam.Value = mlngStepId
            Case "[ver_no]"
                prmParam.Value = mstrVersionNo
            Case "[s_label]"
                prmParam.Value = mstrStepLabel
            Case "[s_file_name]"
                prmParam.Value = mstrStepTextFile
            Case "[s_text]"
                prmParam.Value = mstrStepText
            Case "[s_start_dir]"
                prmParam.Value = mstrStartDir
            Case "[p_step_id]"
                prmParam.Value = mlngParentStepId
            Case "[p_version_no]"
                prmParam.Value = mstrParentVersionNo
            Case "[seq_no]"
                prmParam.Value = mintSequenceNo
            Case "[enabled]"
                prmParam.Value = mblnEnabledFlag
            Case "[s_level]"
                prmParam.Value = mintStepLevel
            Case "[deg_parallelism]"
                prmParam.Value = mstrDegreeParallelism
            Case "[exec_mechanism]"
                prmParam.Value = mintExecutionMechanism
            Case "[fail_dtls]"
                prmParam.Value = mstrFailureDetails
            Case "[cont_criteria]"
                prmParam.Value = mintContinuationCriteria
            Case "[global]"
                prmParam.Value = mblnGlobalFlag
            Case "[archived]"
                prmParam.Value = mblnArchivedFlag
            Case "[output_file]"
                prmParam.Value = mstrOutputFile
'           Case "[log_file]"
'               prmParam.Value = mstrLogFile
            Case "[error_file]"
                prmParam.Value = mstrErrorFile
            Case "[it_name]"
                prmParam.Value = mstrIteratorName
            Case Else
                ' Write the parameter name that is faulty
                WriteError errInvalidParameter, mstrSource, _
                      prmParam.Name
                On Error GoTo 0
                Err.Raise errInvalidParameter, mstrSource, _
                      LoadResString(errInvalidParameter)
        End Select
    Next prmParam
```

```
    If qyExec.Parameters("s_id") = 0 Or
StringEmpty(qyExec.Parameters("ver_no")) Then
        WriteError errInvalidParameter, mstrSource
        On Error GoTo 0
        Err.Raise errInvalidParameter, mstrSource,
LoadResString(errInvalidParameter)
    End If

    Exit Sub

AssignParametersErr:

    mstrSource = mstrModuleName & "AssignParameters"
    Call LogErrors(Errors)
    On Error GoTo 0
    Err.Raise vbObjectError + errAssignParametersFailed, _
        mstrSource, LoadResString(errAssignParametersFailed)

End Sub

Public Sub Modify()

    Dim strUpdate As String
    Dim qy As QueryDef

    On Error GoTo ModifyErr
    mstrSource = mstrModuleName & "Modify"

    ' Check if the database object is valid
    Call CheckDB

    ' Check if the step record is valid
    Call Validate

    ' The step_id and version_no will never be updated -
    ' whenever a step is modified a copy of the old step will
    ' be created with an incremented version_no

#If USE_JET Then

    strUpdate = "update att_steps " & _
        " set step_label = [s_label] " & _
        " , step_file_name = [s_file_name] " & _
        " , step_text = [s_text] " & _
        " , start_directory = [s_start_dir] " & _
        " , workspace_id = [w_id] " & _
        " , parent_step_id = [p_step_id] " & _
        " , parent_version_no = [p_version_no] " & _
        " , sequence_no = [seq_no] " & _
        " , step_level = [s_level] " & _
        " , enabled_flag = [enabled] " & _
        " , degree_parallelism = [deg_parallelism] " & _
        " , execution_mechanism = [exec_mechanism] " & _
        " , failure_details = [fail_dtls] " & _
        " , continuation_criteria = [cont_criteria] " & _
        " , global_flag = [global] " & _
        " , archived_flag = [archived] " & _
        " , output_file_name = [output_file] " & _
        " , error_file_name = [error_file] " & _
        " , iterator_name = [it_name] "

        ' " , log_file_name = [log_file] " & _

    ' Append the Where clause
    strUpdate = strUpdate & " where step_id = [s_id] " & _
        " and version_no = [ver_no]"

    Set qy = mdbsDatabase.CreateQueryDef(gstrEmptyString, strUpdate)

    ' Call a procedure to execute the Querydef object
    Call AssignParameters(qy)
    qy.Execute dbFailOnError

    If qy.RecordsAffected = 0 Then
        On Error GoTo 0
        Err.Raise vbObjectError + errModifyStepFailed, _
            mstrSource, LoadResString(errModifyStepFailed)
    End If

    qy.Close

#Else

    strUpdate = "update att_steps " & _
        " set step_label = "

    ' For fields that may be null, call a function to determine
    ' the string to be appended to the update statement
    strUpdate = strUpdate &
mFieldValue.MakeStringFieldValid(mstrStepLabel)

    strUpdate = strUpdate & " , step_file_name = " &
mFieldValue.MakeStringFieldValid(mstrStepTextFile)
    strUpdate = strUpdate & " , step_text = " &
mFieldValue.MakeStringFieldValid(mstrStepText)
    strUpdate = strUpdate & " , start_directory = " &
mFieldValue.MakeStringFieldValid(mstrStartDir)

    strUpdate = strUpdate & " , workspace_id = " &
Str(mlngWorkspaceId) & _
        " , parent_step_id = " & Str(mlngParentStepId) & _
        " , parent_version_no = " &
mFieldValue.MakeStringFieldValid(mstrParentVersionNo) & _
        " , sequence_no = " & Str(mintSequenceNo) & _
        " , step_level = " & Str(mintStepLevel) & _
        " , enabled_flag = " & Str(mblnEnabledFlag) & _
        " , degree_parallelism = " &
mFieldValue.MakeStringFieldValid(mstrDegreeParallelism) & _
        " , execution_mechanism = " & Str(mintExecutionMechanism) & _
        " , failure_details = " &
mFieldValue.MakeStringFieldValid(mstrFailureDetails) & _
        " , continuation_criteria = " & Str(mintContinuationCriteria) & _
        " , global_flag = " & Str(mblnGlobalFlag) & _
        " , archived_flag = " & Str(mblnArchivedFlag) & _
        " , output_file_name = " &
mFieldValue.MakeStringFieldValid(mstrOutputFile) & _
        " , error_file_name = " &
mFieldValue.MakeStringFieldValid(mstrErrorFile) & _
        " , iterator_name = " &
mFieldValue.MakeStringFieldValid(mstrIteratorName)

'       " , log_file_name = " &
mFieldValue.MakeStringFieldValid(mstrLogFile) & _

    strUpdate = strUpdate & " where step_id = " & Str(mlngStepId) & _
        " and version_no = " &
mFieldValue.MakeStringFieldValid(mstrVersionNo)

    BugMessage strUpdate
    mdbsDatabase.Execute strUpdate, dbFailOnError
#End If

    Exit Sub

ModifyErr:
    LogErrors Errors
    mstrSource = mstrModuleName & "Modify"
    On Error GoTo 0
    Err.Raise vbObjectError + errModifyStepFailed, _
        mstrSource, LoadResString(errModifyStepFailed)
```

```
End Sub
Private Sub CheckDB()
   ' Check if the database object has been initialized

   If mdbsDatabase Is Nothing Then
      ShowError errInvalidDB
      On Error GoTo 0
      Err.Raise vbObjectError + errInvalidDB, _
         mstrModuleName, LoadResString(errInvalidDB)
   End If

End Sub

Public Sub Delete()

   Dim strDelete As String
   Dim qy As DAO.QueryDef

   On Error GoTo DeleteErr

   Call CheckDB

   strDelete = "delete from att_steps " & _
         " where step_id = [s_id] " & _
         " and version_no = [ver_no] "
'   mdbsDatabase.Execute strDelete, dbFailOnError
   Set qy = mdbsDatabase.CreateQueryDef(gstrEmptyString, strDelete)

   Call AssignParameters(qy)
   qy.Execute dbFailOnError

   qy.Close

   Exit Sub

DeleteErr:
   LogErrors Errors
   On Error GoTo 0
   Err.Raise vbObjectError + errDeleteStepFailed, _
         mstrModuleName & "Delete",
LoadResString(errDeleteStepFailed)
End Sub
Public Property Get DegreeParallelism() As String

   DegreeParallelism = mstrDegreeParallelism

End Property
Public Property Get Position() As Long

   Position = mlngPosition

End Property

Public Property Let DegreeParallelism(ByVal vdata As String)

   ' The degree of parallelism must be zero for all global steps
   ' This check must be made by the global step class. Only
   ' generic step validations will be carried out by this
   ' class
   mstrDegreeParallelism = vdata

End Property

Public Property Let ExecutionMechanism(ByVal vdata As
ExecutionMethod)

   BugAssert vdata = gintExecuteODBC Or vdata = gintExecuteShell
Or vdata = gintNoOption, _
         "Execution mechanism invalid"
   mintExecutionMechanism = vdata

End Property

Public Property Let FailureDetails(ByVal vdata As String)

   mstrFailureDetails = vdata

End Property
Public Property Let SequenceNo(ByVal vdata As Integer)
   mintSequenceNo = vdata
End Property

Public Property Let Position(ByVal vdata As Long)
   mlngPosition = vdata
End Property

Public Property Let ParentStepId(ByVal vdata As Long)
   mlngParentStepId = vdata
End Property

Public Property Get SequenceNo() As Integer

   SequenceNo = mintSequenceNo

End Property

Public Property Get StepLevel() As Integer
   StepLevel = mintStepLevel
End Property

Public Property Get ParentVersionNo() As String
   ParentVersionNo = mstrParentVersionNo
End Property

Public Property Let ParentVersionNo(ByVal vdata As String)
   mstrParentVersionNo = vdata
End Property

Public Property Get ParentStepId() As Long
   ParentStepId = mlngParentStepId
End Property

Public Property Let WorkspaceId(ByVal vdata As Long)
   mlngWorkspaceId = vdata
End Property

Public Property Let VersionNo(ByVal vdata As String)
   ' The version number of a step is stored in the x.y format where
   ' x represents a change to the step as a result of modifications
   ' to any of the step properties
   ' y represents a change to the step as a result of modifications
   ' to the sub-steps associated with it. Hence the y-component
   ' of the version will be incremented when a sub-step is added,
   ' modified or deleted
   ' x will be referred to throughout this code as the parent
   ' component of the version and y will be referred to as the
   ' child component of the version
   ' The version information for a step is maintained by the
   ' calling function

   mstrVersionNo = vdata

End Property

Public Property Get StepType() As gintStepType

   On Error GoTo StepTypeErr

   If mintStepType = 0 Then
      ' The step type variable has not been initialized -
```

```
      If mblnGlobalFlag Then
         mintStepType = gintGlobalStep
      ElseIf IsStringEmpty(mstrStepText) And _
            IsStringEmpty(mstrStepTextFile) Then
         mintStepType = gintManagerStep
      Else
         mintStepType = gintWorkerStep
      End If
   End If

   StepType = mintStepType

   Exit Property

StepTypeErr:
   LogErrors Errors
   mstrSource = mstrModuleName & "StepType"
   On Error GoTo 0
   Err.Raise vbObjectError + errGetStepTypeFailed, _
         mstrSource, _
         LoadResString(errGetStepTypeFailed)

End Property

Public Property Let StepType(vdata As gintStepType)

   On Error GoTo StepTypeErr

   Select Case vdata
      Case gintGlobalStep, gintManagerStep, gintWorkerStep
         mintStepType = vdata

      Case Else
         On Error GoTo 0
         Err.Raise vbObjectError + errStepTypeInvalid, _
               mstrModuleName & "StepType",
LoadResString(errStepTypeInvalid)
   End Select
   Exit Property

StepTypeErr:
   LogErrors Errors
   mstrSource = mstrModuleName & "StepType"
   On Error GoTo 0
   Err.Raise vbObjectError + errLetStepTypeFailed, _
         mstrSource, _
         LoadResString(errLetStepTypeFailed)

End Property

Public Property Get WorkspaceId() As Long
   WorkspaceId = mlngWorkspaceId
End Property

Public Property Get ContinuationCriteria() As ContinuationCriteria

   ContinuationCriteria = mintContinuationCriteria

End Property

Public Property Let ContinuationCriteria(ByVal vdata As
ContinuationCriteria)

   ' The Continuation criteria must be null for all global steps
   ' and non-null for all manager and worker steps
   ' These checks will have to be made by the corresponding
   ' classes - only generic step validations will be made
   ' by this class
   BugAssert vdata = gintOnFailureAbortSiblings Or vdata =
gintOnFailureCompleteSiblings _
         Or vdata = gintOnFailureSkipSiblings Or vdata =
gintOnFailureAbort _
         Or vdata = gintOnFailureContinue Or vdata =
gintOnFailureAsk _
         Or vdata = gintNoOption, _
         "Invalid continuation criteria"
   mintContinuationCriteria = vdata

End Property
Public Property Get ExecutionMechanism() As ExecutionMethod

   ExecutionMechanism = mintExecutionMechanism

End Property


Public Property Get FailureDetails() As String

   FailureDetails = mstrFailureDetails

End Property

Public Property Let StepText(ByVal vdata As String)
   ' Has to be null for manager steps
   ' The check will have to be made by the user interface or
   ' by the manager step class
   mstrStepText = vdata
End Property
Public Property Let StepLevel(ByVal vdata As Integer)

   ' The step level must be zero for all global steps
   ' This check must be made in the global step class
   mintStepLevel = vdata

End Property
Public Property Get StepText() As String
   StepText = mstrStepText
End Property

Public Property Let StepTextFile(ByVal vdata As String)
   ' Has to be null for manager steps
   ' The check will have to be made by the user interface and
   ' by the manager step class
   mstrStepTextFile = vdata
End Property

Public Property Get StepTextFile() As String
   StepTextFile = mstrStepTextFile
End Property

Public Property Let StepLabel(ByVal vdata As String)
   ' Cannot be null for manager steps
   ' But this check cannot be made here since we do not know
   ' at this point if the step being created is a manager
   ' or a worker step
   ' The check will have to be made by the user interface and
   ' by the manager step class
   mstrStepLabel = vdata
End Property

Public Property Get StepLabel() As String
   StepLabel = mstrStepLabel
End Property

Public Property Let StartDir(ByVal vdata As String)
   mstrStartDir = vdata
End Property

Public Property Get StartDir() As String
   StartDir = mstrStartDir
```

```
End Property

Public Property Get VersionNo() As String
   ' The version number of a step is stored in the x.y format where
   ' x represents a change to the step as a result of modifications
   ' to any of the step properties
   ' y represents a change to the step as a result of modifications
   ' to the sub-steps associated with it. Hence the y-component
   ' of the version will be incremented when a sub-step is added,
   ' modified or deleted
   ' x will be referred to throughout this code as the parent
   ' component of the version and y will be referred to as the
   ' child component of the version
   ' The version information for a step is maintained by the
   ' calling function

   VersionNo = mstrVersionNo

End Property

Public Property Get StepId() As Long

   StepId = mlngStepId

End Property
Public Property Get NextStepId() As Long

   Dim lngNextId As Long

   On Error GoTo NextStepIdErr

   ' First check if the database object is valid
   Call CheckDB

   ' Retrieve the next identifier using the sequence class
   Set mStepSeq = New cSequence
   Set mStepSeq.IdDatabase = mdbsDatabase
   mStepSeq.IdentifierColumn = "step_id"
   lngNextId = mStepSeq.Identifier
   Set mStepSeq = Nothing

   NextStepId = lngNextId
   Exit Property

NextStepIdErr:
   LogErrors Errors
   mstrSource = mstrModuleName & "NextStepId"
   On Error GoTo 0
   Err.Raise vbObjectError + errStepIdGetFailed, _
      mstrSource, LoadResString(errStepIdGetFailed)

End Property
Public Property Let StepId(ByVal vdata As Long)

   mlngStepId = vdata

End Property

Private Sub Class_Initialize()

   ' Initialize the operation indicator variable to Query
   ' It will be modified later by the collection class when
   ' inserts, updates or deletes are performed
   mintOperation = QueryOp
   mbIsNewVersion = False
   msOldVersion = gstrEmptyString

   Set mFieldValue = New cStringSM
   Set mcIterators = New cNodeCollections

End Sub

Private Sub Class_Terminate()

   Set mFieldValue = Nothing
   Set mcIterators = Nothing

End Sub
```

cStepTree.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cStepTree"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:       cStepTree.cls
'              Microsoft TPC-H Kit Ver. 1.00
'              Copyright Microsoft, 1999
'              All Rights Reserved
'
'
'  PURPOSE:    Implements step navigation functions such as
determining
'              the child of a step and so on.
'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

' Used to indicate the source module name when errors
' are raised by this class
Private Const mstrModuleName As String = "cStepTree."
Private mstrSource As String

Public StepRecords As cArrSteps
Public Property Get HasChild(Optional ByVal StepKey As String, _
      Optional ByVal StepId As Long = 0) As Boolean

   Dim lTemp As Long

   HasChild = False
   StepId = GetStepId(StepKey, StepId)

   For lTemp = 0 To StepRecords.StepCount - 1
      If StepRecords(lTemp).StepType <> gintGlobalStep And
StepRecords(lTemp).ParentStepId = StepId Then
         HasChild = True
         Exit For
      End If
   Next lTemp

End Property
Public Property Get ChildStep(Optional ByVal StepKey As String, _
      Optional ByVal StepId As Long = 0) As cStep

   Dim lTemp As Long

   Set ChildStep = Nothing
   StepId = GetStepId(StepKey, StepId)

   For lTemp = 0 To StepRecords.StepCount - 1
      If StepRecords(lTemp).StepType <> gintGlobalStep And
StepRecords(lTemp).ParentStepId = StepId And _
            StepRecords(lTemp).SequenceNo = gintMinSequenceNo
Then
         Set ChildStep = StepRecords(lTemp)
```

```
        Exit For
      End If
    Next lTemp

End Property
Public Property Get NextStep(Optional ByVal StepKey As String, _
      Optional ByVal StepId As Long = 0) As cStep

    Dim lTemp As Long
    Dim cChildStep As cStep

    Set NextStep = Nothing
    StepId = GetStepId(StepKey, StepId)
    Set cChildStep = StepRecords.QueryStep(StepId)

    For lTemp = 0 To StepRecords.StepCount - 1
      If StepRecords(lTemp).StepType <> gintGlobalStep And _
            StepRecords(lTemp).ParentStepId = cChildStep.ParentStepId
And _
            StepRecords(lTemp).SequenceNo = cChildStep.SequenceNo
+ 1 Then
        Set NextStep = StepRecords(lTemp)
        Exit For
      End If
    Next lTemp

End Property
Private Function GetStepId(Optional ByVal StepKey As String, _
      Optional ByVal StepId As Long = 0) As Long
    If StepId = 0 Then
      If StringEmpty(StepKey) Then
        Err.Raise vbObjectError + errMandatoryParameterMissing, _
              mstrModuleName & "GetStepId",
LoadResString(errMandatoryParameterMissing)
      Else
        GetStepId = IIf(IsLabel(StepKey), 0,
MakeIdentifierValid(StepKey))
      End If
    Else
      GetStepId = StepId
    End If
End Function
```

cStringSM.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cStringSM"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:       cStringSM.cls
'              Microsoft TPC-H Kit Ver. 1.00
'              Copyright Microsoft, 1999
'              All Rights Reserved
'
'
'  PURPOSE:    This module contains common procedures that can be
used
'              to manipulate strings
'              It is called StringSM, since String is a Visual Basic keyword
'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

' Used to indicate the source module name when errors
' are raised by this class
Private mstrSource As String
Private Const mstrModuleName As String = "cStringSM."

Private mstrText As String

Private Const mstrNullValue = "null"
Private Const mstrSQ = "'"
Private Const mstrEnvVarSeparator = "%"
Public Function InsertEnvVariables( _
      Optional ByVal strComString As String) As String
    ' This function replaces all environment variables in
    ' the passed in string with their values - they are
    ' enclosed by "%"

    Dim intPos As Integer
    Dim intEndPos As Integer
    Dim strEnvVariable As String
    Dim strValue As String
    Dim strCommand As String

    On Error GoTo InsertEnvVariablesErr
    mstrSource = mstrModuleName & "InsertEnvVariables"

    ' Initialize the return value of the function to the
    ' passed in command
    If IsStringEmpty(strComString) Then
      strCommand = mstrText
    Else
      strCommand = strComString
    End If

    intPos = InStr(strCommand, mstrEnvVarSeparator)
    Do While intPos <> 0
      ' Extract the environment variable from the passed
      ' in string
      intEndPos = InStr(intPos + 1, strCommand, mstrEnvVarSeparator)
      strEnvVariable = Mid(strCommand, intPos + 1, intEndPos - intPos
- 1)

      ' Get the value of the variable and call a function
      ' to replace the variable with it's value
      strValue = Environ$(strEnvVariable)
      strCommand = ReplaceSubString(strCommand, _
            mstrEnvVarSeparator & strEnvVariable &
mstrEnvVarSeparator, _
            strValue)

      intPos = InStr(strCommand, mstrEnvVarSeparator)
    Loop

    InsertEnvVariables = strCommand
    Exit Function

InsertEnvVariablesErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    ' Return an empty string
    InsertEnvVariables = gstrEmptyString

End Function
Public Function MakeStringFieldValid( _
      Optional strField As String = gstrEmptyString) As String
    ' Returns a string that can be appended to any insert
    ' or modify (sql) statement
    ' If an argument is not passed to this function, the
    ' default text property is used

    Dim strTemp As String

    On Error GoTo MakeStringFieldValidErr
```

```
    If IsStringEmpty(strField) Then
        strTemp = mstrText
    Else
        strTemp = strField
    End If

    ' It checks whether the text is empty
    ' If so, it returns the string, "null"
    If IsStringEmpty(strTemp) Then
        MakeStringFieldValid = mstrNullValue
    Else
        ' Single-quotes have to be replaced by two single-quotes,
        ' since a single-quote is the identifier delimiter
        ' character - call a procedure to do the replace
        strTemp = ReplaceSubString(strTemp, mstrSQ, mstrSQ & mstrSQ)

        ' Replace pipe characters with the corresponding chr function
        strTemp = ReplaceSubString(strTemp, "|", "' & Chr(124) & '")

        ' Enclose the string in single quotes
        MakeStringFieldValid = mstrSQ & strTemp & mstrSQ

    End If

    Exit Function

MakeStringFieldValidErr:
    mstrSource = mstrModuleName & "MakeStringFieldValid"
    LogErrors Errors
    On Error GoTo 0
    Err.Raise vbObjectError + errMakeFieldValidFailed, _
            mstrSource, LoadResString(errMakeFieldValidFailed)

End Function
Public Function MakeDateFieldValid( _
        Optional dtmField As Date = gdtmEmpty) As String
    ' Returns a string that can be appended to any insert
    ' or modify (sql) statement

    ' Enclose the date in single quotes
    MakeDateFieldValid = mstrSQ & dtmField & mstrSQ

End Function

Private Function IsStringEmpty(strToCheck As String) As Boolean

    If strToCheck = gstrEmptyString Then
        IsStringEmpty = True
    Else
        IsStringEmpty = False
    End If

End Function
Public Function ReplaceSubString(ByVal MainString As String, _
        ByVal ReplaceString As String, _
        ByVal ReplaceWith As String) As String

    ' Replaces all occurrences of ReplaceString in MainString with
ReplaceWith

    Dim intPos As Integer
    Dim strTemp As String

    On Error GoTo ReplaceSubStringErr

    strTemp = MainString

    intPos = InStr(strTemp, ReplaceString)
    Do While intPos <> 0
        strTemp = Left(strTemp, intPos - 1) & ReplaceWith & _
                Mid(strTemp, intPos + Len(ReplaceString))
        intPos = InStr(intPos + Len(ReplaceString) + 1, strTemp,
ReplaceString)
    Loop
    ReplaceSubString = strTemp

    Exit Function

ReplaceSubStringErr:
    Call LogErrors(Errors)
    mstrSource = mstrModuleName & "ReplaceSubString"
    On Error GoTo 0
    Err.Raise vbObjectError + errParseStringFailed, _
        mstrSource, _
        LoadResString(errParseStringFailed)

End Function

Public Property Get Text() As String
Attribute Text.VB_UserMemId = 0
    Text = mstrText
End Property

Public Property Let Text(ByVal vdata As String)
    mstrText = vdata
End Property
```

cSubStep.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cSubStep"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:       cSubStep.cls
'              Microsoft TPC-H Kit Ver. 1.00
'              Copyright Microsoft, 1999
'              All Rights Reserved
'
'
'  PURPOSE:    This module encapsulates the properties of sub-steps
'              that are used during the execution of a workspace.
'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

' Used to indicate the source module name when errors
' are raised by this class
Private Const mstrModuleName As String = "cSubStep"

Private mlngStepId As Long
Private mintRunning As Integer ' Number of running tasks
Private mintComplete As Integer ' Number of completed tasks
' The last iterator for this sub-step
Private mcLastIterator As cRunItDetails

Public Function NewIteration(cStepRec As cStep) As cIterator
    ' Calls a procedure to determine the next iterator value
    ' for the passed in step - returns the value to be used
    ' in the iteration.
    ' It updates the instance node with the new iteration
    ' for the step.

    Dim cItRec As cIterator
```

```
   On Error GoTo NewIterationErr

   ' Call a function that will populate an iterator record
   ' with the iterator values
   Set cItRec = NextIteration(cStepRec)

   ' Initialize the run node with the new iterator
   ' values
   If Not mcLastIterator Is Nothing Then
      If cItRec Is Nothing Then
         mcLastIterator.Value = gstrEmptyString
      Else
         mcLastIterator.Value = cItRec.Value

         ' And if the iterator is a list of values, then update
         ' the sequence number as well
         If mcLastIterator.IteratorType = gintValue Then
            mcLastIterator.Sequence = cItRec.SequenceNo
         End If
      End If
   End If

   Set NewIteration = cItRec
   Set cItRec = Nothing

   Exit Function

NewIterationErr:
   ' Log the error code raised by Visual Basic
   Call LogErrors(Errors)
   On Error GoTo 0
   Err.Raise vbObjectError + errIterateFailed, mstrModuleName, _
      LoadResString(errIterateFailed)

End Function
Public Function NextIteration(cStepRec As cStep) As cIterator

   ' Retrieves the next iterator value for the passed in step -
   ' returns an iterator record with the new iterator values

   Dim cItRec As cIterator
   Dim vntIterators As Variant
   Dim lngValue As String

   On Error GoTo NextIterationErr

   vntIterators = cStepRec.Iterators

   If Not mcLastIterator Is Nothing Then
      ' The run node contains the iterator details
      ' Get the next value for the iterator
      If mcLastIterator.IteratorType = gintValue Then
         ' Find the next iterator that appears in the list of
         ' iterator values
         Set cItRec = NextInSequence(vntIterators,
mcLastIterator.Sequence)
      Else
         lngValue = CLng(Trim$(mcLastIterator.Value))
         ' Determine whether the new iterator value falls in the
         ' range between From and To
         If (mcLastIterator.RangeStep > 0 And _
               (mcLastIterator.RangeFrom <= mcLastIterator.RangeTo)
And _
               (mcLastIterator.RangeStep + lngValue) <=
mcLastIterator.RangeTo) Or _
               (mcLastIterator.RangeStep < 0 And _
               (mcLastIterator.RangeFrom >= mcLastIterator.RangeTo)
And _
               (mcLastIterator.RangeStep + lngValue) >=
mcLastIterator.RangeTo) Then
            Set cItRec = New cIterator
            cItRec.Value = Trim$(CStr(mcLastIterator.RangeStep +
lngValue))
         Else
            Set cItRec = Nothing
         End If
      End If
   Else
      Set cItRec = Nothing
   End If

   Set NextIteration = cItRec
   Exit Function

NextIterationErr:
   ' Log the error code raised by Visual Basic
   Call LogErrors(Errors)
   On Error GoTo 0
   Err.Raise vbObjectError + errIterateFailed, mstrModuleName, _
      LoadResString(errIterateFailed)

End Function
Public Sub InitializeIt(cPendingStep As cStep, _
      ColParameters As cArrParameters, _
      Optional vntIterators As Variant)

   ' Initializes the LastIteration structure with the iterator details for the
   ' passed in step

   On Error GoTo InitializeItErr

   If IsMissing(vntIterators) Then
      vntIterators = cPendingStep.Iterators
   End If

   If IsArray(vntIterators) And Not IsEmpty(vntIterators) Then
      mcLastIterator.IteratorName = cPendingStep.IteratorName
      If vntIterators(LBound(vntIterators)).IteratorType = _
            gintValue Then
         mcLastIterator.IteratorType = gintValue
         ' Since the sequence numbers begin at 0
         mcLastIterator.Sequence = gintMinIteratorSequence - 1
      Else
         mcLastIterator.IteratorType = gintFrom
         Call InitializeItRange(vntIterators, cPendingStep.WorkspaceId,
_
               ColParameters)
      End If
   Else
      Set mcLastIterator = Nothing
   End If

   Exit Sub

InitializeItErr:
   ' Log the error code raised by Visual Basic
   Call LogErrors(Errors)
   On Error GoTo 0
   Err.Raise vbObjectError + errIterateFailed, mstrModuleName, _
      LoadResString(errIterateFailed)

End Sub

Private Sub InitializeItRange(vntIterators As Variant, ByVal
lWorkspace As Long, _
      ColParameters As cArrParameters)

   ' Initializes the LastIteration structure for range iterators from the
   ' passed in variant containing the iterator records
```

```
   Dim lngIndex As Long
   Dim cItRec As cIterator

   On Error GoTo InitializeItRangeErr

   If IsArray(vntIterators) And Not IsEmpty(vntIterators) Then

      ' Check if the iterator range has been completely initialized
      RangeComplete (vntIterators)

      ' Initialize the Run node with the values for the From,
      ' To and Step boundaries
      For lngIndex = LBound(vntIterators) To UBound(vntIterators)
         Set cItRec = vntIterators(lngIndex)
         Select Case cItRec.IteratorType
            Case gintFrom
               mcLastIterator.RangeFrom =
SubstituteParameters(cItRec.Value, lWorkspace,
WspParameters:=ColParameters)
            Case gintTo
               mcLastIterator.RangeTo =
SubstituteParameters(cItRec.Value, lWorkspace,
WspParameters:=ColParameters)
            Case gintStep
               mcLastIterator.RangeStep =
SubstituteParameters(cItRec.Value, lWorkspace,
WspParameters:=ColParameters)
            Case Else
               On Error GoTo 0
               Err.Raise vbObjectError + errTypeInvalid,
mstrModuleName, _
                     LoadResString(errTypeInvalid)
         End Select
      Next lngIndex

      mcLastIterator.Value = Trim$(CStr(mcLastIterator.RangeFrom -
mcLastIterator.RangeStep))
   End If

   Exit Sub

InitializeItRangeErr:
   ' Log the error code raised by Visual Basic
   Call LogErrors(Errors)
   On Error GoTo 0
   Err.Raise vbObjectError + errIterateFailed, mstrModuleName, _
      LoadResString(errIterateFailed)

End Sub
Private Function NextInSequence(vntIterators As Variant, _
      lngOldSequence As Long) As cIterator

   Dim lngIndex As Long
   Dim cItRec As cIterator

   On Error GoTo NextInSequenceErr

   If IsArray(vntIterators) And Not IsEmpty(vntIterators) Then
      For lngIndex = LBound(vntIterators) To UBound(vntIterators)
         Set cItRec = vntIterators(lngIndex)
         If cItRec.IteratorType <> gintValue Then
            On Error GoTo 0
            Err.Raise vbObjectError + errTypeInvalid, mstrModuleName,
_
                  LoadResString(errTypeInvalid)
         End If
         If cItRec.SequenceNo = lngOldSequence + 1 Then
            Exit For
         End If
      Next lngIndex

      If cItRec.SequenceNo <> lngOldSequence + 1 Then
         Set cItRec = Nothing
      End If
   Else
      Set cItRec = Nothing
   End If

   Set NextInSequence = cItRec

   Exit Function

NextInSequenceErr:
   ' Log the error code raised by Visual Basic
   Call LogErrors(Errors)
   On Error GoTo 0
   Err.Raise vbObjectError + errIterateFailed, mstrModuleName, _
      LoadResString(errIterateFailed)

End Function

Public Property Get LastIterator() As cRunItDetails

   Set LastIterator = mcLastIterator

End Property
Public Property Set LastIterator(vdata As cRunItDetails)

   Set mcLastIterator = vdata

End Property

Public Property Get TasksRunning() As Integer

   TasksRunning = mintRunning

End Property

Public Property Let TasksRunning(ByVal vdata As Integer)

   mintRunning = vdata

End Property

Public Property Get TasksComplete() As Integer

   TasksComplete = mintComplete

End Property
Public Property Let TasksComplete(ByVal vdata As Integer)

   mintComplete = vdata

End Property
Public Property Get StepId() As Long

   StepId = mlngStepId

End Property
Public Property Let StepId(ByVal vdata As Long)

   mlngStepId = vdata

End Property
```

cSubSteps.cls

```
VERSION 1.0 CLASS
BEGIN
```

```
  MultiUse = -1  'True
END
Attribute VB_Name = "cSubSteps"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:       cSubSteps.cls
'              Microsoft TPC-H Kit Ver. 1.00
'              Copyright Microsoft, 1999
'              All Rights Reserved
'
'
'  PURPOSE:    This module provides a type-safe wrapper around
cVector to
'              implement a collection of cSubStep objects.
'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

Private mcSubSteps As cVector

Public Sub Add(ByVal objItem As cSubStep)

   mcSubSteps.Add objItem

End Sub


Public Sub Clear()

   mcSubSteps.Clear

End Sub


Public Function Count() As Long

   Count = mcSubSteps.Count

End Function


Public Function Delete(ByVal lngDelete As Long) As cSubStep

   Set Delete = mcSubSteps.Delete(lngDelete)

End Function


Public Property Get Item(ByVal Position As Long) As cSubStep
Attribute Item.VB_UserMemId = 0

   Set Item = mcSubSteps.Item(Position)

End Property

Private Sub Class_Initialize()

   Set mcSubSteps = New cVector

End Sub

Private Sub Class_Terminate()

   Set mcSubSteps = Nothing

End Sub
```

cTermProcess.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cTermProcess"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:       cTermProcess.cls
'              Microsoft TPC-H Kit Ver. 1.00
'              Copyright Microsoft, 1999
'              All Rights Reserved
'
'
'  PURPOSE:    This module raises an event if a completed step exists.
'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

Private WithEvents moTimer As cTimerSM
Attribute moTimer.VB_VarHelpID = -1
Private bTermProcessExists As Boolean
Public Event TermProcessExists()

Public Sub ProcessTerminated()

   bTermProcessExists = True
   moTimer.Enabled = True

End Sub

Private Sub Class_Initialize()

   bTermProcessExists = False

   Set moTimer = New cTimerSM
   moTimer.Enabled = False

End Sub

Private Sub Class_Terminate()

   Set moTimer = Nothing

End Sub

Private Sub moTimer_Timer()

   On Error GoTo moTimer_TimerErr

   If bTermProcessExists Then
      RaiseEvent TermProcessExists
   End If

   moTimer.Enabled = False
   bTermProcessExists = False

   Exit Sub

moTimer_TimerErr:
   LogErrors Errors

End Sub
```

cTermStep.cls

```
VERSION 1.0 CLASS
```

```
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cTermStep"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:       cTermStep.cls
'              Microsoft TPC-H Kit Ver. 1.00
'              Copyright Microsoft, 1999
'              All Rights Reserved
'
'
'  PURPOSE:    This module encapsulates the properties of steps that
'              have completed execution such as status and time of
completion.
'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

Public TimeComplete As Currency
Public Index As Long
Public InstanceId As Long
Public ExecutionStatus As InstanceStatus
```

cTermSteps.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cTermSteps"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:       cTermSteps.cls
'              Microsoft TPC-H Kit Ver. 1.00
'              Copyright Microsoft, 1999
'              All Rights Reserved
'
'
'  PURPOSE:    This module provides a type-safe wrapper around
cVector to
'              implement a collection of cTermStep objects. Raises an
'              event if a step that has completed execution exists.
'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

Private mcTermSteps As cVector
Private WithEvents moTimer As cTimerSM
Attribute moTimer.VB_VarHelpID = -1
Public Event TermStepExists(cStepDetails As cTermStep)

Public Sub Add(ByVal citem As cTermStep)

   Call mcTermSteps.Add(citem)
   moTimer.Enabled = True

End Sub

Public Sub Clear()

   mcTermSteps.Clear

End Sub

Public Function Delete()

   Call mcTermSteps.Delete(0)
   ' Disable the timer if there are no more pending events
   If mcTermSteps.Count = 0 Then moTimer.Enabled = False

End Function

Public Property Get Item(ByVal Position As Long) As cTermStep

   Set Item = mcTermSteps(Position)

End Property

Public Function Count() As Long

   Count = mcTermSteps.Count

End Function

Private Sub Class_Initialize()

   Set mcTermSteps = New cVector

   Set moTimer = New cTimerSM
   moTimer.Enabled = False

End Sub

Private Sub Class_Terminate()

   Set mcTermSteps = Nothing
   Set moTimer = Nothing

End Sub

Private Sub moTimer_Timer()

   On Error GoTo moTimer_TimerErr

   If mcTermSteps.Count > 0 Then
      ' Since items are appended to the end of the array
      RaiseEvent TermStepExists(mcTermSteps(0))
   Else
      moTimer.Enabled = False
   End If
   Exit Sub

moTimer_TimerErr:
   LogErrors Errors

End Sub
```

cTimerSM.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cTimerSM"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:       cTimer.cls
'              Microsoft TPC-H Kit Ver. 1.00
'              Copyright Microsoft, 1999
'              All Rights Reserved
'
'
'  PURPOSE:    This module implements a timer.
```

```
'  Contact:     Reshma Tharamal (reshmat@microsoft.com)
'

Option Explicit

Public Event Timer()

Private Const mnDefaultInterval As Long = 1

Private mnTimerID As Long
Private mnInterval As Long
Private mfEnabled As Boolean

Public Property Get Interval() As Long
   Interval = mnInterval
End Property
Public Property Let Interval(Value As Long)
   If mnInterval <> Value Then
      mnInterval = Value
      If mfEnabled Then
         SetInterval mnInterval, mnTimerID
      End If
   End If
End Property

Public Property Get Enabled() As Boolean
   Enabled = mfEnabled
End Property
Public Property Let Enabled(Value As Boolean)
   If mfEnabled <> Value Then
      If Value Then
         mnTimerID = StartTimer(mnInterval)
         If mnTimerID <> 0 Then
            mfEnabled = True
            'Storing Me in the global would add a reference to Me, which
            '   would prevent Me from being released, which in turn would
            '   prevent my Class_Terminate code from running. To prevent
            '   this, I store a "soft reference" - the collection holds a
            '   pointer to me without incrementing my reference count.
            gcTimerObjects.Add ObjPtr(Me), Str$(mnTimerID)
         End If
      Else
         StopTimer mnTimerID
         mfEnabled = False
         gcTimerObjects.Remove Str$(mnTimerID)
      End If
   End If
End Property

Private Sub Class_Initialize()
   If gcTimerObjects Is Nothing Then Set gcTimerObjects = New
Collection
   mnInterval = mnDefaultInterval
End Sub

Private Sub Class_Terminate()
   Enabled = False
End Sub

Friend Sub Tick()
   RaiseEvent Timer
End Sub
```

cVBErrorsSM.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cVBErrorsSM"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
Attribute VB_Ext_KEY = "SavedWithClassBuilder" ,"Yes"
Attribute VB_Ext_KEY = "Top_Level" ,"Yes"
'  FILE:       cVBErrors.cls
'              Microsoft TPC-H Kit Ver. 1.00
'              Copyright Microsoft, 1999
'              All Rights Reserved
'
'
'  PURPOSE:     This module encapsulates the handling of Visual Basic
errors.
'              This module does not do any error handling - any error
handler
'              will erase the errors object!
'  Contact:     Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

' The Execute class exposes a method, WriteError through which we can
write to the
' error log that is currently being used by the Execute object. Store a
reference to
' Execute object locally.
Private mcExecObjRef As EXECUTEDLLLib.Execute
Public Sub WriteError(ByVal ErrorCode As errErrorConstants, _
       Optional ByVal ErrorSource As String = gstrEmptyString, _
       Optional ByVal OptArgs As String = gstrEmptyString)

   Dim sError As String

   sError = "StepMaster Error:" & ErrorCode & vbCrLf &
LoadResString(ErrorCode) & vbCrLf

   If Not StringEmpty(ErrorSource) Then
      sError = sError & "(Source: " & ErrorSource & ")" & vbCrLf
   End If
   sError = sError & OptArgs

   Call LogMessage(sError)

End Sub
Private Function InitErrorString() As String
   ' Initializes a string with all the properties of the
   ' Err object

   Dim strError As String
   Dim errCode As Long

   If Err.Number = 0 Then
      InitErrorString = gstrEmptyString
   Else
   With Err
      If Err.Number > vbObjectError And Err.Number < (vbObjectError
+ 65536) Then
         errCode = .Number - vbObjectError
      Else
         errCode = .Number
      End If
      strError = "Error #: " & errCode & vbCrLf
      strError = strError & "Description: " & .Description & vbCrLf
      strError = strError & "Source: " & Err.Source & vbCrLf
   End With

   Debug.Print strError
   InitErrorString = strError
   End If
```

```
End Function
Public Sub LogVBErrors()

   Dim strErr As String

   strErr = InitErrorString

   On Error GoTo LogVBErrorsErr

   If Not StringEmpty(strErr) Then
      ' Write an error using the WriteError method of the Execute object.
      If Not mcExecObjRef Is Nothing Then
         mcExecObjRef.WriteError strErr
      Else
         WriteMessage strErr
      End If
   End If

   Err.Clear

   Exit Sub

LogVBErrorsErr:
   Call LogErrors(Errors)
   ' Since write to the error file for the step has failed, write to the
project log
   Call WriteMessage(strErr)

End Sub
Public Sub DisplayErrors()

   Dim strErr As String

   strErr = InitErrorString

   If Not StringEmpty(strErr) Then
      ' Display the error message
      MsgBox strErr
   End If

   Err.Clear

End Sub
Public Sub LogMessage(strMsg As String)

   On Error GoTo LogMessageErr

   ' Write an error using the WriteError method of the Execute object.
   If Not mcExecObjRef Is Nothing Then
      mcExecObjRef.WriteError strMsg
   Else
      WriteMessage strMsg
   End If

   Exit Sub

LogMessageErr:
   Call LogErrors(Errors)
   ' Since write to the error file for the step has failed, write to the
project log
   Call WriteMessage(strMsg)

End Sub
Public Property Set ErrorFile(vdata As EXECUTEDLLLib.Execute)

   Set mcExecObjRef = vdata

End Property
Private Sub Class_Terminate()

   Set mcExecObjRef = Nothing

End Sub
```

cVector.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cVector"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:       cVector.cls
'              Microsoft TPC-H Kit Ver. 1.00
'              Copyright Microsoft, 1999
'              All Rights Reserved
'
'
'  PURPOSE:     This class implements an array of objects.
'  Contact:     Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

' Used to indicate the source module name when errors
' are raised by this class
Private mstrSource As String
Private Const mstrModuleName As String = "cVector."

' Array counter
Private mlngCount As Long
Private mcarrItems() As Object

Public Sub Add(ByVal objItem As Object)
   ' Adds the passed in Object variable to the array

   On Error GoTo AddErr

   ReDim Preserve mcarrItems(mlngCount)

   ' Set the newly added element in the array to the
   ' passed in variable
   Set mcarrItems(mlngCount) = objItem
   mlngCount = mlngCount + 1

   Exit Sub

AddErr:
   LogErrors Errors
   gstrSource = mstrModuleName & "Add"
   On Error GoTo 0
   Err.Raise vbObjectError + errLoadInArrayFailed, _
         mstrSource, _
         LoadResString(errLoadInArrayFailed)

End Sub
Public Sub Clear()

   ' Clear the array
   ReDim mcarrItems(0)
   mlngCount = 0

End Sub

Public Function Delete(ByVal lngDelete As Long) As Object

   Dim lngIndex As Long
```

```
    On Error GoTo DeleteErr

    If lngDelete < (mlngCount - 1) Then

        ' We want to maintain the order of all items in the
        ' array - so move all remaining elements in the array
        ' up by 1
        For lngIndex = lngDelete To mlngCount - 2
            MoveDown lngIndex
        Next lngIndex

    End If

    ' Return the deleted node
    Set Delete = mcarrItems(mlngCount - 1)

    ' Delete the last Node from the array
    mlngCount = mlngCount - 1
    If mlngCount > 0 Then
        ReDim Preserve mcarrItems(0 To mlngCount - 1)
    Else
        ReDim mcarrItems(0)
    End If

    Exit Function

DeleteErr:
    LogErrors Errors
    mstrSource = mstrModuleName & "Delete"
    On Error GoTo 0
    Err.Raise vbObjectError + errDeleteArrayElementFailed, _
            mstrSource, _
            LoadResString(errDeleteArrayElementFailed)

End Function
Public Property Get Item(ByVal Position As Long) As Object
Attribute Item.VB_UserMemId = 0

    ' Returns the element at the passed in position in the array
    If Position >= 0 And Position < mlngCount Then
        Set Item = mcarrItems(Position)
    Else
        On Error GoTo 0
        Err.Raise vbObjectError + errItemDoesNotExist, mstrSource, _
            LoadResString(errItemDoesNotExist)
    End If

End Property
Public Property Set Item(ByVal Position As Long, _
        ByVal Value As Object)

    ' Returns the element at the passed in position in the array
    If Position >= 0 Then
        ' If the passed in position is outside the array
        ' bounds, then resize the array
        If Position >= mlngCount Then
            ReDim Preserve mcarrItems(Position)
            mlngCount = Position + 1
        End If

        ' Set the newly added element in the array to the
        ' passed in variable
        Set mcarrItems(Position) = Value
    Else
        On Error GoTo 0
        Err.Raise vbObjectError + errItemDoesNotExist, mstrSource, _
            LoadResString(errItemDoesNotExist)
    End If

End Property
Public Sub MoveUp(ByVal Position As Long)
    ' Moves the element at the passed in position up by 1

    Dim cTemp As Object

    If Position > 0 And Position < mlngCount Then
        Set cTemp = mcarrItems(Position)

        Set mcarrItems(Position) = mcarrItems(Position - 1)
        Set mcarrItems(Position - 1) = cTemp
    End If

End Sub
Public Sub MoveDown(ByVal Position As Long)
    ' Moves the element at the passed in position down by 1

    Dim cTemp As Object

    If Position >= 0 And Position < mlngCount - 1 Then
        Set cTemp = mcarrItems(Position)

        Set mcarrItems(Position) = mcarrItems(Position + 1)
        Set mcarrItems(Position + 1) = cTemp
    End If

End Sub

Public Function Count() As Long

    Count = mlngCount

End Function


Private Sub Class_Initialize()

    mlngCount = 0

End Sub


Private Sub Class_Terminate()

    Call Clear

End Sub
```

cVectorLng.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cVectorLng"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:       cVectorLng.cls
'              Microsoft TPC-H Kit Ver. 1.00
'              Copyright Microsoft, 1999
'              All Rights Reserved
'
'
'  PURPOSE:     This class implements an array of longs.
'  Contact:     Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

' Used to indicate the source module name when errors
```

```
' are raised by this class
Private mstrSource As String
Private Const mstrModuleName As String = "cVectorLng."

' Array counter
Private mlngCount As Long
Private mcarrItems() As Long

Public Sub Add(ByVal lngItem As Long)
   ' Adds the passed in long variable to the array

   On Error GoTo AddErr

   ReDim Preserve mcarrItems(mlngCount)

   ' Set the newly added element in the array to the
   ' passed in variable
   mcarrItems(mlngCount) = lngItem
   mlngCount = mlngCount + 1

   Exit Sub

AddErr:
   LogErrors Errors
   gstrSource = mstrModuleName & "Add"
   On Error GoTo 0
   Err.Raise vbObjectError + errLoadInArrayFailed, _
         mstrSource, _
         LoadResString(errLoadInArrayFailed)

End Sub
Public Sub Clear()

   ' Clear the array
   ReDim mcarrItems(0)

End Sub

Public Sub Delete(Optional ByVal Position As Long = -1, _
      Optional ByVal Item As Long = -1)
   ' The user can opt to delete either a specific item in
   ' the list or the item at a specified position. If no
   ' parameters are passed in, we delete the element at
   ' position 0!

   Dim lngDelete As Long
   Dim lngIndex As Long

   On Error GoTo DeleteErr

   If Position = -1 Then
      ' Since we can never store an element at position -1,
      ' we can be sure that the user is trying to delete
      ' a given item
      lngDelete = Find(Item)
   Else
      lngDelete = Position
   End If

   If lngDelete < (mlngCount - 1) Then

      ' We want to maintain the order of all items in the
      ' array - so move all remaining elements in the array
      ' up by 1
      For lngIndex = lngDelete To mlngCount - 2
         MoveDown lngIndex
      Next lngIndex

   End If

   ' Delete the last Node from the array
   mlngCount = mlngCount - 1
   If mlngCount > 0 Then
      ReDim Preserve mcarrItems(0 To mlngCount - 1)
   Else
      ReDim mcarrItems(0)
   End If

   Exit Sub

DeleteErr:
   LogErrors Errors
   mstrSource = mstrModuleName & "Delete"
   On Error GoTo 0
   Err.Raise vbObjectError + errDeleteArrayElementFailed, _
         mstrSource, _
         LoadResString(errDeleteArrayElementFailed)

End Sub
Public Function Find(ByVal Item As Long) As Long

   ' Returns the position at which the passed in value occurs
   ' in the array

   Dim lngIndex As Long

   On Error GoTo FindErr

   ' Find the element in the array to be deleted
   For lngIndex = 0 To mlngCount - 1

      If mcarrItems(lngIndex) = Item Then
         Find = lngIndex
         Exit Function
      End If

   Next lngIndex

   Find = -1

   Exit Function

FindErr:
   LogErrors Errors
   mstrSource = mstrModuleName & "Find"
   On Error GoTo 0
   Err.Raise vbObjectError + errItemNotFound, mstrSource, _
      LoadResString(errItemNotFound)

End Function
Public Property Get Item(ByVal Position As Long) As Long
Attribute Item.VB_UserMemId = 0

   ' Returns the element at the passed in position in the array
   If Position >= 0 And Position < mlngCount Then
      Item = mcarrItems(Position)
   Else
      On Error GoTo 0
      Err.Raise vbObjectError + errItemDoesNotExist, mstrSource, _
         LoadResString(errItemDoesNotExist)
   End If

End Property
Public Property Let Item(ByVal Position As Long, _
      ByVal Value As Long)

   ' Returns the element at the passed in position in the array
   If Position >= 0 Then
      ' If the passed in position is outside the array
      ' bounds, then resize the array
```

```
        If Position >= mlngCount Then
            ReDim Preserve mcarrItems(Position)
            mlngCount = Position + 1
        End If

        ' Set the newly added element in the array to the
        ' passed in variable
        mcarrItems(Position) = Value
    Else
        On Error GoTo 0
        Err.Raise vbObjectError + errItemDoesNotExist, mstrSource, _
            LoadResString(errItemDoesNotExist)
    End If

End Property
Public Sub MoveUp(ByVal Position As Long)
    ' Moves the element at the passed in position up by 1

    Dim lngTemp As Long

    If Position > 0 And Position < mlngCount Then
        lngTemp = mcarrItems(Position)

        mcarrItems(Position) = mcarrItems(Position - 1)
        mcarrItems(Position - 1) = lngTemp
    End If

End Sub
Public Sub MoveDown(ByVal Position As Long)
    ' Moves the element at the passed in position down by 1

    Dim lngTemp As Long

    If Position >= 0 And Position < mlngCount - 1 Then
        lngTemp = mcarrItems(Position)

        mcarrItems(Position) = mcarrItems(Position + 1)
        mcarrItems(Position + 1) = lngTemp
    End If

End Sub

Public Function Count() As Long

    Count = mlngCount

End Function


Private Sub Class_Initialize()

    mlngCount = 0

End Sub


Private Sub Class_Terminate()

    Call Clear

End Sub
```

cVectorStr.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cVectorStr"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:       cVectorStr.cls
'              Microsoft TPC-H Kit Ver. 1.00
'              Copyright Microsoft, 1999
'              All Rights Reserved
'
'
'  PURPOSE:     This class implements an array of strings.
'  Contact:     Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

' Used to indicate the source module name when errors
' are raised by this class
Private mstrSource As String
Private Const mstrModuleName As String = "cVectorStr."

' Array counter
Private mlngCount As Long
Private mcarrItems() As String

Public Sub Add(ByVal strItem As String)
    ' Adds the passed in string variable to the array

    On Error GoTo AddErr

    ReDim Preserve mcarrItems(mlngCount)

    ' Set the newly added element in the array to the
    ' passed in variable
    mcarrItems(mlngCount) = strItem
    mlngCount = mlngCount + 1

    Exit Sub

AddErr:
    Call LogErrors(Errors)
    gstrSource = mstrModuleName & "Add"
    On Error GoTo 0
    Err.Raise vbObjectError + errLoadInArrayFailed, _
            mstrSource, _
            LoadResString(errLoadInArrayFailed)

End Sub
Public Sub Clear()

    ' Clear the array
    ReDim mcarrItems(0)

End Sub

Public Sub Delete(Optional ByVal Position As Long = -1, _
        Optional ByVal Item As String = -1)
    ' The user can opt to delete either a specific item in
    ' the list or the item at a specified position. If no
    ' parameters are passed in, we delete the element at
    ' position 0!

    Dim lngDelete As Long
    Dim lngIndex As Long

    On Error GoTo DeleteErr
    mstrSource = mstrModuleName & "Delete"

    If Position = -1 Then
        ' Since we can never store an element at position -1,
        ' we can be sure that the user is trying to delete
        ' a given item
```

```
        lngDelete = Find(Item)
    Else
        lngDelete = Position
    End If

    If lngDelete < (mlngCount - 1) Then

        ' We want to maintain the order of all items in the
        ' array - so move all remaining elements in the array
        ' up by 1
        For lngIndex = lngDelete To mlngCount - 2
            MoveDown lngIndex
        Next lngIndex

    End If

    ' Delete the last Node from the array
    mlngCount = mlngCount - 1
    If mlngCount > 0 Then
        ReDim Preserve mcarrItems(0 To mlngCount - 1)
    Else
        ReDim mcarrItems(0)
    End If

    Exit Sub

DeleteErr:
    Call LogErrors(Errors)
    mstrSource = mstrModuleName & "Delete"
    On Error GoTo 0
    Err.Raise vbObjectError + errDeleteArrayElementFailed, _
            mstrSource, _
            LoadResString(errDeleteArrayElementFailed)

End Sub
Public Function Find(ByVal Item As String) As Long

    ' Returns the position at which the passed in value occurs
    ' in the array

    Dim lngIndex As Long

    On Error GoTo FindErr
    mstrSource = mstrModuleName & "Find"

    ' Find the element in the array to be deleted
    For lngIndex = 0 To mlngCount - 1

        If mcarrItems(lngIndex) = Item Then
            Find = lngIndex
            Exit Function
        End If

    Next lngIndex

    Find = -1

    Exit Function

FindErr:
    Call LogErrors(Errors)
    mstrSource = mstrModuleName & "Find"
    On Error GoTo 0
    Err.Raise vbObjectError + errItemNotFound, mstrSource, _
        LoadResString(errItemNotFound)

End Function
Public Property Get Item(ByVal Position As Long) As String
Attribute Item.VB_UserMemId = 0

    ' Returns the element at the passed in position in the array
    If Position >= 0 And Position < mlngCount Then
        Item = mcarrItems(Position)
    Else
        On Error GoTo 0
        Err.Raise vbObjectError + errItemDoesNotExist, mstrSource, _
            LoadResString(errItemDoesNotExist)
    End If

End Property
Public Property Let Item(ByVal Position As Long, _
        ByVal Value As String)

    ' Returns the element at the passed in position in the array
    If Position >= 0 Then
        ' If the passed in position is outside the array
        ' bounds, then resize the array
        If Position >= mlngCount Then
            ReDim Preserve mcarrItems(Position)
            mlngCount = Position + 1
        End If

        ' Set the newly added element in the array to the
        ' passed in variable
        mcarrItems(Position) = Value
    Else
        On Error GoTo 0
        Err.Raise vbObjectError + errItemDoesNotExist, mstrSource, _
            LoadResString(errItemDoesNotExist)
    End If

End Property
Public Sub MoveUp(ByVal Position As Long)
    ' Moves the element at the passed in position up by 1

    Dim strTemp As String

    If Position > 0 And Position < mlngCount Then
        strTemp = mcarrItems(Position)

        mcarrItems(Position) = mcarrItems(Position - 1)
        mcarrItems(Position - 1) = strTemp
    End If

End Sub
Public Sub MoveDown(ByVal Position As Long)
    ' Moves the element at the passed in position down by 1

    Dim strTemp As String

    If Position >= 0 And Position < mlngCount - 1 Then
        strTemp = mcarrItems(Position)

        mcarrItems(Position) = mcarrItems(Position + 1)
        mcarrItems(Position + 1) = strTemp
    End If

End Sub

Public Function Count() As Long

    Count = mlngCount

End Function


Private Sub Class_Initialize()

    mlngCount = 0
```


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```
End Sub
Private Sub Class_Terminate()

   Call Clear

End Sub
```

cWorker.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cWorker"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:       cWorker.cls
'              Microsoft TPC-H Kit Ver. 1.00
'              Copyright Microsoft, 1999
'              All Rights Reserved
'
'
'  PURPOSE:    Encapsulates the properties and methods of a worker
step.
'              Implements the cStep class - carries out initializations
'              and validations that are specific to worker steps.
'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

Implements cStep

' Object variable to keep the step reference in
Private mcStep As cStep

' Used to indicate the source module name when errors
' are raised by this class
Private mstrSource As String
Private Const mstrModuleName As String = "cWorker."
Private Sub cStep_AddAllIterators()

   Call mcStep.AddAllIterators

End Sub

Private Property Let cStep_StartDir(ByVal RHS As String)

   mcStep.StartDir = RHS

End Property

Private Property Get cStep_StartDir() As String

   cStep_StartDir = mcStep.StartDir

End Property

Private Property Set cStep_NodeDB(RHS As DAO.Database)

   Set mcStep.NodeDB = RHS

End Property

Private Property Get cStep_NodeDB() As DAO.Database

   Set cStep_NodeDB = mcStep.NodeDB

End Property

Private Function cStep_IncVersionY() As String

   cStep_IncVersionY = mcStep.IncVersionY

End Function
Private Function cStep_IsNewVersion() As Boolean
   cStep_IsNewVersion = mcStep.IsNewVersion
End Function
Private Function cStep_OldVersionNo() As String
   cStep_OldVersionNo = mcStep.OldVersionNo
End Function

Private Function cStep_IncVersionX() As String

   cStep_IncVersionX = mcStep.IncVersionX

End Function
Private Sub cStep_UpdateIteratorVersion()

   Call mcStep.UpdateIteratorVersion

End Sub

Private Function cStep_IteratorCount() As Long

   cStep_IteratorCount = mcStep.IteratorCount

End Function

Private Sub cStep_UnloadIterators()

   Call mcStep.UnloadIterators

End Sub

Private Sub cStep_SaveIterators()

   Call mcStep.SaveIterators

End Sub
Private Property Get cStep_IteratorName() As String

   cStep_IteratorName = mcStep.IteratorName

End Property
Private Property Let cStep_IteratorName(ByVal RHS As String)

   mcStep.IteratorName = RHS

End Property

Private Sub cStep_LoadIterator(cItRecord As cIterator)

   Call mcStep.LoadIterator(cItRecord)

End Sub
Private Sub cStep_DeleteIterator(cItRecord As cIterator)

   Call mcStep.DeleteIterator(cItRecord)

End Sub

Private Sub cStep_InsertIterator(cItRecord As cIterator)

   Call mcStep.InsertIterator(cItRecord)

End Sub
Private Function cStep_Iterators() As Variant
```

```
    cStep_Iterators = mcStep.Iterators

End Function
Private Sub cStep_ModifyIterator(cItRecord As cIterator)

    Call mcStep.ModifyIterator(cItRecord)

End Sub
Private Sub cStep_RemoveIterator(cItRecord As cIterator)

    Call mcStep.RemoveIterator(cItRecord)

End Sub
Private Sub cStep_UpdateIterator(cItRecord As cIterator)

    Call mcStep.UpdateIterator(cItRecord)

End Sub
Private Sub cStep_AddIterator(cItRecord As cIterator)

    Call mcStep.AddIterator(cItRecord)

End Sub

Private Property Let cStep_Position(ByVal RHS As Long)

    mcStep.Position = RHS

End Property

Private Property Get cStep_Position() As Long

    cStep_Position = mcStep.Position

End Property

Private Function cStep_Clone(Optional cCloneStep As cStep) As cStep

    Dim cNewWorker As cWorker

    Set cNewWorker = New cWorker
    Set cStep_Clone = mcStep.Clone(cNewWorker)

End Function

Private Sub StepTextOrFileEntered()
    ' Checks if either the step text or the name of the file containing
    ' the text has been entered
    ' If both of them are null or both of them are not null,
    ' the worker step is invalid and an error is raised
    If StringEmpty(mcStep.StepText) And
StringEmpty(mcStep.StepTextFile) Then
        ShowError errStepTextAndFileNull
        On Error GoTo 0
        Err.Raise vbObjectError + errStepTextAndFileNull, _
            mstrSource, LoadResString(errStepTextAndFileNull)
    End If

End Sub

Private Property Get cStep_IndOperation() As Operation

    cStep_IndOperation = mcStep.IndOperation

End Property

Private Property Let cStep_IndOperation(ByVal RHS As Operation)

    mcStep.IndOperation = RHS

End Property

Private Property Get cStep_NextStepId() As Long

    cStep_NextStepId = mcStep.NextStepId

End Property

Private Property Let cStep_OutputFile(ByVal RHS As String)

    mcStep.OutputFile = RHS

End Property

Private Property Get cStep_OutputFile() As String

    cStep_OutputFile = mcStep.OutputFile

End Property

Private Property Let cStep_ErrorFile(ByVal RHS As String)

    mcStep.ErrorFile = RHS

End Property

Private Property Get cStep_ErrorFile() As String

    cStep_ErrorFile = mcStep.ErrorFile

End Property
'Private Property Let cStep_LogFile(ByVal RHS As String)
'
'    mcStep.LogFile = RHS
'
'End Property
'
'Private Property Get cStep_LogFile() As String
'
'    cStep_LogFile = mcStep.LogFile
'
'End Property

Private Property Let cStep_ArchivedFlag(ByVal RHS As Boolean)

    mcStep.ArchivedFlag = RHS

End Property

Private Property Get cStep_ArchivedFlag() As Boolean

    cStep_ArchivedFlag = mcStep.ArchivedFlag

End Property

Private Sub Class_Initialize()

    ' Create the object
    Set mcStep = New cStep

    ' Initialize the object with valid values for a Worker step
    ' The global flag should be the first field to be initialized
    ' since subsequent validations might try to check if the
    ' step being created is global
    mcStep.GlobalFlag = False
'    mcStep.GlobalRunMethod = gintNoOption
    mcStep.StepType = gintWorkerStep

End Sub
Private Sub Class_Terminate()
```

```
    ' Remove the step object
    Set mcStep = Nothing

End Sub
Private Sub cStep_Add()

    ' Call a private procedure to see if the step text has been
    ' entered - since a worker step actually executes a step, entry
    ' of the text is mandatory
    Call StepTextOrFileEntered

    ' Call the Add method of the step class to carry out the insert
    mcStep.Add

End Sub

Private Property Get cStep_ContinuationCriteria() As
ContinuationCriteria

    cStep_ContinuationCriteria = mcStep.ContinuationCriteria

End Property

Private Property Let cStep_ContinuationCriteria(ByVal RHS As
ContinuationCriteria)

    ' The Continuation criteria must be non-null for all worker steps.
    ' Check if the Continuation Criteria is valid
    Select Case RHS
        Case gintOnFailureAbortSiblings, gintOnFailureCompleteSiblings,
_
                gintOnFailureSkipSiblings, gintOnFailureAbort, _
                gintOnFailureContinue, gintOnFailureAsk
            mcStep.ContinuationCriteria = RHS

        Case Else
            On Error GoTo 0
            Err.Raise vbObjectError + errContCriteriaInvalid, _
                    mstrModuleName, LoadResString(errContCriteriaInvalid)
    End Select

End Property

Private Property Let cStep_DegreeParallelism(ByVal RHS As String)

    mcStep.DegreeParallelism = RHS

End Property

Private Property Get cStep_DegreeParallelism() As String

    cStep_DegreeParallelism = mcStep.DegreeParallelism

End Property

Private Sub cStep_Delete()

    mcStep.Delete

End Sub

Private Property Get cStep_EnabledFlag() As Boolean

    cStep_EnabledFlag = mcStep.EnabledFlag

End Property

Private Property Let cStep_EnabledFlag(ByVal RHS As Boolean)

    mcStep.EnabledFlag = RHS

End Property

Private Property Let cStep_ExecutionMechanism(ByVal RHS As
ExecutionMethod)

    On Error GoTo ExecutionMechanismErr
    mstrSource = mstrModuleName & "cStep_ExecutionMechanism"

    Select Case RHS
        Case gintExecuteShell, gintExecuteODBC
            mcStep.ExecutionMechanism = RHS

        Case Else
            On Error GoTo 0
            Err.Raise vbObjectError + errExecutionMechanismInvalid, _
                    mstrSource,
LoadResString(errExecutionMechanismInvalid)
    End Select

    Exit Property

ExecutionMechanismErr:
    LogErrors Errors
    mstrSource = mstrModuleName & "cStep_ExecutionMechanism"
    On Error GoTo 0
    Err.Raise vbObjectError + errExecutionMechanismLetFailed, _
        mstrSource, LoadResString(errExecutionMechanismLetFailed)

End Property

Private Property Get cStep_ExecutionMechanism() As
ExecutionMethod

    cStep_ExecutionMechanism = mcStep.ExecutionMechanism

End Property

Private Property Let cStep_FailureDetails(ByVal RHS As String)

    mcStep.FailureDetails = RHS

End Property

Private Property Get cStep_FailureDetails() As String

    cStep_FailureDetails = mcStep.FailureDetails

End Property

Private Property Get cStep_GlobalFlag() As Boolean

    cStep_GlobalFlag = mcStep.GlobalFlag

End Property

Private Property Let cStep_GlobalFlag(ByVal RHS As Boolean)

    ' Set the global flag to false - this flag is initialized when
    ' an instance of the class is created. Just making sure that
    ' nobody changes the value inadvertently
    mcStep.GlobalFlag = False

End Property
Private Sub cStep_Modify()

    ' Call a private procedure to see if the step text has been
    ' entered - since a worker step actually executes a step, entry
    ' of the text is mandatory
```

```
    Call StepTextOrFileEntered

    ' Call the Modify method of the step class to carry out the update
    mcStep.Modify

End Sub

Private Property Let cStep_ParentStepId(ByVal RHS As Long)

    mcStep.ParentStepId = RHS

End Property

Private Property Get cStep_ParentStepId() As Long

    cStep_ParentStepId = mcStep.ParentStepId

End Property

Private Property Let cStep_ParentVersionNo(ByVal RHS As String)

    mcStep.ParentVersionNo = RHS

End Property

Private Property Get cStep_ParentVersionNo() As String

    cStep_ParentVersionNo = mcStep.ParentVersionNo

End Property

Private Property Let cStep_SequenceNo(ByVal RHS As Integer)

    mcStep.SequenceNo = RHS

End Property

Private Property Get cStep_SequenceNo() As Integer

    cStep_SequenceNo = mcStep.SequenceNo

End Property

Private Property Let cStep_StepId(ByVal RHS As Long)

    mcStep.StepId = RHS

End Property

Private Property Get cStep_StepId() As Long

    cStep_StepId = mcStep.StepId

End Property


Private Property Let cStep_StepLabel(ByVal RHS As String)

    mcStep.StepLabel = RHS

End Property

Private Property Get cStep_StepLabel() As String

    cStep_StepLabel = mcStep.StepLabel

End Property


Private Property Let cStep_StepLevel(ByVal RHS As Integer)

    mcStep.StepLevel = RHS

End Property

Private Property Get cStep_StepLevel() As Integer

    cStep_StepLevel = mcStep.StepLevel

End Property

Private Property Let cStep_StepText(ByVal RHS As String)

    mcStep.StepText = RHS

End Property

Private Property Get cStep_StepText() As String

    cStep_StepText = mcStep.StepText

End Property

Private Property Let cStep_StepTextFile(ByVal RHS As String)

    mcStep.StepTextFile = RHS

End Property

Private Property Get cStep_StepTextFile() As String

    cStep_StepTextFile = mcStep.StepTextFile

End Property

Private Property Let cStep_StepType(RHS As gintStepType)

    mcStep.StepType = gintWorkerStep

End Property

Private Property Get cStep_StepType() As gintStepType

    cStep_StepType = mcStep.StepType

End Property

Private Sub cStep_Validate()
    ' The validate routines for each of the steps will
    ' carry out the specific validations for the type and
    ' call the generic validation routine

    On Error GoTo cStep_ValidateErr

    ' Validations specific to worker steps

    ' Check if the step text or a file name has been
    ' specified
    Call StepTextOrFileEntered

    mcStep.Validate

    Exit Sub

cStep_ValidateErr:
    LogErrors Errors
    mstrSource = mstrModuleName & "cStep_Validate"
    On Error GoTo 0
    Err.Raise vbObjectError + errValidateFailed, _
        mstrSource, _
```

```
        LoadResString(errValidateFailed)
End Sub

Private Property Let cStep_VersionNo(ByVal RHS As String)

   mcStep.VersionNo = RHS

End Property

Private Property Get cStep_VersionNo() As String

   cStep_VersionNo = mcStep.VersionNo

End Property

Private Property Let cStep_WorkspaceId(ByVal RHS As Long)

   mcStep.WorkspaceId = RHS

End Property

Private Property Get cStep_WorkspaceId() As Long

   cStep_WorkspaceId = mcStep.WorkspaceId

End Property
```

cWorkspace.cls

```
VERSION 1.0 CLASS
BEGIN
  MultiUse = -1  'True
END
Attribute VB_Name = "cWorkspace"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = True
Attribute VB_PredeclaredId = False
Attribute VB_Exposed = False
'  FILE:       cWorkspace.cls
'              Microsoft TPC-H Kit Ver. 1.00
'              Copyright Microsoft, 1999
'              All Rights Reserved
'
'
'  PURPOSE:    Encapsulates the properties and methods of a
workspace.
'              Contains functions to insert, update and delete
'              att_workspaces records from the database.
'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

' Local variable(s) to hold property value(s)
Private mlngWorkspaceId As Long
Private mstrWorkspaceName As String
Private mblnArchivedFlag As Boolean
Private mdbsStepMaster As Database

' Used to indicate the source module name when errors
' are raised by this class
Private mstrSource As String
Private Const mstrModuleName As String = "cWorkspace."

' The cSequence class is used to generate unique workspace identifiers
Private mWorkspaceSeq As cSequence

' The StringSM class is used to carry out string operations
Private mFieldValue As cStringSM

Public Function Clone() As cWorkspace

   ' Creates a copy of a given workspace

   Dim cCloneWsp As cWorkspace

   On Error GoTo CloneErr

   Set cCloneWsp = New cWorkspace

   ' Copy all the workspace properties to the newly
   ' created workspace
   cCloneWsp.WorkspaceId = mlngWorkspaceId
   cCloneWsp.WorkspaceName = mstrWorkspaceName
   cCloneWsp.ArchivedFlag = mblnArchivedFlag

   ' And set the return value to the newly created workspace
   Set Clone = cCloneWsp

   Exit Function

CloneErr:
   LogErrors Errors
   mstrSource = mstrModuleName & "Clone"
   On Error GoTo 0
   Err.Raise vbObjectError + errCloneFailed, _
         mstrSource, LoadResString(errCloneFailed)

End Function

Public Property Let ArchivedFlag(ByVal vdata As Boolean)

   mblnArchivedFlag = vdata

End Property

Public Property Get ArchivedFlag() As Boolean

   ArchivedFlag = mblnArchivedFlag

End Property

Public Property Set WorkDatabase(vdata As Database)

   Set mdbsStepMaster = vdata

End Property

Private Sub WorkspaceNameDuplicate()
   ' Check if the workspace name already exists in the workspace

   Dim rstWorkspace As Recordset
   Dim strSql As String
   Dim qy As DAO.QueryDef

   On Error GoTo WorkspaceNameDuplicateErr
   mstrSource = mstrModuleName & "WorkspaceNameDuplicate"

   ' Create a recordset to retrieve the count of records
   ' having the same workspace name
   strSql = " Select count(*) as workspace_count " & _
      " from att_workspaces " & _
      " where workspace_name = [w_name] " & _
      " and workspace_id <> [w_id] "
   Set qy = mdbsStepMaster.CreateQueryDef(gstrEmptyString, strSql)

   ' Call a procedure to assign the parameter values
   Call AssignParameters(qy)

   Set rstWorkspace = qy.OpenRecordset(dbOpenForwardOnly)
```

```
'       mFieldValue.MakeStringFieldValid (mstrWorkspaceName) & _
'       " and workspace_id <> " & _
'       Str(mlngWorkspaceId)
'
'    Set rstWorkspace = mdbsStepMaster.OpenRecordset( _
'       strSQL, dbOpenForwardOnly)

    If rstWorkspace![workspace_count] > 0 Then
        rstWorkspace.Close
        qy.Close
        ShowError errDuplicateWorkspaceName
        On Error GoTo 0
        Err.Raise vbObjectError + errDuplicateWorkspaceName, _
            mstrSource, LoadResString(errDuplicateWorkspaceName)
    End If
    rstWorkspace.Close
    qy.Close

    Exit Sub

WorkspaceNameDuplicateErr:
    Call LogErrors(Errors)
    mstrSource = mstrModuleName & "WorkspaceNameDuplicate"
    On Error GoTo 0
    Err.Raise vbObjectError + errWorkspaceNameDuplicateFailed, _
        mstrSource, LoadResString(errWorkspaceNameDuplicateFailed)

End Sub
Public Property Let WorkspaceName(vdata As String)

    On Error GoTo WorkspaceNameErr
    mstrSource = mstrModuleName & "WorkspaceName"

    If vdata = gstrEmptyString Then

        On Error GoTo 0
        ' Propogate this error back to the caller
        Err.Raise vbObjectError + errWorkspaceNameMandatory, _
            mstrSource, LoadResString(errWorkspaceNameMandatory)
    Else
        mstrWorkspaceName = vdata
    End If
    Exit Property

WorkspaceNameErr:
    LogErrors Errors
    mstrSource = mstrModuleName & "WorkspaceName"
    On Error GoTo 0
    Err.Raise vbObjectError + errWorkspaceNameSetFailed, _
        mstrSource, LoadResString(errWorkspaceNameSetFailed)

End Property

Public Property Let WorkspaceId(vdata As Long)

    On Error GoTo WorkspaceIdErr
    mstrSource = mstrModuleName & "WorkspaceId"

    If (vdata > 0) Then
        mlngWorkspaceId = vdata
    Else
        ' Propogate this error back to the caller
        On Error GoTo 0
        Err.Raise vbObjectError + errWorkspaceIdInvalid, _
            mstrSource, LoadResString(errWorkspaceIdInvalid)
    End If

    Exit Property

WorkspaceIdErr:
    LogErrors Errors
    mstrSource = mstrModuleName & "WorkspaceId"
    On Error GoTo 0
    Err.Raise vbObjectError + errWorkspaceIdSetFailed, _
        mstrSource, LoadResString(errWorkspaceIdSetFailed)

End Property

Public Sub AddWorkspace()

    Dim strInsert As String
    Dim qy As DAO.QueryDef

    On Error GoTo AddWorkspaceErr

    ' Retrieve the next identifier using the sequence class
    Set mWorkspaceSeq = New cSequence
    Set mWorkspaceSeq.IdDatabase = mdbsStepMaster
    mWorkspaceSeq.IdentifierColumn = FLD_ID_WORKSPACE
    mlngWorkspaceId = mWorkspaceSeq.Identifier
    Set mWorkspaceSeq = Nothing

    ' Call procedure to raise an error if the Workspace name
    ' already exists in the db
    Call WorkspaceNameDuplicate

    ' A new record will have the archived_flag turned off
    mblnArchivedFlag = False

    ' Create a temporary querydef object
    strInsert = "insert into att_workspaces " & _
            "( workspace_id, workspace_name, " & _
            " archived_flag ) " & _
            " values ( [w_id], [w_name], [archived] ) "
    Set qy = mdbsStepMaster.CreateQueryDef(gstrEmptyString,
strInsert)

    ' Call a procedure to assign the parameter values
    Call AssignParameters(qy)

    qy.Execute dbFailOnError
    qy.Close

'    strInsert = "insert into att_workspaces " & _
'            "( workspace_id, workspace_name, " & _
'            " archived_flag ) " & _
'            " values ( " & _
'            Str(mlngWorkspaceId) & _
'            ", " &
mFieldValue.MakeStringFieldValid(mstrWorkspaceName) & _
'            ", " & Str(mblnArchivedFlag) & _
'            " ) "
'    mdbsStepMaster.Execute strInsert, dbFailOnError
'
    Exit Sub

AddWorkspaceErr:

    Call LogErrors(Errors)
    mstrSource = mstrModuleName & "AddWorkspace"
    On Error GoTo 0
    Err.Raise vbObjectError + errWorkspaceInsertFailed, _
        mstrSource, LoadResString(errWorkspaceInsertFailed)

End Sub
Private Sub AssignParameters(qyExec As DAO.QueryDef)
    ' Assigns values to the parameters in the querydef object
    ' The parameter names are cryptic to make them different
    ' from the field names. When the parameter names are
    ' the same as the field names, parameters in the where
```

```
    ' clause do not get created.

    Dim prmParam As DAO.Parameter

    On Error GoTo AssignParametersErr
    mstrSource = mstrModuleName & "AssignParameters"

    For Each prmParam In qyExec.Parameters
        Select Case prmParam.Name
            Case "[w_id]"
                prmParam.Value = mlngWorkspaceId

            Case "[w_name]"
                prmParam.Value = mstrWorkspaceName

            Case "[archived]"
                prmParam.Value = mblnArchivedFlag

            Case Else
                ' Write the parameter name that is faulty
                WriteError errInvalidParameter, mstrSource, _
                        prmParam.Name
                On Error GoTo 0
                Err.Raise errInvalidParameter, mstrSource, _
                        LoadResString(errInvalidParameter)
        End Select
    Next prmParam

    Exit Sub

AssignParametersErr:

    mstrSource = mstrModuleName & "AssignParameters"
    Call LogErrors(Errors)
    On Error GoTo 0
    Err.Raise vbObjectError + errAssignParametersFailed, _
        mstrSource, LoadResString(errAssignParametersFailed)

End Sub
Public Sub DeleteWorkspace()

    Dim strDelete As String
    Dim qy As DAO.QueryDef

    On Error GoTo DeleteWorkspaceErr

    strDelete = "delete from att_workspaces " & _
        " where workspace_id = [w_id]"
    Set qy = mdbsStepMaster.CreateQueryDef(gstrEmptyString,
strDelete)

    ' Call a procedure to assign the parameter values
    Call AssignParameters(qy)

    qy.Execute dbFailOnError
    qy.Close

'    mdbsStepMaster.Execute strDelete, dbFailOnError
'        " where workspace_id = " & _
'        Str(mlngWorkspaceId)

    Exit Sub

DeleteWorkspaceErr:
    Call LogErrors(Errors)
    mstrSource = mstrModuleName & "DeleteWorkspace"
    On Error GoTo 0
    Err.Raise vbObjectError + errWorkspaceDeleteFailed, _
        mstrSource, LoadResString(errWorkspaceDeleteFailed)
End Sub

Public Sub ModifyWorkspace()

    Dim strUpdate As String
    Dim qy As DAO.QueryDef

    On Error GoTo ModifyWorkspaceErr

    ' Call procedure to raise an error if the Workspace name
    ' already exists in the db
    Call WorkspaceNameDuplicate

    strUpdate = "update att_workspaces " & _
        " set workspace_name = [w_name] " & _
        ", archived_flag = [archived] " & _
        " where workspace_id = [w_id] "
    Set qy = mdbsStepMaster.CreateQueryDef(gstrEmptyString,
strUpdate)

    ' Call a procedure to assign the parameter values
    Call AssignParameters(qy)

    qy.Execute dbFailOnError
    qy.Close

'    strUpdate = "update att_workspaces " & _
'        " set workspace_name = " & _
'        mFieldValue.MakeStringFieldValid(mstrWorkspaceName) & _
'        ", archived_flag = " & _
'        Str(mblnArchivedFlag) & _
'        " where workspace_id = " & _
'        Str(mlngWorkspaceId)
'
'    mdbsStepMaster.Execute strUpdate, dbFailOnError
'
    Exit Sub

ModifyWorkspaceErr:

    Call LogErrors(Errors)
    mstrSource = mstrModuleName & "ModifyWorkspace"
    On Error GoTo 0
    Err.Raise vbObjectError + errWorkspaceUpdateFailed, _
        mstrSource, LoadResString(errWorkspaceUpdateFailed)

End Sub
Public Property Get WorkspaceName() As String

    WorkspaceName = mstrWorkspaceName

End Property

Public Property Get WorkspaceId() As Long

    WorkspaceId = mlngWorkspaceId

End Property

Private Sub Class_Initialize()

    ' Each function will append it's own name to this
    ' variable
    mstrSource = "cWorkspace."

    Set mFieldValue = New cStringSM

End Sub

Private Sub Class_Terminate()
```

```
    Set mdbsStepMaster = Nothing
    Set mFieldValue = Nothing

End Sub
```

DatabaseSM.bas

```
Attribute VB_Name = "DatabaseSM"
'  FILE:      DatabaseSM.bas
'             Microsoft TPC-H Kit Ver. 1.00
'             Copyright Microsoft, 1999
'             All Rights Reserved
'
'
'  PURPOSE:   Contains all the database initialization/cleanup
'             procedures for the project. Also contains upgrade
'             database upgrade functions.
'  Contact:   Reshma Tharamal (reshmat@microsoft.com)
'
' This module is called DatabaseSM, since Database is a standard
' Visual Basic object and we want to avoid any confusion with it.

Option Explicit

Public wrkJet As Workspace
Public dbsAttTool As Database
Public gblnDbOpen As Boolean
Public gRunEngine As rdoEngine

' Used to indicate the source module name when errors
' are raised by this module
Private Const mstrModuleName As String = "DatabaseSM."
Public Const gsDefDBFileExt As String = ".stp"
Private Const msDefDBFile As String = "\SMData" & gsDefDBFileExt

Private Const merrFileNotFound As Integer = 3024
Private Const merrDaoTableMissing As Integer = 3078

Private Const STEPMASTER_SETTINGS_VAL_NAME_DBFILE As
String = "WorkspaceFile"

Public Const DEF_NO_COUNT_DISPLAY          As Boolean = False
Public Const DEF_NO_EXECUTE                As Boolean = False
Public Const DEF_PARSE_QUERY_ONLY          As Boolean = False
Public Const DEF_ANSI_QUOTED_IDENTIFIERS   As Boolean =
False
Public Const DEF_ANSI_NULLS                As Boolean = True
Public Const DEF_SHOW_QUERY_PLAN           As Boolean = False
Public Const DEF_SHOW_STATS_TIME           As Boolean = False
Public Const DEF_SHOW_STATS_IO             As Boolean = False
Public Const DEF_PARSE_ODBC_MSG_PREFIXES   As Boolean =
True
Public Const DEF_ROW_COUNT                 As Long = 0
Public Const DEF_TSQL_BATCH_SEPARATOR      As String =
"GO"
Public Const DEF_QUERY_TIME_OUT            As Long = 0
Public Const DEF_SERVER_LANGUAGE           As String =
"(Default)"
Public Const DEF_CHARACTER_TRANSLATION     As Boolean =
True
Public Const DEF_REGIONAL_SETTINGS         As Boolean = False

Public Const PARAM_DEFAULT_DIR             As String =
"DEFAULT_DIR"
Public Const PARAM_DEFAULT_DIR_DESC        As String =
"Default destination directory " & _
            "for all output and error files. If it is blank, the StepMaster
installation directory will be used."

Public Const PARAM_RUN_ID                  As String = "RUN_ID"
Public Const PARAM_RUN_ID_DESC             As String = "The run
identifier for a run. " & _
            "Any modifications will be overwritten before each run."

Public Const PARAM_OUTPUT_DIR              As String =
"OUTPUT_DIR"
Public Const PARAM_OUTPUT_DIR_DESC         As String = "The
output directory for a run. " & _
            "Any modifications will be overwritten before each run."

Public Const CONNECTION_STRINGS_TO_NAME_SUFFIX As
String = "_NAME"

Private Const TBL_RUN_STEP_HDR As String = "run_header"
Private Const TBL_RUN_STEP_DTLS As String = "run_step_details"
Public Const TBL_CONNECTION_DTLS As String =
"connection_dtls"
Public Const TBL_CONNECTION_STRINGS As String =
"workspace_connections"
Public Const TBL_STEPS As String = "att_steps"

Public Const FLD_ID_CONN_NAME As String =
"connection_name_id"
Public Const FLD_ID_WORKSPACE As String = "workspace_id"
Public Const FLD_ID_STEP As String = "step_id"
Public Const FLD_ID_PARAMETER As String = "parameter_id"

Public Const FLD_CONN_DTL_CONNECTION_NAME As String =
"connection_name"
Public Const FLD_CONN_DTL_CONNECTION_STRING As String =
"connection_string_name"
Public Const FLD_CONN_DTL_CONNECTION_TYPE As String =
"connection_type"

Public Const FLD_CONN_STR_CONNECTION_NAME As String =
"connection_name"

Public Const FLD_STEPS_EXEC_MECHANISM As String =
"execution_mechanism"
Public Const FLD_STEPS_EXEC_DTL As String = "start_directory"
Public Const FLD_STEPS_VERSION_NO As String = "version_no"

Public Const DATA_TYPE_CURRENCY As String = "CURRENCY"
Public Const DATA_TYPE_LONG As String = "Long"
Public Const DATA_TYPE_INTEGER As String = "INTEGER"
Public Const DATA_TYPE_TEXT255 As String = "Text(255)"

Private Sub InsertBuiltInParameter(dbFile As Database, sParamName
As String, _
      sParamValue As String, sParamDesc As String)

    Dim sBuf As String
    Dim cTempStr As New cStringSM
    Dim lId As Long
    Dim rTemp As DAO.Recordset
    Dim rParam As DAO.Recordset
    Dim cTempSeq As cSequence

    ' Create the passed in built-in parameter, for each workspace in the db
    Set cTempSeq = New cSequence
    Set cTempSeq.IdDatabase = dbFile
    cTempSeq.IdentifierColumn = FLD_ID_PARAMETER

    sBuf = "select * from att_workspaces "
    Set rTemp = dbFile.OpenRecordset(sBuf, dbOpenSnapshot)
    If rTemp.RecordCount <> 0 Then
      rTemp.MoveFirst

      While Not rTemp.EOF
        sBuf = "select * from workspace_parameters " & _
```

```
            " where workspace_id = " & Str(rTemp!workspace_id) & _
            " and parameter_name = " &
cTempStr.MakeStringFieldValid(sParamName)
        Set rParam = dbFile.OpenRecordset(sBuf, dbOpenSnapshot)
        If rParam.RecordCount <> 0 Then
          rParam.MoveFirst
          ' Since the parameter already exists, change it to a built-in
type
          sBuf = "update workspace_parameters " & _
                " set parameter_type = " & CStr(gintParameterBuiltIn) &
_
                ", description = " &
cTempStr.MakeStringFieldValid(sParamDesc) & _
                " where workspace_id = " & Str(rTemp!workspace_id) &
_
                " and parameter_id = " & Str(rParam!parameter_id)
        Else
          ' Else, insert a parameter record
          lId = cTempSeq.Identifier
          sBuf = "insert into workspace_parameters " & _
                "( workspace_id, parameter_id, " & _
                " parameter_name, parameter_value, " & _
                " description, parameter_type ) " & _
                " values ( " & _
                Str(rTemp!workspace_id) & ", " & Str(lId) & ", " & _
                cTempStr.MakeStringFieldValid(sParamName) & ", " &
_
                cTempStr.MakeStringFieldValid(sParamValue) & ", " &
_
                cTempStr.MakeStringFieldValid(sParamDesc) & ", " &
_
                CStr(gintParameterBuiltIn) & _
                " ) "
        End If
        dbFile.Execute sBuf, dbFailOnError
        rParam.Close

        rTemp.MoveNext
      Wend
    End If
    rTemp.Close

End Sub
Public Sub InitRunEngine()

    Set gRunEngine = New rdoEngine
    gRunEngine.rdoDefaultCursorDriver = rdUseServer

End Sub

Public Function DefaultDBFile() As String
    DefaultDBFile = GetSetting(App.Title, "Settings",
STEPMASTER_SETTINGS_VAL_NAME_DBFILE, App.Path &
msDefDBFile)
End Function

Public Sub CloseDatabase()

    Dim dbsInstance As Database
    Dim recInstance As Recordset

    On Error GoTo CloseDatabaseErr

    ' Close all open recordsets and databases in the workspace
    For Each dbsInstance In wrkJet.Databases

      For Each recInstance In dbsAttTool.Recordsets
        recInstance.Close
      Next recInstance
      dbsInstance.Close
    Next dbsInstance

    Set dbsAttTool = Nothing

    gblnDbOpen = False
    wrkJet.Close

    Exit Sub

CloseDatabaseErr:

    Call LogErrors(Errors)
    Resume Next

End Sub

Private Function NoDbChanges(sVerTo As String, sVerFrom As
String) As Boolean

    If sVerTo = gsVersion242 And sVerFrom = gsVersion241 Then
      NoDbChanges = True
    ElseIf sVerTo = gsVersion242 And sVerFrom = gsVersion24 Then
      NoDbChanges = True
    ElseIf sVerTo = gsVersion253 And sVerFrom = gsVersion251 Then
      NoDbChanges = True
    ElseIf sVerTo = gsVersion255 And sVerFrom = gsVersion251 Then
      NoDbChanges = True
    Else
      NoDbChanges = False
    End If

End Function

Public Function SMOpenDatabase(Optional strDbName As String =
gstrEmptyString) As Boolean
    Dim sVersion As String
    Dim bOpeningDb As Boolean ' This flag is used to check if
OpenDatabase failed

    On Error GoTo OpenDatabaseErr

    bOpeningDb = False
    SMOpenDatabase = False

    ' Create Microsoft Jet Workspace object.
    If Not gblnDbOpen Then
      Set wrkJet = CreateWorkspace("att_tool_workspace_setup",
"admin", gstrEmptyString, dbUseJet)
    End If

    ' Prompt the user for the database file if it is not passed in
    If StringEmpty(strDbName) Then
      strDbName = BrowseDBFile
      If StringEmpty(strDbName) Then
        Exit Function
      End If
    End If

    Do
      If gblnDbOpen Then
#If Not RUN_ONLY Then
        CloseOpenWorkspaces
#End If
        Set wrkJet = CreateWorkspace("att_tool_workspace_setup",
"admin", gstrEmptyString, dbUseJet)
      End If

      ' Toggle the bOpeningDb flag around the OpenDatabase method -
the value
```

```
        ' of this flag will be checked by the error handler to determine if it
is
        ' the OpenDatabase that failed.
        BugMessage "DB File: " & strDbName

        bOpeningDb = True
        ' Open the database for exclusive use
        Set dbsAttTool = wrkJet.OpenDatabase(strDbName,
Options:=True)
        bOpeningDb = False

        If dbsAttTool Is Nothing Then
            ' If the file is not present in the directory, display
            ' an error and ask the user to enter a new path
            Call ShowError(errOpenDbFailed, OptArgs:=strDbName)

            strDbName = BrowseDBFile
        Else
            sVersion = DBVersion(dbsAttTool)

            ' Make sure the application and db version numbers match
            If sVersion = gsVersion Then
                Call InitializeData(strDbName)
                gblnDbOpen = True
                SMOpenDatabase = True
            Else
                If UpgradeDb(wrkJet, dbsAttTool, gsVersion, sVersion) Then
                    Call InitializeData(strDbName)
                    gblnDbOpen = True
                    SMOpenDatabase = True
                Else
                    dbsAttTool.Close
                    Set dbsAttTool = Nothing

                    ShowError errVersionMismatch, _
                        OptArgs:=" Please install Version '" & gsVersion & "'
of the workspace definition file."
                    strDbName = BrowseDBFile
                End If
            End If
        End If
    Loop While gblnDbOpen = False And Not StringEmpty(strDbName)

    Exit Function

OpenDatabaseErr:
    Call DisplayErrors(Errors)

    ' If the OpenDatabase failed, continue
    If bOpeningDb Then
        Resume Next
    End If

    Call ShowError(errOpenDbFailed, OptArgs:=strDbName)

End Function
Private Sub InitializeData(sDb As String)

    Set gcParameters = New cArrParameters
    Set gcParameters.ParamDatabase = dbsAttTool

    Set gcSteps = New cArrSteps
    Set gcSteps.StepDB = dbsAttTool

    Set gcConstraints = New cArrConstraints
    Set gcConstraints.ConstraintDB = dbsAttTool

    Set gcConnections = New cConnections
    Set gcConnections.ConnDb = dbsAttTool

    Set gcConnDtls = New cConnDtls
    Set gcConnDtls.ConnDb = dbsAttTool

    ' Disable the error handler since this is not a critical step
    On Error GoTo 0
    SaveSetting App.Title, "Settings",
STEPMASTER_SETTINGS_VAL_NAME_DBFILE, sDb
End Sub
Private Sub UpdateContinuationCriteria(dbFile As DAO.Database)

    Dim qyTemp As DAO.QueryDef
    Dim sBuf As String

    On Error GoTo UpdateContinuationCriteriaErr

    sBuf = "Since this version of the executable incorporates failure
processing, " & _
            "the upgrade will update the On Failure field for each of the
steps " & _
            "to 'Continue' to be compatible with the existing behaviour. " &
_
            "Proceed?"
    If Not Confirm(Buttons:=vbYesNo, strMessage:=sBuf,
strTitle:="Upgrade database") Then
        Exit Sub
    End If

    ' Create a recordset object to retrieve all steps for
    ' the given workspace
    sBuf = " update att_steps a " & _
        " set continuation_criteria = " & CStr(gintOnFailureContinue) & _
        " where archived_flag = [archived] "

    ' Find the highest X-component of the version number
    sBuf = sBuf & " AND cint( mid( version_no, 1, instr( version_no, "
& gstrDQ & gstrVerSeparator & gstrDQ & " ) - 1 ) ) = " & _
        " ( select max( cint( mid( version_no, 1, instr( version_no, " &
gstrDQ & gstrVerSeparator & gstrDQ & " ) - 1 ) ) ) " & _
        " from att_steps AS d " & _
        " WHERE a.step_id = d.step_id ) "

    ' Find the highest Y-component of the version number for the highest
X-component
    sBuf = sBuf & " AND cint( mid( version_no, instr( version_no, " &
gstrDQ & gstrVerSeparator & gstrDQ & " ) + 1 ) ) = " & _
        " ( select max( cint( mid( version_no, instr( version_no, " &
gstrDQ & gstrVerSeparator & gstrDQ & " ) + 1 ) ) ) " & _
        " from att_steps AS b " & _
        " Where a.step_id = b.step_id " & _
        " AND cint( mid( version_no, 1, instr( version_no, " & gstrDQ &
gstrVerSeparator & gstrDQ & " ) - 1 ) ) = " & _
        " ( select max( cint( mid( version_no, 1, instr( version_no, " &
gstrDQ & gstrVerSeparator & gstrDQ & " ) - 1 ) ) ) " & _
        " from att_steps AS c " & _
        " WHERE a.step_id = c.step_id ) ) "

    ' Create a temporary Querydef object
    Set qyTemp = dbFile.CreateQueryDef(gstrEmptyString, sBuf)
    qyTemp.Parameters("archived").Value = False

    qyTemp.Execute dbFailOnError
    qyTemp.Close

    Exit Sub

UpdateContinuationCriteriaErr:
    Call LogErrors(Errors)
    Err.Raise vbObjectError + errModifyStepFailed, mstrModuleName, _
            LoadResString(errModifyStepFailed)
```

```
End Sub

Private Sub UpdateDbDtls(dbFile As Database, sNewVersion As
String)

   Dim sSql As String
   Dim cTemp As New cStringSM

   On Error GoTo UpdateDbDtlsErr

   sSql = "update db_details " & _
         " set db_version = " &
cTemp.MakeStringFieldValid(sNewVersion)

   dbFile.Execute sSql, dbFailOnError

   Exit Sub

UpdateDbDtlsErr:
   Call LogErrors(Errors)
   Err.Raise vbObjectError + errUpgradeFailed, mstrModuleName, _
         LoadResString(errUpgradeFailed)

End Sub

Private Sub Upgrade10to21(UpgradeWsp As DAO.Workspace, dbFile
As Database, sVersion As String)

   Dim sSql As String

   On Error GoTo Upgrade10to21Err

   Call UpdateDbDtls(dbFile, sVersion)

   Call UpdateContinuationCriteria(dbFile)

   Exit Sub

Upgrade10to21Err:
   UpgradeWsp.Rollback
   Call LogErrors(Errors)
   Err.Raise vbObjectError + errUpgradeFailed, mstrModuleName, _
         LoadResString(errUpgradeFailed)

End Sub
Private Sub Upgrade21to23(UpgradeWsp As DAO.Workspace, dbFile
As Database, sVersion As String)

   Dim sBuf As String
   Dim cTempStr As New cStringSM

   On Error GoTo Upgrade21to23Err

   ' Add a parameter type field and a description field to the parameter
table
   sBuf = "alter table workspace_parameters " & _
         " add column description TEXT(255) "
   dbFile.Execute sBuf, dbFailOnError

   sBuf = "alter table workspace_parameters " & _
         " add column parameter_type INTEGER "
   dbFile.Execute sBuf, dbFailOnError

   ' Initialize the parameter type on all parameters to indicate generic
parameters
   sBuf = "update workspace_parameters " & _
         " set parameter_type = " & CStr(gintParameterGeneric)
   dbFile.Execute sBuf, dbFailOnError

   sBuf = "Release 2.3 onwards, connection string parameters will be "
& _
         "displayed in a separate node. After this upgrade, all connection
" & _
         "string parameters will appear under the Globals/Connection
Strings " & _
         "node in the workspace. "
   Call MsgBox(sBuf, vbOKOnly + vbApplicationModal, "Upgrade
database")

   ' Update the parameter type on all parameters that look like db
connection strings
   sBuf = "update workspace_parameters " & _
         " set parameter_type = " & CStr(gintParameterConnect) & _
         " where UCase(parameter_value) like '*DRIVER*' " & _
         " or UCase(parameter_value) like '*DSN*'"
   dbFile.Execute sBuf, dbFailOnError

   ' Add an elapsed time field to the run_step_details table - this field is
   ' needed to store the elapsed time in milliseconds.
   sBuf = "alter table run_step_details " & _
         " add column elapsed_time LONG "
   dbFile.Execute sBuf, dbFailOnError

   ' The failure_details field has some data for the case when an ODBC
failure
   ' threshold was specified. Since that's no longer relevant, update the
failure_details
   ' field for records with failure_criteria = gintFailureODBC to empty.
   ' failure_criteria = gintFailureODBC = 1
   sBuf = "update att_steps " & _
         " set failure_details = " &
cTempStr.MakeStringFieldValid(gstrEmptyString) & _
         " where failure_criteria = '1'"
   dbFile.Execute sBuf, dbFailOnError

   Call UpdateDbDtls(dbFile, sVersion)

   UpgradeWsp.CommitTrans

   On Error GoTo DropColumnErr

   UpgradeWsp.BeginTrans

   ' This ddl cannot be in the same transaction as the failure_details
update
   ' But we can do this in a separate transaction since we do not expect
this
   ' statement to fail - AND, it doesn't matter if this transaction fails
   ' Drop the failure_criteria column from the att_steps table
   sBuf = "alter table att_steps " & _
         " drop column failure_criteria "
   dbFile.Execute sBuf, dbFailOnError

   Exit Sub

DropColumnErr:
   Call LogErrors(Errors)
   ShowError errDeleteColumnFailed
   Exit Sub

Upgrade21to23Err:
   UpgradeWsp.Rollback
   Call LogErrors(Errors)
   Err.Raise vbObjectError + errUpgradeFailed, mstrModuleName, _
         LoadResString(errUpgradeFailed)

End Sub
Private Sub Upgrade23to24(UpgradeWsp As DAO.Workspace, dbFile
As Database, sVersion As String)
```


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```
    Dim sBuf As String
    Dim lId As Long
    Dim rTemp As DAO.Recordset
    Dim cTempStr As New cStringSM

    On Error GoTo Upgrade23to24Err

    ' Add a new table for connection properties
    sBuf = CreateConnectionsTableScript()
    ' TODO: Not sure of column sizes for row count,
tsql_batch_separator and server_language
    dbFile.Execute sBuf, dbFailOnError

    ' Move all connection parameters from the parameter table to the
connections tables
    ' Insert default values for the newly added connection properties
    sBuf = "select * from workspace_parameters " & _
            "where parameter_type = " & CStr(gintParameterConnect)
    Set rTemp = dbFile.OpenRecordset(sBuf, dbOpenSnapshot)
    lId = 1
    If rTemp.RecordCount <> 0 Then
        rTemp.MoveFirst

        While Not rTemp.EOF
            sBuf = "insert into workspace_connections " & _
             "( workspace_id, connection_id, " & _
             "connection_name, connection_value, " & _
             "description, no_count_display, " & _
             "no_execute, parse_query_only, " & _
             "ANSI_quoted_identifiers, ANSI_nulls, " & _
             "show_query_plan, show_stats_time, " & _
             "show_stats_io, parse_odbc_msg_prefixes, " & _
             "row_count, tsql_batch_separator, " & _
             "query_time_out, server_language, " & _
             "character_translation, regional_settings ) " & _
            " values ( " & _
            Str(rTemp!workspace_id) & ", " & Str(lId) & ", " & _
            cTempStr.MakeStringFieldValid("" & rTemp!parameter_name)
& ", " & _
            cTempStr.MakeStringFieldValid("" & rTemp!parameter_value)
& ", " & _
            cTempStr.MakeStringFieldValid("" & rTemp!Description) & ",
" & _
            Str(DEF_NO_COUNT_DISPLAY) & ", " & _
            Str(DEF_NO_EXECUTE) & ", " &
Str(DEF_PARSE_QUERY_ONLY) & ", " & _
            Str(DEF_ANSI_QUOTED_IDENTIFIERS) & ", " &
Str(DEF_ANSI_NULLS) & ", " & _
            Str(DEF_SHOW_QUERY_PLAN) & ", " &
Str(DEF_SHOW_STATS_TIME) & ", " & _
            Str(DEF_SHOW_STATS_IO) & ", " &
Str(DEF_PARSE_ODBC_MSG_PREFIXES) & ", " & _
            Str(DEF_ROW_COUNT) & ", " &
cTempStr.MakeStringFieldValid(DEF_TSQL_BATCH_SEPARATOR)
& ", " & _
            Str(DEF_QUERY_TIME_OUT) & ", " &
cTempStr.MakeStringFieldValid(DEF_SERVER_LANGUAGE) & ", "
& _
            Str(DEF_CHARACTER_TRANSLATION) & ", " &
Str(DEF_REGIONAL_SETTINGS) & _
            " ) "
            dbFile.Execute sBuf, dbFailOnError

            lId = lId + 1
            rTemp.MoveNext
        Wend
    End If
    rTemp.Close

    ' Add an identifier column for the connection_id field
    sBuf = "alter table att_identifiers " & _
            " add column connection_id long "
    dbFile.Execute sBuf, dbFailOnError

    ' Initialize the value of the connection identifier, initialized above
    sBuf = "update att_identifiers " & _
            " set connection_id = " & Str(lId)
    dbFile.Execute sBuf, dbFailOnError

    ' Delete all connection strings from the parameter table
    sBuf = "delete from workspace_parameters " & _
             "where parameter_type = " & CStr(gintParameterConnect)
    dbFile.Execute sBuf, dbFailOnError

    ' Create the built-in parameter, default directory, for each workspace
in the db
    Call InsertBuiltInParameter(dbFile, PARAM_DEFAULT_DIR,
gstrEmptyString, PARAM_DEFAULT_DIR_DESC)

    Call UpdateDbDtls(dbFile, sVersion)

    Exit Sub

Upgrade23to24Err:
    UpgradeWsp.Rollback
    Call LogErrors(Errors)
    Err.Raise vbObjectError + errUpgradeFailed, mstrModuleName, _
            LoadResString(errUpgradeFailed)

End Sub
Private Sub Upgrade243to25(UpgradeWsp As DAO.Workspace, dbFile
As Database, sVersion As String)

    Dim sBuf As String
    Dim qy As DAO.QueryDef
    Dim rTemp As DAO.Recordset
    Dim lId As Long
    Dim cTempStr As New cStringSM

    On Error GoTo Upgrade243to25Err

    sBuf = "Release " & gsVersion25 & " onwards, new 'Connections'
must be created for all " & _
            "connection strings. " & vbCrLf & vbCrLf & _
            "Connections will appear under the Globals/Connections " & _
            "node in the workspace. " & vbCrLf & _
            "A list of all 'Connections' (instead of 'Connection Strings') " &
_
            "in the workspace will be displayed in the 'Connections' field for
" & _
            "ODBC steps on the Step definition screen. " & vbCrLf &
vbCrLf & _
            "Each Connection can be marked as static or dynamic. " &
vbCrLf & _
            "Dynamic connections will be created when a step starts
execution and " & _
            "closed once the step completes. " & vbCrLf & _
            "Static connections will be kept open till the run completes." &
vbCrLf & vbCrLf & _
            "Currently dynamic 'Connections' have been created for all
existing 'Connection Strings' " & _
            "with the suffix " &
CONNECTION_STRINGS_TO_NAME_SUFFIX
    Call MsgBox(sBuf, vbOKOnly + vbApplicationModal, "Upgrade
database")

    ' Add a new table for the connection name entity
    ' This table has been added in order to satisfy the TPC-H requirement
that
```

```
    ' all the queries in a stream need to be executed on a single
connection.
    sBuf = CreateConnectionDtlsTableScript()
    dbFile.Execute sBuf, dbFailOnError

    ' Add an identifier column for the connection_name_id field
    sBuf = "alter table att_identifiers " & _
           " add column " & FLD_ID_CONN_NAME & " long "
    dbFile.Execute sBuf, dbFailOnError

    Call UpdateDbDtls(dbFile, sVersion)

    ' insert connection_dtl records for each of the connection strings
    sBuf = "select * from " & TBL_CONNECTION_STRINGS
    Set rTemp = dbFile.OpenRecordset(sBuf, dbOpenSnapshot)

    sBuf = "insert into " & TBL_CONNECTION_DTLS & _
            "( " & FLD_ID_WORKSPACE & _
            ", " & FLD_ID_CONN_NAME & _
            ", " & FLD_CONN_DTL_CONNECTION_NAME & _
            ", " & FLD_CONN_DTL_CONNECTION_STRING & _
            ", " & FLD_CONN_DTL_CONNECTION_TYPE & " ) " & _
           " values ( [w_id], [c_id], [c_name], [c_str], [c_type] ) "
    Set qy = dbFile.CreateQueryDef("", sBuf)

    lId = glMinId
    If rTemp.RecordCount <> 0 Then
       rTemp.MoveFirst

       While Not rTemp.EOF
          qy.Parameters("w_id").Value =
rTemp.Fields(FLD_ID_WORKSPACE)
          qy.Parameters("c_id").Value = lId
          qy.Parameters("c_name").Value =
rTemp.Fields(FLD_CONN_STR_CONNECTION_NAME) &
CONNECTION_STRINGS_TO_NAME_SUFFIX
          qy.Parameters("c_str").Value =
rTemp.Fields(FLD_CONN_STR_CONNECTION_NAME)
          qy.Parameters("c_type").Value = ConnTypeDynamic

          qy.Execute dbFailOnError

          lId = lId + 1
          rTemp.MoveNext
       Wend
    End If
    qy.Close
    rTemp.Close

    ' Initialize the value of the connection_name_id
    sBuf = "update att_identifiers " & _
           " set " & FLD_ID_CONN_NAME & " = " & Str(lId)
    dbFile.Execute sBuf, dbFailOnError

    ' Update the start_directory field in att_steps to point to the newly
    ' created connections
    Call ReadStepsInWorkspace(rTemp, qy, glInvalidId,
dbLoad:=dbFile, _
           bSelectArchivedRecords:=False)

    sBuf = "update " & TBL_STEPS & _
       " set " & FLD_STEPS_EXEC_DTL & " = [c_name] " & _
       " where " & FLD_ID_STEP & " = [s_id] " & _
       " and " & FLD_STEPS_VERSION_NO & " = [ver_no] "
    Set qy = dbFile.CreateQueryDef("", sBuf)

    If rTemp.RecordCount <> 0 Then
       rTemp.MoveFirst

       While Not rTemp.EOF
          If rTemp.Fields(FLD_STEPS_EXEC_MECHANISM).Value =
gintExecuteODBC Then
             If Not (StringEmpty("" &
rTemp.Fields(FLD_STEPS_EXEC_DTL))) Then
                sBuf = rTemp.Fields(FLD_STEPS_EXEC_DTL)
                ' Strip the enclosing "%" characters
                sBuf = Mid(sBuf, 2, Len(sBuf) - 2) &
CONNECTION_STRINGS_TO_NAME_SUFFIX

                qy.Parameters("c_name").Value = sBuf
                qy.Parameters("s_id").Value =
rTemp.Fields(FLD_ID_STEP)
                qy.Parameters("ver_no").Value =
rTemp.Fields(FLD_STEPS_VERSION_NO)

                qy.Execute dbFailOnError
             End If
          End If
          rTemp.MoveNext
       Wend
    End If

    qy.Close
    rTemp.Close

    Exit Sub

Upgrade243to25Err:
    UpgradeWsp.Rollback
    Call LogErrors(Errors)
    Err.Raise vbObjectError + errUpgradeFailed, mstrModuleName, _
           LoadResString(errUpgradeFailed)

End Sub
Private Sub Upgrade25to251(UpgradeWsp As DAO.Workspace, dbFile
As Database, sVersion As String)

    On Error GoTo Upgrade25to251Err

    ' Create the built-in parameters, run_id and output_dir, for each
workspace in the db
    Call InsertBuiltInParameter(dbFile, PARAM_RUN_ID,
gstrEmptyString, PARAM_RUN_ID_DESC)
    Call InsertBuiltInParameter(dbFile, PARAM_OUTPUT_DIR,
gstrEmptyString, PARAM_OUTPUT_DIR_DESC)

    Call UpdateDbDtls(dbFile, sVersion)

    Exit Sub

Upgrade25to251Err:
    UpgradeWsp.Rollback
    Call LogErrors(Errors)
    Err.Raise vbObjectError + errUpgradeFailed, mstrModuleName, _
           LoadResString(errUpgradeFailed)

End Sub

Private Sub Upgrade242to243(UpgradeWsp As DAO.Workspace,
dbFile As Database, sVersion As String)

    Dim sBuf As String
    Dim cTempStr As New cStringSM
    Dim iResponse As Integer

    On Error GoTo DeleteHistoryErr

    Call DeleteRunHistory(dbFile)

    On Error GoTo Upgrade242to243Err
```

```
   UpgradeWsp.CommitTrans

   UpgradeWsp.BeginTrans

   ' Add a parameter type field and a description field to the parameter
table
   sBuf = "alter table run_step_details " & _
         " add column parent_instance_id LONG "

   dbFile.Execute sBuf, dbFailOnError

   sBuf = "alter table run_step_details " & _
         " add column iterator_value TEXT(255) "

   dbFile.Execute sBuf, dbFailOnError

   Call AlterFieldType(dbFile, TBL_RUN_STEP_DTLS, "start_time",
DATA_TYPE_CURRENCY)
   Call AlterFieldType(dbFile, TBL_RUN_STEP_DTLS, "end_time",
DATA_TYPE_CURRENCY)
   Call AlterFieldType(dbFile, TBL_RUN_STEP_HDR, "start_time",
DATA_TYPE_CURRENCY)
   Call AlterFieldType(dbFile, TBL_RUN_STEP_HDR, "end_time",
DATA_TYPE_CURRENCY)

   Call UpdateDbDtls(dbFile, sVersion)

   Exit Sub

DeleteHistoryErr:
   ' This is not a critical error - continue with upgrade
   Call LogErrors(Errors)
   Resume Next

Upgrade242to243Err:
   UpgradeWsp.Rollback
   Call LogErrors(Errors)
   Err.Raise vbObjectError + errUpgradeFailed, mstrModuleName, _
         LoadResString(errUpgradeFailed)

End Sub
'*********************************************************
********
' The AlterFieldType Sub procedure requires three string
' parameters. The first string specifies the name of the table
' containing the field to be changed. The second string specifies
' the name of the field to be changed. The third string specifies
' the new data type for the field.
'*********************************************************
********

Private Sub AlterFieldType(dbFile As Database, TblName As String,
FieldName As String, _
               NewDataType As String)
   Dim qdf As DAO.QueryDef
   Dim sSql As String

   ' Add a temporary field to the table.
   sSql = "ALTER TABLE [" & TblName & _
         "] ADD COLUMN AlterTempField " & NewDataType
   Set qdf = dbFile.CreateQueryDef("", sSql)
   qdf.Execute

   ' Copy the data from old field into the new field.
   qdf.SQL = "UPDATE DISTINCTROW [" & TblName & "] SET
AlterTempField = [" & FieldName & "]"
   qdf.Execute

   ' Delete the old field.
   qdf.SQL = "ALTER TABLE [" & TblName & "] DROP COLUMN
[" & FieldName & "]"
   qdf.Execute

   ' Rename the temporary field to the old field's name.
   dbFile.TableDefs("[" & TblName &
"]").Fields("AlterTempField").Name = FieldName
   dbFile.TableDefs.Refresh

   ' Clean up.
End Sub
Private Sub Upgrade01to21(UpgradeWsp As DAO.Workspace, dbFile
As DAO.Database, sVersion As String)
   Dim sSql As String

   On Error GoTo Upgrade01to21Err

   sSql = "Create table db_details (" & _
         "db_version              Text(50) " & _
   ");"

   dbFile.Execute sSql, dbFailOnError

   sSql = "insert into db_details " & _
         "( db_version ) values ( '" & sVersion & "' ) "

   dbFile.Execute sSql, dbFailOnError

   Call UpdateContinuationCriteria(dbFile)

   Exit Sub

Upgrade01to21Err:
   Call LogErrors(Errors)
   UpgradeWsp.Rollback
   Err.Raise vbObjectError + errUpgradeFailed, mstrModuleName, _
         LoadResString(errUpgradeFailed)

End Sub
Private Function UpgradeDb(UpgradeWsp As DAO.Workspace, dbFile
As Database, _
      sVerTo As String, sVerFrom As String) As Boolean

   Dim sMsg As String

   On Error GoTo UpgradeDbErr

   UpgradeDb = False
   If Not ValidUpgrade(sVerTo, sVerFrom) Then Exit Function

   If NoDbChanges(sVerTo, sVerFrom) Then
      UpgradeDb = True
      Exit Function
   End If

   sMsg = "The database needs to be upgraded from Version " &
sVerFrom & _
         " to Version " & sVerTo & "." & vbCrLf & _
         "Proceed?"
   If Not Confirm(Buttons:=vbYesNo, strMessage:=sMsg,
strTitle:="Upgrade database") Then
      Exit Function
   End If

   UpgradeWsp.BeginTrans

   Select Case sVerFrom
      Case gsVersion25
         Call Upgrade25to251(UpgradeWsp, dbFile, gsVersion251)
```

```
        Case gsVersion243
            Call Upgrade243to25(UpgradeWsp, dbFile, gsVersion25)
            Call Upgrade25to251(UpgradeWsp, dbFile, gsVersion251)

        Case gsVersion24, gsVersion241, gsVersion242
            sMsg = "After this upgrade, the run history for previous runs
will no longer be available. " & _
                "Continue?"
            If Not Confirm(Buttons:=vbYesNo, strMessage:=sMsg,
strTitle:="Upgrade database") Then
                UpgradeWsp.CommitTrans
                Exit Function
            End If
            Call Upgrade242to243(UpgradeWsp, dbFile, gsVersion243)
            Call Upgrade243to25(UpgradeWsp, dbFile, gsVersion25)
            Call Upgrade25to251(UpgradeWsp, dbFile, gsVersion251)

        Case gsVersion23
            Call Upgrade23to24(UpgradeWsp, dbFile, gsVersion24)
            Call Upgrade242to243(UpgradeWsp, dbFile, gsVersion242)
            Call Upgrade243to25(UpgradeWsp, dbFile, gsVersion25)
            Call Upgrade25to251(UpgradeWsp, dbFile, gsVersion251)

        Case gsVersion21
            Call Upgrade21to23(UpgradeWsp, dbFile, gsVersion23)
            Call Upgrade23to24(UpgradeWsp, dbFile, gsVersion24)
            Call Upgrade242to243(UpgradeWsp, dbFile, gsVersion242)
            Call Upgrade243to25(UpgradeWsp, dbFile, gsVersion25)
            Call Upgrade25to251(UpgradeWsp, dbFile, gsVersion251)

        Case gsVersion10
            Call Upgrade10to21(UpgradeWsp, dbFile, gsVersion21)
            Call Upgrade21to23(UpgradeWsp, dbFile, gsVersion23)
            Call Upgrade23to24(UpgradeWsp, dbFile, gsVersion24)
            Call Upgrade242to243(UpgradeWsp, dbFile, gsVersion242)
            Call Upgrade243to25(UpgradeWsp, dbFile, gsVersion25)
            Call Upgrade25to251(UpgradeWsp, dbFile, gsVersion251)

        Case gsVersion01
            Call Upgrade01to21(UpgradeWsp, dbFile, gsVersion21)
            Call Upgrade21to23(UpgradeWsp, dbFile, gsVersion23)
            Call Upgrade23to24(UpgradeWsp, dbFile, gsVersion24)
            Call Upgrade242to243(UpgradeWsp, dbFile, gsVersion242)
            Call Upgrade243to25(UpgradeWsp, dbFile, gsVersion25)
            Call Upgrade25to251(UpgradeWsp, dbFile, gsVersion251)

    End Select

    UpgradeWsp.CommitTrans

    UpgradeDb = True
    Exit Function

UpgradeDbErr:
    Call LogErrors(Errors)
    ShowError errUpgradeFailed

End Function
Private Function DBVersion(TestDb As Database) As String
    ' Retrieves the database version
    Dim rVersion As Recordset

    On Error GoTo DBVersionErr

    Set rVersion = TestDb.OpenRecordset("Select db_version from
db_details ", _
        dbOpenForwardOnly)

    BugAssert rVersion.RecordCount <> 0
    DBVersion = rVersion!db_version
    rVersion.Close
    Exit Function

DBVersionErr:
    If Err.Number = merrDaoTableMissing Then
        DBVersion = gsVersion01
    Else
        LogErrors Errors
        Err.Raise vbObjectError + errUpgradeFailed, mstrModuleName, _
            LoadResString(errUpgradeFailed)
    End If

End Function

Private Function ValidUpgrade(sVerTo As String, sVerFrom As String)
As Boolean

    If sVerTo = gsVersion And sVerFrom = gsVersion251 Then
        ValidUpgrade = True
    ElseIf sVerTo = gsVersion And sVerFrom = gsVersion25 Then
        ValidUpgrade = True
    ElseIf sVerTo = gsVersion And sVerFrom = gsVersion243 Then
        ValidUpgrade = True
    ElseIf sVerTo = gsVersion And sVerFrom = gsVersion242 Then
        ValidUpgrade = True
    ElseIf sVerTo = gsVersion And sVerFrom = gsVersion241 Then
        ValidUpgrade = True
    ElseIf sVerTo = gsVersion And sVerFrom = gsVersion24 Then
        ValidUpgrade = True
    ElseIf sVerTo = gsVersion And sVerFrom = gsVersion23 Then
        ValidUpgrade = True
    ElseIf sVerTo = gsVersion And sVerFrom = gsVersion21 Then
        ValidUpgrade = True
    ElseIf sVerTo = gsVersion And sVerFrom = gsVersion10 Then
        ValidUpgrade = True
    ElseIf sVerTo = gsVersion And sVerFrom = gsVersion01 Then
        ValidUpgrade = True
    Else
        ValidUpgrade = False
    End If

End Function
```

DebugSM.bas

```
Attribute VB_Name = "DebugSM"
'  FILE:      DebugSM.bas
'             Microsoft TPC-H Kit Ver. 1.00
'             Copyright Microsoft, 1999
'             All Rights Reserved
'
'
'  PURPOSE:   Contains all the functions that carry out error/debug
'             processing for the project.
'  Contact:   Reshma Tharamal (reshmat@microsoft.com)
'
' Most of the functions in this module that manipulate the
' error object do not have an On Error GoTo statement - this
' is because it will clear the passed in error object - let
' the calling functions handle the errors raised by this
' module, if any
Option Explicit

' Used to indicate the source module name when errors
' are raised by this module
Private Const mstrModuleName As String = "DebugSM."

Private mcLogFile As cFileSM
Private mcErrorFile As cFileSM
```

```
Private Const FORMAT_MESSAGE_FROM_SYSTEM = &H1000
Private Const FORMAT_MESSAGE_IGNORE_INSERTS = &H200
Private Const pNull = 0

Declare Function FormatMessage Lib "kernel32" Alias
"FormatMessageA" (ByVal dwFlags As Long, lpSource As Any, ByVal
dwMessageId As Long, ByVal dwLanguageId As Long, ByVal lpbuffer
As String, ByVal nSize As Long, Arguments As Long) As Long
Public Function Confirm(Optional lngMessageCode As
conConfirmMsgCodes, _
      Optional lngTitleCode As conConfirmMsgTitleCodes, _
      Optional TitleParameter As String, _
      Optional ByVal Buttons As Integer = -1, _
      Optional strMessage As String = gstrEmptyString, _
      Optional strTitle As String = gstrEmptyString) _
      As Boolean
   ' Displays a confirmation message corresponding to the
   ' passed in message code. Returns True if the user says
   ' Ok and False otherwise

   Dim intResponse As Integer
   Dim intButtonStyle As Integer

   On Error GoTo ConfirmErr

   Confirm = False

   ' If the buttons style hasn't been specified, set the
   ' default style to display OK and Cancel buttons
   If Buttons = -1 Then
      intButtonStyle = vbOKCancel
   Else
      intButtonStyle = Buttons
   End If

   ' Find the message string for the passed in code
   If StringEmpty(strMessage) Then
      strMessage = Trim$(LoadResString(lngMessageCode))
   End If

   If StringEmpty(strTitle) Then
      strTitle = Trim$(LoadResString(lngTitleCode))
   End If

   If Not StringEmpty(TitleParameter) Then
      strTitle = strTitle & Chr$(vbKeySpace) & _
            gstrSQ & TitleParameter & gstrSQ
   End If

   ' Display the confirmation message with the Cancel button
   ' set to the default - assume that we are confirming
   ' potentially dangerous operations!
   intResponse = MsgBox(strMessage, _
         intButtonStyle + vbQuestion + vbApplicationModal, _
         strTitle)

   ' Translate the user response into a True/False return code
   If intButtonStyle = vbOKCancel Then
      If intResponse = vbOK Then
         Confirm = True
      Else
         Confirm = False
      End If
   Else
      If intResponse = vbYes Then
         Confirm = True
      Else
         Confirm = False
      End If
   End If

   Exit Function

ConfirmErr:
   ' Log the error code raised by Visual Basic
   Call LogErrors(Errors)
   On Error GoTo 0
   gstrSource = mstrModuleName & "Confirm"
   Err.Raise vbObjectError + errConfirmFailed, _
         gstrSource, _
         LoadResString(errConfirmFailed)

End Function
Public Sub LogSystemError()
   Dim eErrCode As Long

   eErrCode = GetLastError()
   If eErrCode <> 0 Then
      WriteToFile "System Error: " & eErrCode & vbCrLf &
ApiError(eErrCode), _
            blnError:=True
   End If

End Sub
Public Function ApiError(ByVal e As Long) As String

   Dim s As String
   Dim c As Long

   s = String(256, 0)
   c = FormatMessage(FORMAT_MESSAGE_FROM_SYSTEM Or _
         FORMAT_MESSAGE_IGNORE_INSERTS, _
         pNull, e, 0&, s, Len(s), ByVal pNull)
   If c Then ApiError = e & ": " & Left$(s, c)

End Function

' Output flags determine output destination of BugAsserts and messages
#Const afLogfile = 1
#Const afMsgBox = 2
#Const afDebugWin = 4
#Const afAppLog = 8

' Display appropriate error message, and then stop
' program.  These errors should NOT be possible in
' shipping product.
Sub BugAssert(ByVal fExpression As Boolean, _
            Optional sExpression As String)
#If afDebug Then
   If fExpression Then Exit Sub
   BugMessage "BugAssert failed: " & sExpression
   Stop
#End If
End Sub

Sub BugMessage(sMsg As String)

#If afDebug And afLogfile Then
   ' Since we are writing log messages, the error flag is turned off
   Call WriteToFile(sMsg, False)
#End If
#If afDebug And afMsgBox Then
   MsgBox sMsg
#End If
#If afDebug And afDebugWin Then
   Debug.Print sMsg
#End If
#If afDebug And afAppLog Then
   App.LogEvent sMsg
```

```
#End If

End Sub
Public Function ProjectLogFile() As String

   ProjectLogFile = mcLogFile.FileName

End Function
Public Function ProjectErrorFile() As String

   ProjectErrorFile = mcErrorFile.FileName

End Function

Private Sub WriteToFile(sMsg As String, Optional ByVal blnError As
Boolean)

   ' Calls procedures to write the passed in message to the log -
   ' The blnError flag is used to indicate that the message
   ' should be logged to the error file - by default the log
   ' file is used

   Dim mcFileObj As cFileSM
   Dim strFileName As String
   Dim strFileHdr As String

   On Error GoTo WriteToFileErr

   If blnError Then
      If mcErrorFile Is Nothing Then
         Set mcErrorFile = New cFileSM
      End If
      Set mcFileObj = mcErrorFile
   Else
      If mcLogFile Is Nothing Then
         Set mcLogFile = New cFileSM
      End If
      Set mcFileObj = mcLogFile
   End If

   If StringEmpty(mcFileObj.FileName) Then
      If blnError Then
         strFileName = gstrProjectPath & "\" & App.EXEName &
".ERR"
         strFileHdr = "Stepmaster Errors"
      Else
         strFileName = gstrProjectPath & "\" & App.EXEName &
".DBG"
         strFileHdr = "Stepmaster Log"
      End If

      mcFileObj.FileName = strFileName
      mcFileObj.WriteLine strFileHdr
      mcFileObj.WriteLine "Log start time : " & Now
   End If

   mcFileObj.WriteLine sMsg

   Exit Sub

WriteToFileErr:
   ' Display the error code raised by Visual Basic
   Call DisplayErrors(Errors)
   ' An error message would've been displayed by the called
   ' procedures

End Sub
Public Sub WriteMessage(sMsg As String)

   Call WriteToFile(sMsg, True)

End Sub

Sub BugTerm()
#If afDebug And afLogfile Then
   ' Close log file
   mcLogFile.CloseFile
#End If
End Sub

Public Sub ShowError(ByVal ErrorCode As errErrorConstants, _
      Optional ByVal ErrorSource As String = gstrEmptyString, _
      Optional ByVal OptArgs As String = gstrEmptyString, _
      Optional ByVal DoWriteError As Boolean = True)

   If DoWriteError Then
      ' Call a procedure to write the error to a log file
      Call WriteError(ErrorCode, ErrorSource, OptArgs)
   End If

   ' Re-initialize the values of the Error object before
   ' displaying the error to the user
   Call InitErrObject(ErrorCode, ErrorSource, OptArgs)

   Call DisplayErrors(Errors)

   Err.Clear

End Sub
Public Sub WriteError(ByVal ErrorCode As errErrorConstants, _
      Optional ByVal ErrorSource As String = gstrEmptyString, _
      Optional ByVal OptArgs As String = gstrEmptyString)

   ' Initialize the values of the Error object before
   ' calling the log function
   Call InitErrObject(ErrorCode, ErrorSource, OptArgs)

   Call LogErrors(Errors)

   Err.Clear

End Sub
Private Sub InitErrObject(ByVal ErrorCode As errErrorConstants, _
      Optional ByVal ErrorSource As String = gstrEmptyString, _
      Optional ByVal OptArgs As String = gstrEmptyString)

   Dim lngError As Long

   lngError = IIf(ErrorCode > vbObjectError And ErrorCode <
vbObjectError + 65535, _
         ErrorCode - vbObjectError, ErrorCode)
   Err.Number = lngError + vbObjectError
   Err.Description = LoadResString(lngError) & OptArgs
   Err.Source = App.EXEName & ErrorSource

End Sub
Public Sub ShowMessage(ByVal MessageCode As errErrorConstants, _
      Optional ByVal OptArgs As String)

   Dim strMessage As String

   On Error GoTo ShowMessageErr

   strMessage = LoadResString(MessageCode) & OptArgs

   ' Write the error to a log file
   BugMessage strMessage

   MsgBox strMessage, vbOKOnly
```

```
   Exit Sub

ShowMessageErr:
   ' Log the error and exit
   Call DisplayErrors(Errors)

End Sub
Public Sub ShowMessageStr(sMessage As String)

   ' Write the error to a log file
   BugMessage sMessage

   MsgBox sMessage, vbOKOnly

End Sub

Public Sub DisplayErrors(myErrCollection As Errors)
   Dim strError As String
   Dim errLoop As Error
   Dim errCode As Long

   ' Enumerate Errors collection and display properties of
   ' each Error object.
   If Err.Number <> 0 Then
      If Err.Number > vbObjectError And Err.Number < (vbObjectError
+ 65536) Then
         errCode = Err.Number - vbObjectError
      Else
         errCode = Err.Number
      End If
      strError = "Error # " & Str(errCode) & " was generated by " _
         & Err.Source & Chr(13) & Err.Description
      MsgBox strError, , "Error", Err.HelpFile, Err.HelpContext
   Else
      For Each errLoop In myErrCollection
         With errLoop
            If Err.Number > vbObjectError And Err.Number <
(vbObjectError + 65536) Then
               errCode = .Number - vbObjectError
            Else
               errCode = .Number
            End If
            strError = "Error #" & errCode & vbCrLf
            strError = strError & "    " & .Description & vbCrLf
            strError = strError & _
               "    (Source: " & .Source & ")" & vbCrLf
'            strError = strError & _
'               "Press F1 to see topic " & .HelpContext & vbCrLf
'            strError = strError & _
'               "    in the file " & .HelpFile & "."
         End With

         MsgBox strError
      Next
   End If

End Sub
Public Sub LogErrors(myErrCollection As Errors)
   Dim cColErrors As cVectorStr
   Dim strError As String
   Dim errLoop As Error
   Dim errCode As Long
   Dim lngIndex As Long

   Set cColErrors = New cVectorStr

   ' Enumerate Errors collection and display properties of
   ' each Error object.
   If Err.Number <> 0 Then
      If Err.Number > vbObjectError And Err.Number < (vbObjectError
+ 65536) Then
         errCode = Err.Number - vbObjectError
      Else
         errCode = Err.Number
      End If
      strError = "Error # " & Str(errCode) & " was generated by " _
         & Err.Source & vbCrLf & Err.Description

      cColErrors.Add strError
   End If

   ' Log all database errors, if any
   For Each errLoop In myErrCollection
      With errLoop
         If Err.Number > vbObjectError And Err.Number <
(vbObjectError + 65536) Then
            errCode = .Number - vbObjectError
         Else
            errCode = .Number
         End If
         strError = "Error #" & errCode & vbCrLf
         strError = strError & "    " & .Description & vbCrLf
         strError = strError & _
            "    (Source: " & .Source & ")" & vbCrLf
      End With

      cColErrors.Add strError
   Next

   ' We can have a error handler now that we have stored all
   ' errors away safely! - having an error handler before
   ' enumerating all the errors would have cleared the error
   ' collection
   On Error GoTo LogErrorsErr
   gstrSource = mstrModuleName & "LogErrors"

   For lngIndex = 0 To cColErrors.Count - 1
      strError = cColErrors(lngIndex)
      Debug.Print strError
      Call WriteToFile(strError, True)
   Next lngIndex

   Set cColErrors = Nothing

   Exit Sub

LogErrorsErr:
   ' Display the error code raised by Visual Basic
   DisplayErrors Errors
   On Error GoTo 0
   ShowError errUnableToWriteError, DoWriteError:=False

End Sub
```

FileCommon.bas

```
Attribute VB_Name = "FileCommon"
'  FILE:      FileCommon.bas
'             Microsoft TPC-H Kit Ver. 1.00
'             Copyright Microsoft, 1999
'             All Rights Reserved
'
'
'  PURPOSE:   This module contains common functionality to display
'             the File Open dialog.
'  Contact:   Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit
```

```
' Used to indicate the source module name when errors
' are raised by this module
Private Const mstrModuleName As String = "FileCommon."

Private Enum EOpenFile
   OFN_OVERWRITEPROMPT = &H2
   OFN_HIDEREADONLY = &H4
   OFN_FILEMUSTEXIST = &H1000
   OFN_EXPLORER = &H80000
End Enum

' The locations for the different output files are presented to
' the user in a list box. These constants are used while loading the
' data and while reading the data from the list box.
' These constants also represent the different file types that are
' displayed to the user in File Open dialogs
Public Enum gFileTypes
   gintOutputFile = 0
'   gintLogFile = 1
   gintErrorFile
   gintStepTextFile
   gintOutputCompareFile
   gintDBFile
   gintDBFileNew
   gintImportFile
   gintExportFile
End Enum

Public Const gsSqlFileSuffix = ".sql"
Public Const gsCmdFileSuffix = ".cmd"

Public Const gsOutputFileSuffix = ".out"
Public Const gstrLogFileSuffix = ".log"
Public Const gsErrorFileSuffix = ".err"
Public Function BrowseDBFile() As String
   ' Prompts the user for a database file with the workspace information
   ' Call CallFileDialog to display the open file dialog
   BrowseDBFile = CallFileDialog(gintDBFile)

End Function
Public Function CallFileDialog(intFileType As Integer, _
      Optional ByVal strDefaultFile As String = gstrEmptyString) As
String
   ' This function initializes the values of the filter property,
   ' the dialog title and flags for the File Open dialog depending
   ' on the FileType passed in
   ' It then calls ShowFileOpenDialog to set these properties and
   ' display the File Open dialog to the user

   ' All the properties used by the File Open dialog are defined
   ' as constants in this function and passed to ShowFileOpenDialog
   ' as parameters. So if any of the dialog properties need to be
   ' modified, these constants are what need to be changed
   Const s_DLG_TITLE_OPEN = "Open"
   Const s_DLG_TITLE_NEW = "New"
   Const s_DLG_TITLE_IMPORT = "Import From"
   Const s_DLG_TITLE_EXPORT = "Export To"

   Const mlng_FILE_STEP_TEXT_FLAGS = OFN_EXPLORER Or
OFN_FILEMUSTEXIST Or OFN_HIDEREADONLY
   Const mlng_FILE_OUTPUT_COMPARE_FLAGS =
mlng_FILE_STEP_TEXT_FLAGS
   Const mlng_FILE_DB_FLAGS = mlng_FILE_STEP_TEXT_FLAGS
   Const mlng_FILE_OUTPUT_FLAGS = OFN_EXPLORER Or
OFN_HIDEREADONLY Or OFN_OVERWRITEPROMPT
   Const mlng_FILE_LOG_FLAGS = mlng_FILE_OUTPUT_FLAGS
   Const mlng_FILE_ERROR_FLAGS =
mlng_FILE_OUTPUT_FLAGS
   Const mlng_FILE_DB_NEW_FLAGS =
mlng_FILE_OUTPUT_FLAGS
   Const mstr_FILE_ALL_FILTER = "|All Files (*.*)|*.*"
   Const mstr_FILE_STEP_TEXT_FILTER = "Query Files (*" &
gsSqlFileSuffix & _
         ")|*" & gsSqlFileSuffix & "|Command Script Files (*" &
gsCmdFileSuffix & _
         ")|*" & gsCmdFileSuffix
   Const mstr_FILE_OUTPUT_COMPARE_FILTER = "Text Files
(*.txt)|*.txt"
   Const mstr_FILE_OUTPUT_FILTER = "Output Files (*.out)|*.out"
   Const mstr_FILE_LOG_FILTER = "Log Files (*.log)|*.log"
   Const mstr_FILE_ERROR_FILTER = "Error Files (*.err)|*.err"
   Const mstr_FILE_DB_FILTER = "Stepmaster Workspace Files (*"
& gsDefDBFileExt & ")|*" & gsDefDBFileExt

   Dim strFileName As String

   On Error GoTo CallFileDialogErr

   Select Case intFileType
      Case gintStepTextFile
         strFileName = ShowFileOpenDialog( _
            mstr_FILE_STEP_TEXT_FILTER &
mstr_FILE_ALL_FILTER, _
            s_DLG_TITLE_OPEN, _
            mlng_FILE_STEP_TEXT_FLAGS, _
            strDefaultFile)

      Case gintOutputCompareFile
         strFileName = ShowFileOpenDialog( _
            mstr_FILE_OUTPUT_COMPARE_FILTER &
mstr_FILE_ALL_FILTER, _
            s_DLG_TITLE_OPEN, _
            mlng_FILE_OUTPUT_COMPARE_FLAGS, _
            strDefaultFile)

      Case gintOutputFile
         strFileName = ShowFileOpenDialog( _
            mstr_FILE_OUTPUT_FILTER & mstr_FILE_ALL_FILTER,
_
            s_DLG_TITLE_OPEN, _
            mlng_FILE_OUTPUT_FLAGS, _
            strDefaultFile)

'      Case gintLogFile
'         strFileName = ShowFileOpenDialog( _
'            mstr_FILE_LOG_FILTER & mstr_FILE_ALL_FILTER, _
'            s_DLG_TITLE_OPEN, _
'            mlng_FILE_LOG_FLAGS, _
'            strDefaultFile)
'
      Case gintErrorFile
         strFileName = ShowFileOpenDialog( _
            mstr_FILE_ERROR_FILTER & mstr_FILE_ALL_FILTER,
_
            s_DLG_TITLE_OPEN, _
            mlng_FILE_ERROR_FLAGS, _
            strDefaultFile)

      Case gintDBFile
         strFileName = ShowFileOpenDialog( _
            mstr_FILE_DB_FILTER & mstr_FILE_ALL_FILTER, _
            s_DLG_TITLE_OPEN, _
            mlng_FILE_DB_FLAGS, _
            strDefaultFile)

      Case gintDBFileNew
         strFileName = ShowFileOpenDialog( _
            mstr_FILE_DB_FILTER & mstr_FILE_ALL_FILTER, _
            s_DLG_TITLE_NEW, _
```


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```
            mlng_FILE_DB_NEW_FLAGS, _
            strDefaultFile)

        Case gintImportFile
            strFileName = ShowFileOpenDialog( _
                mstr_FILE_DB_FILTER & mstr_FILE_ALL_FILTER, _
                s_DLG_TITLE_IMPORT, _
                mlng_FILE_DB_FLAGS, _
                strDefaultFile)

        Case gintExportFile
            strFileName = ShowFileOpenDialog( _
                mstr_FILE_DB_FILTER & mstr_FILE_ALL_FILTER, _
                s_DLG_TITLE_EXPORT, _
                mlng_FILE_DB_FLAGS, _
                strDefaultFile)

        Case Else
            BugAssert True, "Incorrect file type passed in."
            ' Default processing will be for the output file
            strFileName = ShowFileOpenDialog( _
                mstr_FILE_OUTPUT_FILTER & mstr_FILE_ALL_FILTER,
_
                s_DLG_TITLE_OPEN, _
                mlng_FILE_OUTPUT_FLAGS, _
                strDefaultFile)

    End Select
    CallFileDialog = strFileName

    Exit Function

CallFileDialogErr:
    CallFileDialog = gstrEmptyString
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    gstrSource = mstrModuleName & "CallFileDialog"
    Call ShowError(errBrowseFailed)

End Function
```

frmSplash.frm

```
VERSION 5.00
Begin VB.Form frmSplash
  BorderStyle    =  3  'Fixed Dialog
  ClientHeight   =  4710
  ClientLeft     =  45
  ClientTop      =  45
  ClientWidth    =  7455
  ControlBox     =  0  'False
  Icon           =  "frmSplash.frx":0000
  LinkTopic      =  "Form1"
  LockControls   =  -1  'True
  MaxButton      =  0  'False
  MinButton      =  0  'False
  ScaleHeight    =  4710
  ScaleWidth     =  7455
  ShowInTaskbar  =  0  'False
  StartUpPosition =  2  'CenterScreen
  Visible        =  0  'False
  Begin VB.Frame fraMainFrame
    Height       =  4590
    Left         =  45
    TabIndex     =  0
    Top          =  -15
    Width        =  7380
    Begin VB.PictureBox picLogo
      Height     =  2385
      Left       =  510
      Picture    =  "frmSplash.frx":0442
      ScaleHeight =  2325
      ScaleWidth =  1755
      TabIndex   =  1
      Top        =  855
      Width      =  1815
    End
    Begin VB.Label lblReserved
      AutoSize   =  -1  'True
      Caption    =  "All Rights Reserved."
      Height     =  195
      Left       =  5520
      TabIndex   =  8
      Top        =  4080
      Width      =  1440
    End
    Begin VB.Label lblCopyright
      AutoSize   =  -1  'True
      Caption    =  "Copyright © 1998"
      BeginProperty Font
        Name     =  "Arial"
        Size     =  8.25
        Charset  =  0
        Weight   =  400
        Underline =  0  'False
        Italic   =  0  'False
        Strikethrough =  0  'False
      EndProperty
      Height     =  210
      Left       =  5550
      TabIndex   =  7
      Tag        =  "Copyright"
      Top        =  3850
      Width      =  1380
      WordWrap   =  -1  'True
    End
    Begin VB.Label lblCompany
      AutoSize   =  -1  'True
      Caption    =  "Microsoft Corporation"
      BeginProperty Font
        Name     =  "Arial"
        Size     =  8.25
        Charset  =  0
        Weight   =  400
        Underline =  0  'False
        Italic   =  0  'False
        Strikethrough =  0  'False
      EndProperty
      Height     =  210
      Left       =  5460
      TabIndex   =  6
      Tag        =  "Company"
      Top        =  3640
      Width      =  1560
    End
    Begin VB.Label lblRestrictions
      AutoSize   =  -1  'True
      Caption    =  "See License Agreement for Restrictions"
      Height     =  195
      Left       =  460
      TabIndex   =  5
      Top        =  4080
      Width      =  2790
    End
    Begin VB.Label lblProductName
      AutoSize   =  -1  'True
      Caption    =  "StepMaster"
      BeginProperty Font
        Name     =  "Arial"
        Size     =  32.25
```

```
        Charset        =  0
        Weight         =  700
        Underline      =  0  'False
        Italic         =  0  'False
        Strikethrough  =  0  'False
      EndProperty
      Height         =  765
      Left           =  2670
      TabIndex       =  4
      Tag            =  "Product"
      Top            =  1200
      Width          =  3495
    End
    Begin VB.Label lblVersion
      Alignment      =  1  'Right Justify
      AutoSize       =  -1  'True
      Caption        =  "Version 2.4"
      BeginProperty Font
        Name           =  "Arial"
        Size           =  12
        Charset        =  0
        Weight         =  700
        Underline      =  0  'False
        Italic         =  0  'False
        Strikethrough  =  0  'False
      EndProperty
      Height         =  285
      Left           =  4800
      TabIndex       =  3
      Tag            =  "Version"
      Top            =  2040
      Width          =  1275
    End
    Begin VB.Label lblWarning
      AutoSize       =  -1  'True
      Caption        =  "Do Not Redistribute"
      BeginProperty Font
        Name           =  "Arial"
        Size           =  8.25
        Charset        =  0
        Weight         =  400
        Underline      =  0  'False
        Italic         =  0  'False
        Strikethrough  =  0  'False
      EndProperty
      Height         =  210
      Left           =  480
      TabIndex       =  2
      Tag            =  "Warning"
      Top            =  3850
      Width          =  1380
    End
  End
End
Attribute VB_Name = "frmSplash"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = False
Attribute VB_PredeclaredId = True
Attribute VB_Exposed = False
'  FILE:      frmSplash.frm
'             Microsoft TPC-H Kit Ver. 1.00
'             Copyright Microsoft, 1999
'             All Rights Reserved
'
'
'  PURPOSE:   Splash screen for StepMaster
'  Contact:   Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

Private Sub Form_Load()
'    lblVersion.Caption = "Version " & App.Major & "." & App.Minor &
"." & App.Revision
    lblProductName.Caption = App.Title
    lblVersion.Caption = GetVersionString

End Sub
```

frmWorkspaceOpen.frm

```
VERSION 5.00
Begin VB.Form frmWorkspaceOpen
  BorderStyle    =  3  'Fixed Dialog
  Caption        =  "Open Workspace"
  ClientHeight   =  2550
  ClientLeft     =  45
  ClientTop      =  330
  ClientWidth    =  4695
  LinkTopic      =  "Form1"
  LockControls   =  -1  'True
  MaxButton      =  0  'False
  MinButton      =  0  'False
  ScaleHeight    =  2550
  ScaleWidth     =  4695
  ShowInTaskbar  =  0  'False
  StartUpPosition =  1  'CenterOwner
  Begin VB.CommandButton cmdOK
    Caption        =  "OK"
    Default        =  -1  'True
    Height         =  375
    Left           =  2160
    TabIndex       =  2
    Top            =  2040
    Width          =  1095
  End
  Begin VB.CommandButton cmdCancel
    Cancel         =  -1  'True
    Caption        =  "Cancel"
    Height         =  375
    Left           =  3360
    TabIndex       =  3
    Top            =  2040
    Width          =  1095
  End
  Begin VB.ListBox lstWorkspaces
    Height         =  1425
    ItemData       =  "frmWorkspaceOpen.frx":0000
    Left           =  240
    List           =  "frmWorkspaceOpen.frx":0002
    MultiSelect    =  2  'Extended
    TabIndex       =  1
    Top            =  480
    Width          =  4215
  End
  Begin VB.Label lblWorkspaces
    AutoSize       =  -1  'True
    Caption        =  "Workspace"
    Height         =  195
    Left           =  240
    TabIndex       =  0
    Top            =  120
    Width          =  825
  End
End
Attribute VB_Name = "frmWorkspaceOpen"
Attribute VB_GlobalNameSpace = False
Attribute VB_Creatable = False
Attribute VB_PredeclaredId = True
Attribute VB_Exposed = False
```

```
'  FILE:       frmWorkspaceOpen.frm
'            Microsoft TPC-H Kit Ver. 1.00
'            Copyright Microsoft, 1999
'            All Rights Reserved
'
'
'  PURPOSE:    Used to display a list of all workspaces in a
'            workspace definition file for Open, Import, Export
'            and Run (in SMRunOnly) workspace
'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit
#If RUN_ONLY Then
   Private WithEvents cRunOnlyInst As cRunOnly
Attribute cRunOnlyInst.VB_VarHelpID = -1

Private Sub cRunOnlyInst_Done()
   ShowFree
End Sub

Private Sub Run()
   Dim iIndex As Integer

   Set cRunOnlyInst = New cRunOnly

   For iIndex = 0 To Me.lstWorkspaces.ListCount - 1
      If Me.lstWorkspaces.Selected(iIndex) Then
         ShowBusy
         cRunOnlyInst.WorkspaceId =
Me.lstWorkspaces.ItemData(Me.lstWorkspaces.ListIndex)
         cRunOnlyInst.WspName =
Me.lstWorkspaces.List(Me.lstWorkspaces.ListIndex)
         cRunOnlyInst.RunWsp
      End If
   Next iIndex

End Sub

#End If

Private Sub cmdCancel_Click()

   Unload Me

End Sub

Private Sub cmdOK_Click()

#If RUN_ONLY Then
   Call Run
#Else
   Call WorkspaceOpenOk
#End If

End Sub


Private Sub lstWorkspaces_DblClick()

   ' A double click on the workspaces list box is considered
   ' equivalent to selecting an item in the list and then selecting
   ' the OK command
   Call cmdOK_Click

End Sub
```

IteratorCommon.bas

```
Attribute VB_Name = "IteratorCommon"
'  FILE:       IteratorCommon.bas
'            Microsoft TPC-H Kit Ver. 1.00
'            Copyright Microsoft, 1999
'            All Rights Reserved
'
'
'  PURPOSE:    Contains functionality common across StepMaster and
'            SMRunOnly, pertaining to iterators
'            Specifically, functions to read iterators records
'            in the workspace, load them in an array and so on.
'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

' Used to indicate the source module name when errors
' are raised by this module
Private Const mstrModuleName As String = "IteratorCommon."

Public Const gintMinIteratorSequence As Integer = 0

Public Sub RangeComplete(vntIterators As Variant)
   ' This is a debug procedure
   ' Checks if the from, to and step values are present in
   ' the array

   Dim bReset As Byte
   Dim bShift As Byte
   Dim lngIndex As Long

   ' Set the three lowest order bits to 1
   bReset = 7

   BugAssert IsArray(vntIterators) And Not IsEmpty(vntIterators), _
         "Iterators not specified!"

   For lngIndex = LBound(vntIterators) To _
         UBound(vntIterators)
      bShift = 1
      bShift = bShift * (2 ^ (vntIterators(lngIndex).IteratorType - 1))

      bReset = bReset Xor bShift
   Next lngIndex

   ' Assert that all the elements are present
   BugAssert bReset = 0, "Range not completely specified!"

End Sub
Public Sub LoadIteratorsForWsp(cStepsCol As cArrSteps, _
      ByVal lngWorkspaceId As Long, rstStepsInWsp As Recordset)
   ' Initializes the step records in with all the iterator
   ' values for each step

   Dim recIterators As Recordset

   On Error GoTo LoadIteratorsForWspErr

#If QUERY_ALL Then
   Dim dtStart As Date

   dtStart = Now
   Set recIterators = ReadWspIterators(lngWorkspaceId)

   Call LoadIteratorsArray(cStepsCol, recIterators)

   recIterators.Close

   BugMessage "QueryAll Read + load took: " & CStr(DateDiff("s",
dtStart, Now))

#Else
   Dim dtStart As Date
```

```
    Dim qyIt As DAO.QueryDef
    Dim sSql As String

    dtStart = Now
    If rstStepsInWsp.RecordCount = 0 Then
        Exit Sub
    End If

    ' This method has the advantage that if the steps are queried right,
everything else follows
    sSql = "Select step_id, version_no, type, iterator_value, " & _
        " sequence_no " & _
        " from iterator_values " & _
        " where step_id = [s_id] " & _
        " and version_no = [ver_no] "

    ' Order the iterators by sequence within a step
    sSql = sSql & " order by sequence_no "

    Set qyIt = dbsAttTool.CreateQueryDef(gstrEmptyString, sSql)
    rstStepsInWsp.MoveFirst

    While Not rstStepsInWsp.EOF

        qyIt.Parameters("s_id").Value = rstStepsInWsp!step_id
        qyIt.Parameters("ver_no").Value = rstStepsInWsp!version_no

        Set recIterators = qyIt.OpenRecordset(dbOpenSnapshot)

        Call LoadIteratorsArray(cStepsCol, recIterators)
        recIterators.Close

        rstStepsInWsp.MoveNext
    Wend

    qyIt.Close

    BugMessage "Query step at a time Read + load took: " &
CStr(DateDiff("s", dtStart, Now))

#End If

    Exit Sub

LoadIteratorsForWspErr:
    LogErrors Errors
    gstrSource = mstrModuleName & "LoadIteratorsForWsp"
    On Error GoTo 0
    Err.Raise vbObjectError + errLoadRsInArrayFailed, _
            gstrSource, _
            LoadResString(errLoadRsInArrayFailed)

End Sub
Private Function ReadWspIterators(ByVal lngWorkspaceId As Long)
As Recordset

    ' This function will return a recordset that is populated
    ' with the iterators for all the steps in a given workspace

    Dim recIterators As Recordset
    Dim qyIt As DAO.QueryDef
    Dim strSql As String

    On Error GoTo ReadWspIteratorsErr
    gstrSource = mstrModuleName & "ReadWspIterators"

    strSql = "Select i.step_id, i.version_no, " & _
        " i.type, i.iterator_value, " & _
        " i.sequence_no " & _
        " from iterator_values i, att_steps a " & _
        " where i.step_id = a.step_id " & _
        " and i.version_no = a.version_no " & _
        " and a.workspace_id = [w_id] " & _
        " and a.archived_flag = [archived] "

    ' Find the highest X-component of the version number
    strSql = strSql & " AND cint( mid( a.version_no, 1, instr(
a.version_no, " & gstrDQ & gstrVerSeparator & gstrDQ & " ) - 1 ) ) = "
& _
        " ( select max( cint( mid( version_no, 1, instr( version_no, " &
gstrDQ & gstrVerSeparator & gstrDQ & " ) - 1 ) ) ) " & _
        " from att_steps AS d " & _
        " WHERE a.step_id = d.step_id ) "

    ' Find the highest Y-component of the version number for the highest
X-component
    strSql = strSql & " AND cint( mid( a.version_no, instr( a.version_no,
" & gstrDQ & gstrVerSeparator & gstrDQ & " ) + 1 ) ) = " & _
        " ( select max( cint( mid( version_no, instr( version_no, " &
gstrDQ & gstrVerSeparator & gstrDQ & " ) + 1 ) ) ) " & _
        " from att_steps AS b " & _
        " Where a.step_id = b.step_id " & _
        " AND cint( mid( version_no, 1, instr( version_no, " & gstrDQ &
gstrVerSeparator & gstrDQ & " ) - 1 ) ) = " & _
        " ( select max( cint( mid( version_no, 1, instr( version_no, " &
gstrDQ & gstrVerSeparator & gstrDQ & " ) - 1 ) ) ) " & _
        " from att_steps AS c " & _
        " WHERE a.step_id = c.step_id ) ) "


    ' Order the iterators by sequence within a step
    strSql = strSql & " order by i.step_id, i.sequence_no "

    Set qyIt = dbsAttTool.CreateQueryDef(gstrEmptyString, strSql)
    qyIt.Parameters("w_id").Value = lngWorkspaceId
    qyIt.Parameters("archived").Value = False

    Set recIterators = qyIt.OpenRecordset(dbOpenSnapshot)

    qyIt.Close
    Set ReadWspIterators = recIterators

    Exit Function

ReadWspIteratorsErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    On Error GoTo 0
    Err.Raise vbObjectError + errReadDataFailed, _
            gstrSource, LoadResString(errReadDataFailed)

End Function
Private Sub LoadIteratorsArray(cStepsCol As cArrSteps, _
        recIterators As Recordset)
    ' Initializes the step records with the iterators for
    ' the step

    Dim cNewIt As cIterator
    Dim cStepRec As cStep
    Dim lngStepId As Long

    On Error GoTo LoadIteratorsArrayErr
    gstrSource = mstrModuleName & "LoadIteratorsArray"

    If recIterators.RecordCount = 0 Then
        Exit Sub
    End If

    recIterators.MoveFirst
    While Not recIterators.EOF
```

```
        Set cNewIt = New cIterator

        lngStepId = CLng(ErrorOnNullField(recIterators, "step_id"))
        If Not cStepRec Is Nothing Then
            If cStepRec.StepId <> lngStepId Then
                Set cStepRec = cStepsCol.QueryStep(lngStepId)
            End If
        Else
            Set cStepRec = cStepsCol.QueryStep(lngStepId)
        End If

        ' Initialize iterator values
        cNewIt.IteratorType = CInt(ErrorOnNullField(recIterators,
"type"))
        cNewIt.Value = CStr(ErrorOnNullField(recIterators,
"iterator_value"))
        cNewIt.SequenceNo = CInt(ErrorOnNullField(recIterators,
"sequence_no"))

        ' Add this record to the array of iterators
        cStepRec.LoadIterator cNewIt

        Set cNewIt = Nothing
        recIterators.MoveNext
    Wend

    Exit Sub

LoadIteratorsArrayErr:
    LogErrors Errors
    gstrSource = mstrModuleName & "LoadIteratorsArray"
    On Error GoTo 0
    Err.Raise vbObjectError + errLoadRsInArrayFailed, _
            gstrSource, _
            LoadResString(errLoadRsInArrayFailed)

End Sub
```

MsgConfirm.bas

```
Attribute VB_Name = "MsgConfirm"
'  FILE:      MsgConfirm.bas
'             Microsoft TPC-H Kit Ver. 1.00
'             Copyright Microsoft, 1999
'             All Rights Reserved
'
'
'  PURPOSE:    Contains constants for confirmation messages that
'              will be displayed by StepMaster
'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

' A public enum containing the codes for all the confirmation
' messages that will be used by the project - each of the codes
' has the prefix, con
Public Enum conConfirmMsgCodes
    conWspDelete = 2000
    conSave
    conStopRun
    conSaveConnect
    conSaveDB
End Enum

' A public enum containing the titles for all the confirmation
' messages that will be used by the project - each of the codes
' has the prefix, cont - most confirmation message codes will
' have a corresponding title code in here
Public Enum conConfirmMsgTitleCodes
    contWspDelete = 3000
    contSave
    contStopRun
    contSaveConnect
    contSaveDB
End Enum
```

OpenFiles.bas

```
Attribute VB_Name = "OpenFiles"
'  FILE:      OpenFiles.bas
'             Microsoft TPC-H Kit Ver. 1.00
'             Copyright Microsoft, 1999
'             All Rights Reserved
'
'
'  PURPOSE:    This module holds a list of all files that have been
'              opened by the project. This module is needed since there
'              is no way to share static data between different instances
'              of a class.
'              Many procedure in this module do not do any error handling -
'              this is 'coz it is also used by procedures that log error
'              messages and any error handler will erase the collection
'              of errors!

'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit


' Used to indicate the source module name when errors
' are raised by this class
Private Const mstrModuleName As String = ".OpenFiles."

Private mOpenFiles As cNodeCollections

Private Const mstrTempDir As String = "\Temp\"

' The maximum number of temporary files that we can create in a
' session
Private Const mlngMaxFileIndex As Long = 999999
Private Const mstrFileIndexFormat As String = "000000"
Private Const mstrTempFilePrefix As String = "SM"
Private Const mstrTempFileSuffix As String = ".cmd"

Private Const merrFileNotFound As Long = 76
Private Function GetFileHandle(strFileName) As cFileInfo

    Dim lngIndex As Long
    Dim blnFileOpen As Boolean

    If Not mOpenFiles Is Nothing Then

        blnFileOpen = False
        For lngIndex = 0 To mOpenFiles.Count - 1
            If mOpenFiles(lngIndex).FileName = strFileName Then
                blnFileOpen = True
                Exit For
            End If
        Next lngIndex

        If blnFileOpen Then
            Set GetFileHandle = mOpenFiles(lngIndex)
        Else
            Set GetFileHandle = Nothing
        End If
    Else
        Set GetFileHandle = Nothing
    End If

End Function
```

```
Private Function GetTempFileDir() As String

   Dim strTempFileDir As String

   On Error GoTo GetTempFileDirErr

   strTempFileDir = gstrProjectPath & mstrTempDir

   If StringEmpty(Dir$(strTempFileDir, vbDirectory)) Then
      MkDir strTempFileDir
   End If

   GetTempFileDir = strTempFileDir

   Exit Function

GetTempFileDirErr:
   ' Log the error code raised by Visual Basic
   Call LogErrors(Errors)
   gstrSource = mstrModuleName & "GetTempFileDir"
   On Error GoTo 0
   Err.Raise vbObjectError + errProgramError, gstrSource, _
         LoadResString(errProgramError)

End Function
Public Function MakePathValid(strFileName As String) As String
   ' Checks if the passed in file path is valid

   Dim strFileDir As String
   Dim strTempDir As String
   Dim strTempFile As String
   Dim intPos As Integer
   Dim intStart As Integer

   On Error GoTo MakePathValidErr
   gstrSource = mstrModuleName & "MakePathValid"

   strTempFile = strFileName
   intPos = InstrR(strFileName, gstrFileSeparator)

   If intPos > 0 Then
      strFileDir = Left$(strTempFile, intPos - 1)
      If StringEmpty(Dir$(strFileDir, vbDirectory)) Then
         ' Loop through the entire path starting at the root
         ' since Mkdir can create only one level of sub-directory
         ' at a time
         intStart = InStr(strFileDir, gstrFileSeparator)

         Do While strTempDir <> strFileDir

            If intStart > 0 Then
               strTempDir = Left$(strFileDir, intStart - 1)
            Else
               strTempDir = strFileDir
            End If

            If StringEmpty(Dir$(strTempDir, vbDirectory)) Then
               ' If the specified directory doesn't exist, try to
               ' create it.
               MkDir strTempDir
            Else
               ' The directory exists - go to it's sub-directory
            End If
            intStart = InStr(intStart + 1, strFileDir, gstrFileSeparator)
         Loop

         ' Sanity check
         If StringEmpty(Dir$(strFileDir, vbDirectory)) Then
            ' We were unable to create the file directory
            ShowError errCreateDirectoryFailed, gstrSource, _
                  strFileDir, DoWriteError:=False
            MakePathValid = gstrEmptyString
         Else
            MakePathValid = strTempFile
         End If
      Else
         ' The specified directory exists - we should be able
         ' to create the output file in it
         MakePathValid = strTempFile
      End If
   Else
      ' The user has only specified a filename - VB will try
      ' to create it in the current directory
      MakePathValid = strTempFile
   End If

   Exit Function

MakePathValidErr:
   ' Log the error code raised by Visual Basic
   Call LogErrors(Errors)
   gstrSource = mstrModuleName & "MakePathValid"
   ' Log the filename for debug
   Call WriteError(errInvalidFile, gstrSource, strTempFile)
   On Error GoTo 0
   Err.Raise vbObjectError + errProgramError, gstrSource, _
         LoadResString(errProgramError)

End Function
Public Function OpenFileSM(strFileName As String) As Integer
   Dim intHFile As Integer
   Dim NewFileInfo As cFileInfo

   On Error GoTo OpenFileSMErr
   gstrSource = mstrModuleName & "OpenFileSM"

   If StringEmpty(strFileName) Then
      On Error GoTo 0
      Err.Raise vbObjectError + errInvalidFile, gstrSource, _
            LoadResString(errInvalidFile)
   End If

   If mOpenFiles Is Nothing Then
      Set mOpenFiles = New cNodeCollections
   End If

   Set NewFileInfo = GetFileHandle(strFileName)

   If NewFileInfo Is Nothing Then
      ' The file has not been opened yet

      ' If the filename has not been initialized, do not
      ' attempt to open it
      strFileName = MakePathValid(strFileName)

      If strFileName <> gstrEmptyString Then
         intHFile = FreeFile
         Open strFileName For Output Shared As intHFile

         Set NewFileInfo = New cFileInfo
         NewFileInfo.FileHandle = intHFile
         NewFileInfo.FileName = strFileName
         mOpenFiles.Load NewFileInfo
      Else
         ' Either the directory was invalid or s'thing failed
         ' Display the error to the user instead of trying
         ' to log to the file
         ShowError errInvalidFile, gstrSource, strFileName, _
               DoWriteError:=False
```

```
        intHFile = 0
      End If
    Else
      intHFile = NewFileInfo.FileHandle
    End If

    OpenFileSM = intHFile

    Exit Function

OpenFileSMErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    ' The Open command failed for some reason - write an error
    ' and let the calling function handle the error
    ShowError errInvalidFile, gstrSource, strFileName, _
          DoWriteError:=False
    OpenFileSM = 0

End Function
Public Function CreateTempFile() As String

    Dim strTempFileDir As String
    Dim strTempFileName As String

    Static lngLastFileIndex As Long

    On Error GoTo CreateTempFileErr

    strTempFileDir = GetTempFileDir()

    Do
      If lngLastFileIndex = mlngMaxFileIndex Then
        On Error GoTo 0
        Err.Raise vbObjectError + errMaxTempFiles, gstrSource, _
              LoadResString(errMaxTempFiles)
      End If

      lngLastFileIndex = lngLastFileIndex + 1
      strTempFileName = mstrTempFilePrefix & _
            Format$(lngLastFileIndex, mstrFileIndexFormat) & _
            mstrTempFileSuffix

      If Not StringEmpty(Dir$(strTempFileDir & strTempFileName))
Then
        ' Remove any files left over from a previous run,
        ' if they still exist
        Kill strTempFileDir & strTempFileName
      End If

    ' Looping in case the file delete doesn't go through for
    ' some reason
    Loop While Not StringEmpty(Dir$(strTempFileDir &
strTempFileName))

    CreateTempFile = GetShortName(strTempFileDir)
    CreateTempFile = CreateTempFile & strTempFileName

    Exit Function

CreateTempFileErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    gstrSource = gstrSource & "CreateTempFile"
    On Error GoTo 0
    Err.Raise vbObjectError + errProgramError, gstrSource, _
          LoadResString(errProgramError)

End Function
Public Sub CloseFileSM(strFileName As String)
    Dim FileToClose As cFileInfo

    If Not mOpenFiles Is Nothing Then

      ' Get the handle to the open file, if it exists
      Set FileToClose = GetFileHandle(strFileName)

      If Not FileToClose Is Nothing Then
        Close FileToClose.FileHandle

        ' Remove the file info from the collection of open files
        mOpenFiles.Unload FileToClose.Position
      End If
    End If

End Sub
Public Sub CloseOpenFiles()
    Dim lIndex As Long

    If Not mOpenFiles Is Nothing Then
      For lIndex = mOpenFiles.Count - 1 To 0
        CloseFileSM (mOpenFiles(lIndex).FileName)
      Next lIndex
    End If

End Sub
```

ParameterCommon.bas

```
Attribute VB_Name = "ParameterCommon"
'  FILE:      ParameterCommon.bas
'             Microsoft TPC-H Kit Ver. 1.00
'             Copyright Microsoft, 1999
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'
'
'  PURPOSE:   Contains functionality common across StepMaster and
'             SMRunOnly, pertaining to parameters
'             Specifically, functions to load parameter records
'             in an array.
'  Contact:   Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

' Used to indicate the source module name when errors
' are raised by this module
Private Const mstrModuleName As String = "ParameterCommon."

Public Sub LoadRecordsetInParameterArray(rstWorkSpaceParameters
As Recordset, _
    cParamCol As cArrParameters)

    Dim cNewParameter As cParameter

    On Error GoTo LoadRecordsetInParameterArrayErr

    If rstWorkSpaceParameters.RecordCount = 0 Then
      Exit Sub
    End If

    rstWorkSpaceParameters.MoveFirst
    While Not rstWorkSpaceParameters.EOF

      Set cNewParameter = New cParameter

      ' Initialize parameter values
      cNewParameter.ParameterId = rstWorkSpaceParameters.Fields(0)

      ' Call a procedure to raise an error if mandatory fields are
      ' null.
```

```
        cNewParameter.ParameterName = CStr( _
            ErrorOnNullField(rstWorkSpaceParameters,
"parameter_name"))
        cNewParameter.ParameterValue = CheckForNullField( _
            rstWorkSpaceParameters, "parameter_value")
        cNewParameter.WorkspaceId = CStr( _
            ErrorOnNullField(rstWorkSpaceParameters,
FLD_ID_WORKSPACE))
        cNewParameter.ParameterType = CStr( _
            ErrorOnNullField(rstWorkSpaceParameters,
"parameter_type"))
        cNewParameter.Description = CheckForNullField( _
            rstWorkSpaceParameters, "description")

        cParamCol.Load cNewParameter

        Set cNewParameter = Nothing
        rstWorkSpaceParameters.MoveNext
    Wend

    Exit Sub

LoadRecordsetInParameterArrayErr:
    LogErrors Errors
    gstrSource = mstrModuleName & "LoadRecordsetInParameterArray"
    On Error GoTo 0
    Err.Raise vbObjectError + errLoadRsInArrayFailed, gstrSource, _
        LoadResString(errLoadRsInArrayFailed)
End Sub
```

Public.bas

```
Attribute VB_Name = "Public"
'  FILE:      Public.bas
'             Microsoft TPC-H Kit Ver. 1.00
'             Copyright Microsoft, 1999
'             All Rights Reserved
'
'
'  PURPOSE:    This module contains all the public constants for this
project
'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

Public Const gsVersion01 As String = "0.1"
Public Const gsVersion10 As String = "1.0"
Public Const gsVersion21 As String = "2.1"
Public Const gsVersion23 As String = "2.3"
Public Const gsVersion24 As String = "2.4"
Public Const gsVersion241 As String = "2.4.1"
Public Const gsVersion242 As String = "2.4.2"
Public Const gsVersion243 As String = "2.4.3"
Public Const gsVersion25 As String = "2.5"
Public Const gsVersion251 As String = "2.5.1"
Public Const gsVersion253 As String = "2.5.3"
Public Const gsVersion254 As String = "2.5.4"
Public Const gsVersion255 As String = "2.5.5"
Public Const gsVersion As String = gsVersion255

' The same form is used for the creation of new nodes and
' updates to existing nodes (where each node can be a parameter,
' global step, etc.) A tag is set on each flag is used to indicate
' whether it is being called in the insert or update mode. The
' constants for these modes are defined below
Public Const gstrInsertMode = "Insert"
Public Const gstrUpdateMode = "Update"
Public Const gstrPropertiesMode = "View"

Public Const gstrEmptyString = ""
Public Const gstrSQ = "'"
Public Const gstrDQ = """"
Public Const gstrVerSeparator = "."
Public Const gstrBlank = " "

' Constants used to indicate type of node being processed
' The constants for the different objects correspond to the
' indexes in the menu control arrays (for both the main and popup
' menus) that are used to create new objects. That way we can
' use the index passed in by the click event to determine the
' type of node being processed
Public Const gintWorkspace = 1

' Decided to leave it here after some debate over whether it
' actually belongs in the cStep class definition
Public Enum gintStepType
   gintGlobalStep = 3
   gintManagerStep
   gintWorkerStep
End Enum

Public Const gintRunManager = 6
Public Const gintRunWorker = 7

Public Enum gintParameterNodeType
   gintParameter = 8
   gintNodeParamConnection
   gintNodeParamExtension
   gintNodeParamBuiltIn
End Enum

' Leave some constants free for newer types of parameters (?)
Public Const gintConnectionDtl = 15

Public Enum gintLabelNodeType
   gintGlobalsLabel = 21
   gintParameterLabel
   gintParamConnectionLabel
   gintParamExtensionLabel
   gintParamBuiltInLabel
   gintConnDtlLabel
   gintGlobalStepLabel
   gintStepLabel
End Enum

Public Enum ConnectionType
   ConnTypeStatic = 1
   ConnTypeDynamic
End Enum

Public Const giDefaultConnType As Integer = ConnTypeStatic

' The constants defined below are used to identify the different
' tabs. If any more step properties and thereby tabs are added
' to the tabbed dialog on the Step Properties form, they should
' be defined here and accessed in the code only using these
' pre-defined constants
' Note: These constants will mainly be used by the functions that
' initialize, customize and display the Step Properties form
Public Const gintDefinition = 0
Public Const gintExecution = 1
Public Const gintMgrDefinition = 2
Public Const gintPreExecutionSteps = 3
Public Const gintPostExecutionSteps = 4
Public Const gintFileLocations = 5

' These constants correspond to the index values in the imagelist
' associated with the tree view control. The imagelist contains
' the icons that will be displayed for each node.
Public Enum TreeImages
```

```
    gintImageWorkspaceClosed = 1
    gintImageWorkspaceOpen
    gintImageLabelClosed
    gintImageLabelOpen
    gintImageManagerClosedDis
    gintImageManagerClosedEn
    gintImageManagerOpenDis
    gintImageManagerOpenEn
    gintImageWorkerDis
    gintImageWorkerEn
    gintImageGlobalClosed
    gintImageGlobalOpen
    gintImageParameter
    gintImageRun
    gintImagePending
    gintImageStop
    gintImageDisabled
    gintImageAborted
    gintImageFailed
End Enum

' Public variable used to indicate the name of the function
' that raises an error
Public gstrSource As String

' Public instances of the different collections
Public gcParameters As cArrParameters
Public gcSteps As cArrSteps
Public gcConstraints As cArrConstraints
Public gcConnections As cConnections
Public gcConnDtls As cConnDtls

' Public constants for the index values of the different toolbar
' options. Will be used while dynamically enabling/disabling
' these options.
Public Const tbNew = 1
Public Const tbOpen = 2
Public Const tbSave = 3

Public Const tbCut = 5
Public Const tbCopy = 6
Public Const tbPaste = 7
Public Const tbDelete = 8

Public Const tbProperties = 10
Public Const tbRun = 11
Public Const tbStop = 12

' The initial version #
Public Const gstrMinVersion As String = "0.0"
Public Const gstrGlobalParallelism As String = "0"
Public Const gintMinParallelism As Integer = 1
Public Const gintMaxParallelism As Integer = 100

' Constant for the minimum identifier, used for all identifier, viz.
' step, workspace, etc.
Public Const glMinId As Long = 1
Public Const glInvalidId As Long = -1

' A parameter that has a special meaning to Stepmaster
' The system time will be substituted wherever it occurs
' (typically as a part of the error, log ... file names
Public Const gstrTimeStamp As String = "TIMESTAMP"
Public Const gstrEnvVarSeparator = "%"
Public Const gstrFileSeparator = "\"
Public Const gstrUnderscore = "_"

' Constants used by date and time formatting functions
Public Const gsTimeSeparator = ":"
Public Const gsDateSeparator = "-"
Public Const gsMsSeparator = "."
Public Const gsDtFormat = "00"
Public Const gsYearFormat = "0000"
Public Const gsTmFormat = "00"
Public Const gsMSecondFormat = "000"

' Default nothing value for a date variable
Public Const gdtmEmpty As Currency = 0

Public Const FMT_WSP_LOG_FILE As String = "yyyymmdd-hhnnss"

Public gsContCriteria() As String
' Note: Update the initialization of gsExecutionStatus in Initialize() if
the
' InstanceStatus values are modified - also the boundary checks
Public gsExecutionStatus() As String

Public Const gsConnTypeStatic As String = "Static"
Public Const gsConnTypeDynamic As String = "Dynamic"

#If RUN_ONLY Then
Public Const gsCaptionRunWsp As String = "Run Workspace"
#End If

' Valid operations on a cNode object
Public Enum Operation
    QueryOp = 1
    InsertOp = 2
    UpdateOp = 3
    DeleteOp = 4
End Enum
```

RunCommon.bas

```
Attribute VB_Name = "RunCommon"
'  FILE:      RunCommon.bas
'             Microsoft TPC-H Kit Ver. 1.00
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'
'
'  PURPOSE:    Contains common functions that are used during the
execution
'             of a workspace.
'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

' Used to indicate the source module name when errors
' are raised by this class
Private Const mstrModuleName As String = ".RunCommon."


Public Function GetInstanceItValue(cInstanceRec As cInstance) As
String

    ' Returns the iterator value for the instance, if an
    ' iterator has been defined for it
    Dim cStepIt As cRunColIt
    Dim cRunIterator As cRunItNode

    On Error GoTo GetInstanceItValueErr

    ' Since we create a dummy instance for Disabled and Pending steps,
    ' doesn't make sense to look at their iterators
    If cInstanceRec.Status <> gintDisabled And cInstanceRec.Status <>
gintPending Then
        Set cStepIt = cInstanceRec.Iterators

        If Not StringEmpty(cInstanceRec.Step.IteratorName) Then
```

```
        If cStepIt.Count > 0 Then
            Set cRunIterator = cStepIt(0)
            BugAssert cRunIterator.IteratorName =
cInstanceRec.Step.IteratorName, _
                "The first iterator in the collection is the " & _
                "one that has been defined for the step."
            If cRunIterator.IteratorName =
cInstanceRec.Step.IteratorName Then
                GetInstanceItValue = cRunIterator.Value
            Else
                GetInstanceItValue = gstrEmptyString
            End If
        Else
            GetInstanceItValue = gstrEmptyString
        End If
    Else
        GetInstanceItValue = gstrEmptyString
    End If
  Else
    GetInstanceItValue = gstrEmptyString
  End If

  Exit Function

GetInstanceItValueErr:
  ' Log the error code raised by Visual Basic
  Call LogErrors(Errors)
  On Error GoTo 0
  gstrSource = mstrModuleName & "GetInstanceItValue"
  Err.Raise vbObjectError + errProgramError, gstrSource, _
      LoadResString(errProgramError)

End Function
```

RunInstHelper.bas

```
Attribute VB_Name = "RunInstHelper"
'  FILE:      RunInstHelper.bas
'            Microsoft TPC-H Kit Ver. 1.00
'            Copyright Microsoft, 1999
'            All Rights Reserved
'
'
'  PURPOSE:    This module contains helper procedures that are called
by
'            cRunInst.cls
'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

' Used to indicate the source module name when errors
' are raised by this class
Private Const mstrModuleName As String = "RunInstHelper."

' Should be equal to the number of steps defined in cRunInst.cls
Public Const glngNumConcurrentProcesses As Long = 99
Public Const gintBitsPerByte = 8
Public Function AnyStepRunning(cFreeSteps As cVectorLng, arrFree()
As Byte) As Boolean

  Dim lngIndex As Long
  Dim intPosInByte As Integer
  Dim lngTemp As Long

  ' Check if there are any running instances to wait for
  If cFreeSteps.Count <> glngNumConcurrentProcesses Then

    ' For every free step, reset the corresponding element
    ' in the byte array to 0
    For lngIndex = 0 To cFreeSteps.Count - 1
      lngTemp = cFreeSteps(lngIndex) \ gintBitsPerByte
      intPosInByte = cFreeSteps(lngIndex) Mod gintBitsPerByte

      arrFree(lngTemp) = arrFree(lngTemp) Xor 2 ^ intPosInByte
    Next lngIndex

    AnyStepRunning = False

    ' Check if we have a non-zero bit in the byte array
    For lngIndex = LBound(arrFree) To UBound(arrFree) Step 1
      If arrFree(lngIndex) <> 0 Then
        ' We are waiting for a step to complete
        AnyStepRunning = True
        Exit For
      End If
    Next lngIndex

  Else
    AnyStepRunning = False
  End If

End Function


Public Function OrderConstraints(vntTempCons() As Variant, _
    intConsType As ConstraintType) As Variant
  ' Returns a variant containing all the constraint records in the order
  ' in which they should be executed

  Dim vntTemp As Variant
  Dim lngOuter As Long
  Dim lngInner As Long
  Dim cTempConstraint As cConstraint
  Dim cConstraints() As cConstraint
  Dim lngConsCount As Long
  Dim lngLbound As Long
  Dim lngUbound As Long
  Dim lngStep As Long

  On Error GoTo OrderConstraintsErr

  If intConsType = gintPreStep Then
    ' Since we are travelling up and we need to execute the constraints
    ' for the top-level steps first, reverse the order that they
    ' have been stored in the array
    lngLbound = UBound(vntTempCons)
    lngUbound = LBound(vntTempCons)
    lngStep = -1
  Else
    lngLbound = LBound(vntTempCons)
    lngUbound = UBound(vntTempCons)
    lngStep = 1
  End If

  lngConsCount = 0

  For lngOuter = lngLbound To lngUbound Step lngStep
    vntTemp = vntTempCons(lngOuter)

    If Not IsEmpty(vntTemp) Then
      ' Each of the elements is an array
      For lngInner = LBound(vntTemp) To UBound(vntTemp) Step 1
        If Not IsEmpty(vntTemp(lngInner)) Then
          Set cTempConstraint = vntTemp(lngInner)

          If Not cTempConstraint Is Nothing Then
            ReDim Preserve cConstraints(lngConsCount)
            Set cConstraints(lngConsCount) = cTempConstraint
            lngConsCount = lngConsCount + 1
```

```
            End If
          End If
        Next lngInner
      End If
    Next lngOuter

    ' Set the return value of the function to the array of
    ' constraints that has been built above
    If lngConsCount = 0 Then
      OrderConstraints = Empty
    Else
      OrderConstraints = cConstraints()
    End If

    Exit Function

OrderConstraintsErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    On Error GoTo 0
    Err.Raise vbObjectError + errExecInstanceFailed, _
        mstrModuleName, LoadResString(errExecInstanceFailed)

End Function
```

ShellSM.bas

```
Attribute VB_Name = "ShellSM"
'  FILE:      ShellSM.bas
'             Microsoft TPC-H Kit Ver. 1.00
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'
'
'  PURPOSE:   This module contains a function that creates a process
and
'             waits for it to complete.
'  Contact:   Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

Public Function SyncShell(CommandLine As String, Optional Timeout
As Long, _
    Optional WaitForInputIdle As Boolean) As Boolean

    Dim proc As PROCESS_INFORMATION
    Dim Start As STARTUPINFO
    Dim ret As Long
    Dim nMilliseconds As Long

    BugMessage "Executing: " & CommandLine
    If Timeout > 0 Then
      nMilliseconds = Timeout
    Else
      nMilliseconds = INFINITE
    End If

    'Initialize the STARTUPINFO structure:
    Start.cb = Len(Start)
    Start.dwFlags = STARTF_USESHOWWINDOW
    Start.wShowWindow = SW_SHOWMINNOACTIVE

    'Start the shelled application:
    CreateProcessA 0&, CommandLine, 0&, 0&, 1&, _
      NORMAL_PRIORITY_CLASS, 0&, 0&, Start, proc

    If WaitForInputIdle Then
      'Wait for the shelled application to finish setting up its UI:
      ret = InputIdle(proc.hProcess, nMilliseconds)
    Else
      'Wait for the shelled application to terminate:
      ret = WaitForSingleObject(proc.hProcess, nMilliseconds)
    End If

    CloseHandle proc.hProcess

    'Return True if the application finished. Otherwise it timed out or
erred.
    SyncShell = (ret = WAIT_OBJECT_0)
End Function
```

SMErr.bas

```
Attribute VB_Name = "SMErr"
'  FILE:      SMErr.bas
'             Microsoft TPC-H Kit Ver. 1.00
'             Copyright Microsoft, 1999
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'
'
'  PURPOSE:   This module contains error code for all the errors that
are
'             raised by StepMaster.
'  Contact:   Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

' A public enum containing the codes for all the error
' messages that will be displayed by the project - each
' of the codes has the prefix, err
Public Enum errErrorConstants
    errParameterIdInvalid = 1000
    errParameterNameMandatory
    errParameterInsertFailed
    errStepLabelOrTextOrFileRequired
    errMandatoryNodeTextMissing
    errParameterUpdateFailed
    errDupConnDtlName
    errDummy14
    errContCriteriaMandatory
    errContCriteriaNullForGlobal
    errContCriteriaInvalid = 1010
    errParamSeparatorMissing
    errStepTextOrTextFileMandatory
    errStepTextOrFile
    errEnabledFlagFalseForGlobal
    errEnabledFlagLetFailed
    errDegParallelismNullForGlobal
    errInvalidDegParallelism
    errExecutionMechanismInvalid
    errExecutionMechanismLetFailed
    errStepLevelNull = 1020
    errStepLevelZeroForGlobal
    errStepLevelLetFailed
    errRowCountNumeric
    errConnNameInvalid
    errTimeoutNumeric
    errResetConnPropertiesFailed
    errFailureThresholdNumeric
    errConnectionUpdateFailed
    errGlobalRunMethodMandatory
    errGlobalRunMethodNull = 1030
    errGlobalRunMethodInvalid
    errGlobalRunMethodLetFailed
    errNoTrueOption
    errGetOptionFailed
    errSetEnabled
    errStepLabelTextAndFileNull
    errInvalidNodeType
    errSetOptionFailed
```

errQueryParameterFailed
errParamNotFound = 1040
errQueryStepFailed
errStepNotFound
errReadFromScreenFailed
errCopyPropertiesToFormFailed
errMandatoryFieldNull
errUnableToCheckNull
errUpgradeFailed
errFindStepSequenceFailed
errFindParentStepIdFailed
errCircularReference = 1050
errAddStepFailed
errModifyStepFailed
errDeleteColumnFailed
errFindPositionFailed
errDeleteStepFailed
errRunExistsForStepFailed
errCreateNewParentFailed
errInsertNewStepVersionFailed
errCreateNewStepFailed
errDuplicateParameterName = 1060
errCheckDupParameterNameFailed
errConstraintTypeInvalid
errConstraintTypeLetFailed
errAddConstraintFailed
errWorkspaceIdMandatory
errInvalidWorkspaceData
errGetWorkspaceDetailsFailed
errNoWorkspaceLoaded
errWorkspaceAlreadyOpen
errDuplicateWorkspaceName = 1070
errWorkspaceNameMandatory
errWorkspaceNameSetFailed
errWorkspaceIdInvalid
errWorkspaceIdSetFailed
errWorkspaceInsertFailed
errWorkspaceDeleteFailed
errWorkspaceUpdateFailed
errInvalidFile
errCheckWorkspaceOpenFailed
errWriteFailed = 1080
errDeleteParameterRecordFailed
errUnableToLogOutput
errDeleteDBRecordFailed
errRunExistsForWorkspaceFailed
errClearHistoryFailed
errCreateDBFailed
errImportWspFailed
errStepModifyFailed
errStepDeleteFailed
errDummy3 = 1090
errUnableToGetWorkspace
errInvalidNode
errUnableToRemoveSubtree
errSetFileNameFailed
errStepTypeInvalid
errObjectMandatory
errBuiltInUpdateOnly
errInvalidStep
errTypeOfStepFailed
errGetParentKeyFailed = 1100
errLabelTextAndFileCheckFailed
errStepTextAndFileNull
errTextOrFileCheckFailed
errParentStepManager
errDeleteSubStepsFailed
errWorkspaceNameDuplicateFailed
errNewConstraintVersionFailed
errDeleteStepConstraintsFailed
errOldVersionMandatory
errLoadConstraintsInListFailed = 1110
errLoadGlobalStepsFailed
errDeleteConstraintFailed
errUpdateConstraintFailed
errConstraintIdInvalid
errConstraintIdSetFailed
errGlobalStepIdInvalid
errGlobalStepIdSetFailed
errUpdateVersionFailed
errQueryAdjacentConsFailed
errConstraintNotFound = 1120
errQueryConstraintFailed
errSetDBBeforeLoad
errLoadDataFailed
errLoadRsInArrayFailed
errConstraintsForStepFailed
errPreConstraintsForStepFailed
errPostConstraintsForStepFailed
errExecuteConstraintMethodFailed
errIdOrKeyMandatory
errInListFailed = 1130
errUnableToWriteChanges
errQuickSortFailed
errCheckParentValidFailed
errLogErrorFailed
errCopyListFailed
errConnected
errVersionMismatch
errStepNodeFailed
errWorkspaceSelectedFailed
errIdentifierSelectedFailed = 1140
errCheckForNullFieldFailed
errInstanceInUse
errSetVisiblePropertyFailed
errExportWspFailed
errMakeKeyValidFailed
errDummy16
errRunApplicationFailed
errStepLabelUnique
errDeleteSingleFile
errMakeIdentifierValidFailed = 1150
errTypeOfNodeFailed
errConstraintCommandFailed
errOpenDbFailed
errInsertNewConstraintsFailed
errLoadPostExecutionStepsFailed
errLoadPreExecutionStepsFailed
errCreateNewNodeFailed
errDeleteNodeFailed
errDisplayPopupFailed
errDisplayPropertiesFailed = 1160
errUnableToCreateNewObject
errDiffFailed
errLoadWorkspaceFailed
errTerminateProcessFailed
errCompareFailed
errCreateConnectionFailed
errShowFormFailed
errAbortFailed
errDeleteParameterFailed
errUpdateViewFailed = 1170
errParameterNewFailed
errCopyNodeFailed
errCutNodeFailed
errCheckObjectValidFailed
errDeleteViewNodeFailed
errMainFailed
errNewStepFailed
errProcessStepModifyFailed

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errCustomizeStepFormFailed
errInitializeStepFormFailed = 1180
errInsertStepFailed
errIncVersionYFailed
errIncVersionXFailed
errShowCreateStepFormFailed
errShowStepFormFailed
errStepNewFailed
errUnableToApplyChanges
errUnableToCommitChanges
errGetStepNodeTextFailed
errSelectGlobalRunMethodFailed = 1190
errConnectionNameMandatory
errUpdateStepFailed
errBrowseFailed
errDummy4
errDummy1
errDummy2
errDummy
errUnableToPreviewFile
errCopyWorkspaceFailed
errCopyParameterFailed = 1200
errGetStepTypeAndPositionFailed
errCopyStepFailed
errMandatoryParameterMissing
errDeleteWorkspaceRecordsFailed
errCreateDirectoryFailed
errConfirmDeleteOrMoveFailed
errCreateWorkspaceFailed
errTypeOfObjectFailed
errCreateNodeFailed
errCreateParameterFailed = 1210
errInsertParameterFailed
errCreateStepFailed
errNoConstraintsCreated
errCopyFailed
errCloneFailed
errCloneGlobalFailed
errCloneWorkerFailed
errCloneManagerFailed
errLetStepTypeFailed
errUnableToCloseWorkspace = 1220
errUnableToModifyWorkspace
errUnableToCreateWorkspace
errAddArrayElementFailed
errUpdateSequenceFailed
errCannotCopySubSteps
errSubStepsFailed
errModifyInArrayFailed
errUpdateParentVersionFailed
errGetNodeTextFailed
errAddToArrayFailed = 1230
errDeleteFromArrayFailed
errQueryIndexFailed
errCreateNewConstraintVersionFailed
errGetRootNodeFailed
errPopulateWspDetailsFailed
errLoadRsInTreeFailed
errAddNodeToTreeFailed
errMaxTempFiles
errMoveFailed
errRootNodeKeyInvalid = 1240
errNextNodeFailed
errBranchWillMove
errMoveBranchInvalid
errCreateIdRecordsetFailed
errIdentifierColumnFailed
errGetIdentifierFailed
errGetStepTypeFailed
errUpdateConstraintSeqFailed
errDelParamsInWspFailed
errDuplicateConnectionName = 1250
errOpenWorkspaceFailed
errShowWorkspaceNewFailed
errShowWorkspaceModifyFailed
errPopulateListFailed
errExploreNodeFailed
errInitializeListNodeFailed
errMakeListColumnsFailed
errRefreshViewFailed
errExploreFailed
errCollapseNodeFailed = 1260
errUnableToProcessListViewClick
errSetEnabledForStepFailed
errDisplayStepFormFailed
errSetEnabledPropertyFailed
errInvalidDB
errDeleteConnectionFailed
errInvalidOperation
errLetOperationFailed
errIdGetFailed
errCommitFailed = 1270
errSaveParametersInWspFailed
errDeleteArrayElementFailed
errSaveWorkspaceFailed
errInitializeFailed
errLoadInArrayFailed
errSaveStepsInWspFailed
errCommitStepFailed
errStepIdGetFailed
errUnloadFromArrayFailed
errValidateFailed = 1280
errTextEnteredFailed
errStepLabelMandatory
errTextAndFileNullForManager
errFailureDetailsNullForMgr
errSetTabOrderFailed
errSaveWspConstraintsFailed
errCommitConstraintFailed
errUnloadStepConstraintsFailed
errUnableToModifyMenu
errConfirmFailed = 1290
errInitSubItemsFailed
errUpdateListNodeFailed
errAddNodeFailed
errLoadListNodeFailed
errAddListNodeFailed
errExecutionFailed
errSetListViewStyleFailed
errSetCheckedFailed
errGetCheckedFailed
errUnableToProcessListViewDblClick = 1300
errDefaultPosition
errShellFailed
errOpenFileFailed
errSetTBar97Failed
errConnectFailed
errApiFailed
errRegEntryInvalid
errParseStringFailed
errConstraintsForWspFailed
errPostConstraintsForWspFailed = 1310
errPreConstraintsForWspFailed
errLoadWspPostExecStepsFailed
errLoadWspPreExecStepsFailed
errLoadConstraintsOnFormFailed
errQueryFailed
errPasteNodeFailed
errShowAllWorkspacesFailed
errMakeFieldValidFailed

```
    errInitializeTree
    errRootNodeFailed = 1320
    errDirectionInvalid
    errUnableToDetListProperty
    errUnableToGetListData
    errItemNotFound
    errItemDoesNotExist
    errParamNameInvalid
    errGetParamValueFailed
    errSubValuesFailed
    errStringOpFailed
    errReadWorkspaceDataFailed = 1330
    errUpdateRunDataFailed
    errProgramError
    errUnableToOpenFile
    errLoadRunDataFailed
    errExecuteODBCCommandFailed
    errRunWorkspaceFailed
    errExecuteStepFailed
    errUnableToWriteError
    errRunStepFailed
    errSaveChanges = 1340
    errDragDropFailed
    errInvalidParameter
    errAssignParametersFailed
    errLoadLabelsInTreeFailed
    errInstrRFailed
    errInsertIteratorFailed
    errDeleteIteratorFailed
    errTypeInvalid
    errLoadFailed
    errDeleteFailed = 1350
    errModifyFailed
    errIteratorsFailed
    errInsertFailed
    errUpdateFailed
    errDuplicateIterator
    errSaveFailed
    errReadDataFailed
    errUnloadFailed
    errAddFailed
    errExecuteBranchFailed = 1360
    errRangeNumeric
    errRangeInvalid
    errNextStepFailed
    errUpdateDisplayFailed
    errDateToStringFailed
    errGetElapsedTimeFailed
    errMaxProcessesExceeded
    errInvalidProperty
    errInvalidChild
    errCreateInstanceFailed = 1370
    errInvalidForWorker
    errInstanceOpFailed
    errNavInstancesFailed
    errIterateFailed
    errExecInstanceFailed
    errDupIterator
End Enum
```

SortSM.bas

```
Attribute VB_Name = "SortSM"
'  FILE:      SortSM.bas
'             Microsoft TPC-H Kit Ver. 1.00
'             Copyright Microsoft, 1999
'             All Rights Reserved
'
'
'  PURPOSE:    This module contains an implementation of QuickSort.
'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

' Comment out for case-sensitive sorts
Option Compare Text

' Used to indicate the source module name when errors
' are raised by this module
Private Const mstrModuleName As String = "SortSM."

Private Function Compare(ByVal vntToCompare1 As Variant, _
        ByVal vntToCompare2 As Variant) As Integer

    On Error GoTo CompareErr

    Compare = 0

    If vntToCompare1.SequenceNo < vntToCompare2.SequenceNo Then
        Compare = -1
    ElseIf vntToCompare1.SequenceNo > vntToCompare2.SequenceNo
Then
        Compare = 1
    End If

    Exit Function

CompareErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    On Error GoTo 0
    Err.Raise vbObjectError + errCompareFailed, _
            gstrSource, _
            LoadResString(errCompareFailed)

End Function

Private Sub Swap(ByRef vntToSwap1 As Variant, _
        ByRef vntToSwap2 As Variant)

    Dim vntTemp As Variant

    On Error GoTo SwapErr

    If IsObject(vntToSwap1) And IsObject(vntToSwap2) Then
        Set vntTemp = vntToSwap1
        Set vntToSwap1 = vntToSwap2
        Set vntToSwap2 = vntTemp
    Else
        vntTemp = vntToSwap1
        vntToSwap1 = vntToSwap2
        vntToSwap2 = vntTemp
    End If

    Exit Sub

SwapErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    On Error GoTo 0
    Err.Raise vbObjectError + errQuickSortFailed, mstrModuleName &
"Swap", _
        LoadResString(errQuickSortFailed)

End Sub

Public Sub QuickSort(vntArray As Variant, _
        Optional ByVal intLBound As Integer, _
        Optional ByVal intUBound As Integer)
    ' Sorts a variant array using Quicksort
```

```
    Dim i As Integer
    Dim j As Integer
    Dim vntMid As Variant

    On Error GoTo QuickSortErr

    If IsEmpty(vntArray) Or _
          Not IsArray(vntArray) Then
       Exit Sub
    End If

    ' Set default boundary values for first time through
    If intLBound = 0 And intUBound = 0 Then
       intLBound = LBound(vntArray)
       intUBound = UBound(vntArray)
    End If

    ' BugMessage "Sorting elements " & Str(intLBound) & " and " &
Str(intUBound)

    If intLBound > intUBound Then
       Exit Sub
    End If

    ' Only two elements in this subdivision; exchange if they
    ' are out of order and end recursive calls
    If (intUBound - intLBound) = 1 Then
       If Compare(vntArray(intLBound), vntArray(intUBound)) > 0 Then
          Call Swap(vntArray(intLBound), vntArray(intUBound))
       End If
       Exit Sub
    End If

    ' Set the pivot point
    Set vntMid = vntArray(intUBound)
    i = intLBound
    j = intUBound

    Do
       ' Move in from both sides towards pivot element
       Do While (i < j) And Compare(vntArray(i), vntMid) <= 0
          i = i + 1
       Loop

       Do While (j > i) And Compare(vntArray(j), vntMid) >= 0
          j = j - 1
       Loop

       If i < j Then
          Call Swap(vntArray(i), vntArray(j))
       End If
    Loop While i < j

    ' Since i has been adjusted, swap element i with element,
    ' intUBound
    Call Swap(vntArray(i), vntArray(intUBound))

    ' Recursively call sort array - pass smaller subdivision
    ' first to conserve stack space
    If (i - intLBound) < (intUBound - 1) Then
       ' Recursively sort with adjusted values for upper and
       ' lower bounds
       Call QuickSort(vntArray, intLBound, i - 1)
       Call QuickSort(vntArray, i + 1, intUBound)
    Else
       Call QuickSort(vntArray, i + 1, intUBound)
       Call QuickSort(vntArray, intLBound, i - 1)
    End If
    Exit Sub

QuickSortErr:
    Call LogErrors(Errors)
    On Error GoTo 0
    Err.Raise vbObjectError + errQuickSortFailed, mstrModuleName &
"QuickSort", _
       LoadResString(errQuickSortFailed)

End Sub
```

startup.bas

```
Attribute VB_Name = "Startup"
'  FILE:      Startup.bas
'             Microsoft TPC-H Kit Ver. 1.00
'             Copyright Microsoft, 1999
'             All Rights Reserved
'
'
'  PURPOSE:    This module contains startup and cleanup functions for
the project.
'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

Public Const LISTVIEW_BUTTON = 14

Public gstrProjectPath As String

' Used to indicate the source module name when errors
' are raised by this module
Private Const mstrModuleName As String = "Startup."

Private Sub Initialize()

    On Error GoTo InitializeErr

    ReDim gsContCriteria(gintOnFailureAbort To gintOnFailureAsk) As
String
    gsContCriteria(gintOnFailureAbort) = "Abort"
    gsContCriteria(gintOnFailureContinue) = "Continue"
    gsContCriteria(gintOnFailureCompleteSiblings) = "Execute sibling
steps and stop"
    gsContCriteria(gintOnFailureAbortSiblings) = "Abort sibling steps
and execute next parent"
    gsContCriteria(gintOnFailureSkipSiblings) = "Skip sibling steps and
execute next parent"
    gsContCriteria(gintOnFailureAsk) = "Ask"

    ReDim gsExecutionStatus(gintDisabled To gintAborted) As String
    gsExecutionStatus(gintDisabled) = "Disabled"
    gsExecutionStatus(gintPending) = "Pending"
    gsExecutionStatus(gintRunning) = "Running"
    gsExecutionStatus(gintComplete) = "Complete"
    gsExecutionStatus(gintFailed) = "Failed"
    gsExecutionStatus(gintAborted) = "Stopped"

#If Not RUN_ONLY Then
    ' Call a procedure to change the style of the toolbar
    ' on the Step Properties form
    Call SetTBar97(frmSteps.tblConstraintCommands)

#End If

    Call InitRunEngine

    Exit Sub

InitializeErr:
    ' Log the error code raised by Visual Basic
```

```
    Call LogErrors(Errors)
    gstrSource = mstrModuleName & "Initialize"
    Call ShowError(errInitializeFailed)

End Sub
Sub Main()

    On Error GoTo MainErr

    ' Mousepointer should indicate busy
    Call ShowBusy

    ' Display the Splash screen while we carry out some initialization
    frmSplash.Show
    frmSplash.Refresh

    gstrProjectPath = App.Path

    ' Open the database
    If OpenDBFile() = False Then
        Unload frmSplash
        Exit Sub
    End If

#If Not RUN_ONLY Then
    Load frmMain

    ' Enable the Stop Run menu options only when a workspace is
    ' actually running
    Call EnableStop(False)

    ' Clear all application extension menu items
    Call ClearToolsMenu
#End If

    Call Initialize

    ' Mousepointer - ready to accept user input
    Call ShowFree

    ' Unload the Splash screen and display the main form
    Unload frmSplash

#If RUN_ONLY Then
    frmWorkspaceOpen.Caption = gsCaptionRunWsp

    Call ShowWorkspacesInDb(dbsAttTool)
#Else
    frmMain.Show
#End If

    Exit Sub

MainErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    Call ShowFree
    Call ShowError(errMainFailed)

End Sub
Private Function OpenDBFile() As Boolean
    Dim sDb As String

    On Error GoTo OpenDBFileErr

#If RUN_ONLY Then
    ' Always use the registry setting for the run_only mode
    sDb = DefaultDBFile()
#Else
    ' Check if the user has specified the workspace defn. file to open on
the command line
    ' Else, use the registry setting
    sDb = IIf(StringEmpty(Command), DefaultDBFile(), Command)

    If Len(sDb) > 0 Then
        ' Trim off the enclosing double-quotes if any
        If Mid(sDb, 1, 1) = gstrDQ Then
            If Len(sDb) > 1 Then
                sDb = Mid(sDb, 2)
            Else
                sDb = gstrEmptyString
            End If
        End If
    End If

    If Len(sDb) > 0 Then
        If Mid(sDb, Len(sDb), 1) = gstrDQ Then
            If Len(sDb) > 1 Then
                sDb = Mid(sDb, 1, Len(sDb) - 1)
            Else
                sDb = gstrEmptyString
            End If
        End If
    End If
#End If

    ' Open the database
    OpenDBFile = SMOpenDatabase(sDb)

    Exit Function

OpenDBFileErr:
    Call LogErrors(Errors)
    OpenDBFile = False

End Function
Public Sub Cleanup()

    On Error GoTo CleanupErr

    ' Set the mousepointer to indicate Busy
    Call ShowBusy

#If Not RUN_ONLY Then
    ' Close all open workspaces - will also prompt for unsaved
    ' changes
    Call CloseOpenWorkspaces
#End If

    ' Close all open files
    Call CloseOpenFiles

    ' Reset the mousepointer
    Call ShowFree

    Exit Sub

CleanupErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    Resume Next

End Sub
```

StepCommon.bas

```
Attribute VB_Name = "StepCommon"
'  FILE:      StepCommon.bas
'             Microsoft TPC-H Kit Ver. 1.00
```

```
'           Copyright Microsoft, 1999
'           All Rights Reserved
'
'
'  PURPOSE:    Contains functionality common across StepMaster and
'           SMRunOnly, pertaining to steps
'           Specifically, functions to load iterators records
'           in an array, determine the type of step, etc.
'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

' Used to indicate the source module name when errors
' are raised by this module
Private Const mstrModuleName As String = "StepCommon."

' Step property constants
Private Const mintMinFailureThreshold As Integer = 1
Public Const gintMinSequenceNo As Integer = 1
Public Const gintMinLevel As Integer = 0
Public Function ValidateParallelism(sParallelism As String, lWorkspace
As Long, _
      Optional ParamsInWsp As cArrParameters = Nothing) As String
   ' Returns the degree of parallelism for the step if the user input is
valid
   Dim sTemp As String

   On Error GoTo ValidateParallelismErr
   gstrSource = mstrModuleName & "ValidateParallelism"

   sTemp = SubstituteParameters(Trim$(sParallelism), lWorkspace,
WspParameters:=ParamsInWsp)

   If Not IsNumeric(sTemp) Then
      ShowError errInvalidDegParallelism
      On Error GoTo 0
      Err.Raise vbObjectError + errInvalidDegParallelism, gstrSource, _
            LoadResString(errInvalidDegParallelism)
   Else
      If (CInt(sTemp) < gintMinParallelism) Or (CInt(sTemp) >
gintMaxParallelism) Then
         ShowError errInvalidDegParallelism
         On Error GoTo 0
         Err.Raise vbObjectError + errInvalidDegParallelism, gstrSource,
_
               LoadResString(errInvalidDegParallelism)
      Else
         ValidateParallelism = Trim$(sParallelism)
      End If
   End If

   Exit Function

ValidateParallelismErr:
   ' Log the error code raised by Visual Basic
   gstrSource = mstrModuleName & "ValidateParallelism"
   If Err.Number = vbObjectError + errSubValuesFailed Then
      ShowError errInvalidDegParallelism
   End If

   Call LogErrors(Errors)
   On Error GoTo 0
   Err.Raise vbObjectError + errInvalidDegParallelism, gstrSource, _
      LoadResString(errInvalidDegParallelism)

End Function

Public Function IsGlobal( _
      Optional ByVal StepClass As cStep = Nothing, _
      Optional ByVal StepRecord As Recordset = Nothing, _
      Optional ByVal StepKey As String = gstrEmptyString, _
      Optional ByVal StepId As Long = 0, _
      Optional StepForm As Form = Nothing) As Boolean

   ' This function contains all the possible checks for whether
   ' a step is global - The check that will be made depends on
   ' the parameter passed in

   Dim cStepRecord As cStep

   If Not StepClass Is Nothing Then
      IsGlobal = StepClass.GlobalFlag
      Exit Function
   End If

   If Not StepRecord Is Nothing Then
      IsGlobal = StepRecord![global_flag]
      Exit Function
   End If

   If Not StringEmpty(StepKey) Then
      IsGlobal = InStr(StepKey, gstrGlobalStepPrefix) > 0
      Exit Function
   End If

   If StepId <> 0 Then
      Set cStepRecord = gcSteps.QueryStep(StepId)
      IsGlobal = cStepRecord.GlobalFlag
      Set cStepRecord = Nothing
      Exit Function
   End If

   If Not StepForm Is Nothing Then
      IsGlobal = (StepForm.lblStepType.Caption = Str(gintGlobalStep))
      Exit Function
   End If

   ' Not a single object was passed in! - raise an error
   On Error GoTo 0
   Err.Raise vbObjectError + errObjectMandatory, _
         mstrModuleName & "IsGlobal", _
         LoadResString(errObjectMandatory)

End Function
Public Function TypeOfStep(Optional ByVal StepClass As cStep =
Nothing, _
      Optional ByVal StepRecord As Recordset = Nothing, _
      Optional ByVal StepKey As String = gstrEmptyString, _
      Optional ByVal StepId As Long = 0, _
      Optional StepForm As Form = Nothing) As Integer
   ' Calls functions to determine the type of step
   ' The check that will be made depends on the parameter passed in

   On Error GoTo TypeOfStepErr

   ' Make the check whether a step is global first - both
   ' worker and global steps have the step text or file name
   ' not null - but only the global step will have the global
   ' flag set
   If IsGlobal(StepClass, StepRecord, StepKey, StepId, StepForm) Then
      TypeOfStep = gintGlobalStep
   ElseIf IsManager(StepClass, StepRecord, StepKey, StepId,
StepForm) Then
      TypeOfStep = gintManagerStep
   ElseIf IsWorker(StepClass, StepRecord, StepKey, StepId, StepForm)
Then
      TypeOfStep = gintWorkerStep
   Else
      On Error GoTo 0
      Err.Raise vbObjectError + errInvalidStep, _
```

```
            mstrModuleName & "TypeOfStep", _
            LoadResString(errInvalidStep)
    End If

    Exit Function

TypeOfStepErr:
    ' Log the error code raised by Visual Basic
    Call LogErrors(Errors)
    On Error GoTo 0
    Err.Raise vbObjectError + errTypeOfStepFailed, _
          mstrModuleName & "TypeOfStep", _
          LoadResString(errTypeOfStepFailed)

End Function

Public Function IsStep(intNodeType As Integer) As Boolean
    ' Returns true if the node type corresponds to a global, manager
    ' or worker step
    IsStep = (intNodeType = gintGlobalStep) Or (intNodeType =
gintManagerStep) Or _
        (intNodeType = gintWorkerStep)

End Function

Public Function IsManager(Optional ByVal StepClass As cStep =
Nothing, _
        Optional ByVal StepRecord As Recordset = Nothing, _
        Optional ByVal StepKey As String = gstrEmptyString, _
        Optional ByVal StepId As Long = 0, _
        Optional StepForm As Form = Nothing) As Boolean

    ' This function contains all the possible checks for whether
    ' a step is a manager step - The check that will be made depends
    ' on the parameter passed in

    Dim cStepRecord As cStep

    If Not StepClass Is Nothing Then
        IsManager = (StepClass.StepType = gintManagerStep)
        Exit Function
    End If

    If Not StepRecord Is Nothing Then
        IsManager = (IsNull(StepRecord![step_text]) And
IsNull(StepRecord![step_file_name]))
        Exit Function
    End If

    If Not StringEmpty(StepKey) Then
        IsManager = (InStr(StepKey, gstrManagerStepPrefix) > 0)
        Exit Function
    End If

    If StepId <> 0 Then
        Set cStepRecord = gcSteps.QueryStep(StepId)
        IsManager = (cStepRecord.StepType = gintManagerStep)
        Set cStepRecord = Nothing
        Exit Function
    End If

    If Not StepForm Is Nothing Then
        IsManager = (StepForm.lblStepType.Caption =
Str(gintManagerStep))
        Exit Function
    End If

    ' Not a single object was passed in! - raise an error
    On Error GoTo 0
    Err.Raise vbObjectError + errObjectMandatory, _
            "Step.IsManager", _
            LoadResString(errObjectMandatory)

End Function
Public Function IsWorker( _
        Optional ByVal StepClass As cStep = Nothing, _
        Optional ByVal StepRecord As Recordset = Nothing, _
        Optional ByVal StepKey As String = gstrEmptyString, _
        Optional ByVal StepId As Long = 0, _
        Optional StepForm As Form = Nothing) As Boolean

    ' This function contains all the possible checks for whether
    ' a step is a Worker step - The check that will be made depends
    ' on the parameter passed in

    Dim cStepRecord As cStep

    If Not StepClass Is Nothing Then
        IsWorker = (StepClass.StepType = gintWorkerStep)
        Exit Function
    End If

    If Not StepRecord Is Nothing Then
        IsWorker = (Not StepRecord![global_flag] And _
              (Not IsNull(StepRecord![step_text]) Or Not
IsNull(StepRecord![step_file_name])))
        Exit Function
    End If

    If Not StringEmpty(StepKey) Then
        IsWorker = InStr(StepKey, gstrWorkerStepPrefix) > 0
        Exit Function
    End If

    If StepId <> 0 Then
        Set cStepRecord = gcSteps.QueryStep(StepId)
        IsWorker = (cStepRecord.StepType = gintWorkerStep)
        Set cStepRecord = Nothing
        Exit Function
    End If

    If Not StepForm Is Nothing Then
        IsWorker = (StepForm.lblStepType.Caption =
Str(gintWorkerStep))
        Exit Function
    End If

    ' Not a single object was passed in! - raise an error
    On Error GoTo 0
    Err.Raise vbObjectError + errObjectMandatory, _
            "Step.IsWorker", _
            LoadResString(errObjectMandatory)

End Function
Public Function GetStepNodeText(ByVal cStepNode As cStep) As
String

    On Error GoTo GetStepNodeTextErr

    ' Returns the string that will be displayed as the text
    ' in the tree view node to the user
    If StringEmpty(cStepNode.StepLabel) Then

        If StringEmpty(cStepNode.StepTextFile) Then

            If StringEmpty(cStepNode.StepText) Then
                ' This should never happen
                On Error GoTo 0
                Err.Raise vbObjectError + errStepLabelTextAndFileNull, _
                    gstrSource, _
```

```
            LoadResString(errStepLabelTextAndFileNull)
        Else
            GetStepNodeText = cStepNode.StepText
        End If
    Else
        GetStepNodeText = cStepNode.StepTextFile
    End If
Else
    GetStepNodeText = cStepNode.StepLabel
End If

Exit Function

GetStepNodeTextErr:
  ' Log the error code raised by Visual Basic
  Call LogErrors(Errors)
  On Error GoTo 0
  Err.Raise vbObjectError + errGetStepNodeTextFailed, _
        gstrSource, _
        LoadResString(errGetStepNodeTextFailed)

End Function

Public Function LoadRecordsetInStepsArray(rstSteps As Recordset, _
  cStepCol As cArrSteps) As Boolean

  Dim cNewStep As cStep
  Dim cNewGlobal As cGlobalStep
  Dim cNewManager As cManager
  Dim cNewWorker As cWorker

  On Error GoTo LoadRecordsetInStepsArrayErr

  If rstSteps.RecordCount = 0 Then
    Exit Function
  End If

  rstSteps.MoveFirst
  While Not rstSteps.EOF
    ' For fields that should not be null, a procedure is first
    ' called to raise an error if the field is null

    Set cNewStep = New cStep

    cNewStep.StepType = TypeOfStep(StepRecord:=rstSteps)

    If cNewStep.StepType = gintGlobalStep Then
      Set cNewGlobal = New cGlobalStep
      Set cNewStep = cNewGlobal
    ElseIf cNewStep.StepType = gintManagerStep Then
      Set cNewManager = New cManager
      Set cNewStep = cNewManager
    Else
      Set cNewWorker = New cWorker
      Set cNewStep = cNewWorker
    End If

    ' Initialize the global flag first, since subsequent
    ' validations might depend on whether the step is global
    cNewStep.GlobalFlag = CBool(ErrorOnNullField(rstSteps,
"global_flag"))

    ' Initialize step values
    cNewStep.StepId = CLng(ErrorOnNullField(rstSteps, "step_id"))
    cNewStep.VersionNo = CStr(ErrorOnNullField(rstSteps,
"version_no"))

    cNewStep.StepLabel = CheckForNullField(rstSteps, "step_label")
    cNewStep.StepTextFile = CheckForNullField(rstSteps,
"step_file_name")
    cNewStep.StepText = CheckForNullField(rstSteps, "step_text")
    cNewStep.StartDir = CheckForNullField(rstSteps,
"start_directory")

    cNewStep.WorkspaceId = CLng(ErrorOnNullField(rstSteps,
FLD_ID_WORKSPACE))
    cNewStep.ParentStepId = CLng(ErrorOnNullField(rstSteps,
"parent_step_id"))
    cNewStep.ParentVersionNo = CStr(ErrorOnNullField(rstSteps,
"parent_version_no"))

    cNewStep.SequenceNo = CInt(ErrorOnNullField(rstSteps,
"sequence_no"))
    cNewStep.StepLevel = CInt(ErrorOnNullField(rstSteps,
"step_level"))
    cNewStep.EnabledFlag = CBool(ErrorOnNullField(rstSteps,
"enabled_flag"))

    ' Initialize the execution details for the step
    cNewStep.DegreeParallelism = CheckForNullField(rstSteps,
"degree_parallelism")
    cNewStep.ExecutionMechanism =
CInt(ErrorOnNullField(rstSteps, "execution_mechanism"))
    cNewStep.FailureDetails = CheckForNullField(rstSteps,
"failure_details")
    cNewStep.ContinuationCriteria = CInt(ErrorOnNullField(rstSteps,
"continuation_criteria"))

    ' Initialize the output file locations for the step
    cNewStep.OutputFile = CheckForNullField(rstSteps,
"output_file_name")
    ' cNewStep.LogFile = CheckForNullField(rstSteps,
"log_file_name")
    cNewStep.ErrorFile = CheckForNullField(rstSteps,
"error_file_name")

    ' Initialize the iterator name for the step, if any
    cNewStep.IteratorName = CheckForNullField(rstSteps,
"iterator_name")

    ' Add this record to the array of steps
    cStepCol.Load cNewStep

    Set cNewStep = Nothing
    rstSteps.MoveNext
  Wend

  Exit Function

LoadRecordsetInStepsArrayErr:

  LogErrors Errors
  gstrSource = mstrModuleName & "LoadRecordsetInStepsArray"
  On Error GoTo 0
  Err.Raise vbObjectError + errLoadRsInArrayFailed, gstrSource, _
      LoadResString(errLoadRsInArrayFailed)

End Function
```

TimerSM.bas

```
Attribute VB_Name = "TimerSM"
'  FILE:      TimerSM.bas
'             Microsoft TPC-H Kit Ver. 1.00
'             Copyright Microsoft, 1999
'             All Rights Reserved
'
'
'  PURPOSE:    This module contains wrapper functions for Timer APIs.
'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
```

```
'

Option Explicit

Private Declare Function SetTimer Lib "user32" (ByVal hWnd As
Long, _
   ByVal nIDEvent As Long, ByVal uElapse As Long, ByVal
lpTimerFunc As Long) _
   As Long
Private Declare Function KillTimer Lib "user32" (ByVal hWnd As
Long, _
   ByVal nIDEvent As Long) As Long
Private Declare Sub CopyMemory Lib "kernel32" Alias
"RtlMoveMemory" ( _
   pDest As Any, pSource As Any, ByVal ByteLen As Long)

Public gcTimerObjects As Collection

Private Sub TimerProc(ByVal lHwnd As Long, ByVal lMsg As Long, _
   ByVal lTimerID As Long, ByVal lTime As Long)

   Dim nPtr As Long
   Dim oTimerObject As cTimerSM

   'Create a Timer object from the pointer
   nPtr = gcTimerObjects.Item(Str$(lTimerID))
   CopyMemory oTimerObject, nPtr, 4
   'Call a method which will fire the Timer event
   oTimerObject.Tick
   'Get rid of the Timer object so that VB will not try to release it
   CopyMemory oTimerObject, 0&, 4
End Sub

Public Function StartTimer(lInterval As Long) As Long
   StartTimer = SetTimer(0, 0, lInterval, AddressOf TimerProc)
End Function

Public Sub StopTimer(lTimerID As Long)
   KillTimer 0, lTimerID
End Sub

Public Sub SetInterval(lInterval As Long, lTimerID As Long)
   SetTimer 0, lTimerID, lInterval, AddressOf TimerProc
End Sub
```

ToolsCommon.bas

```
Attribute VB_Name = "ToolsCommon"
'  FILE:      ToolsCommon.bas
'             Microsoft TPC-H Kit Ver. 1.00
'             Copyright Microsoft, 1999
'             All Rights Reserved
'
'
'  PURPOSE:   Contains functions to remove run history and initialize
'             table creation scripts
'  Contact:   Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

Public sCreateTables() As String

Public Const gsExtSeparator As String = "."

Public Sub DeleteRunHistory(dbFile As DAO.Database)
   ' Delete all run history records from the database, viz. the records in
   ' run_header, run_step_details and run_parameters

   Dim sDelete As String

   On Error GoTo DeleteRunHistoryErr

   sDelete = "delete from run_header "
   dbFile.Execute sDelete, dbFailOnError

   sDelete = "delete from run_step_details "
   dbFile.Execute sDelete, dbFailOnError

   sDelete = "delete from run_parameters "
   dbFile.Execute sDelete, dbFailOnError

   sDelete = "update att_identifiers " & _
       " set run_id = " & CStr(glMinId)
   dbFile.Execute sDelete, dbFailOnError

   Exit Sub

DeleteRunHistoryErr:
   LogErrors Errors
   Err.Raise vbObjectError + errDeleteDBRecordFailed,
"DeleteRunHistory", _
         LoadResString(errDeleteDBRecordFailed)

End Sub

Public Function CreateConnectionsTableScript() As String
   ' Returns the table creation script for the workspace_connections table

   Call InitCreateSQLArray
   CreateConnectionsTableScript = sCreateTables(10)
   ReDim sCreateTables(0)

End Function
Public Function CreateConnectionDtlsTableScript() As String
   ' Returns the table creation script for the connection_dtls table

   Call InitCreateSQLArray
   CreateConnectionDtlsTableScript = sCreateTables(11)
   ReDim sCreateTables(0)

End Function

Public Sub InitCreateSQLArray()

ReDim sCreateTables(0 To 11)

sCreateTables(0) = "Create table att_identifiers (" & _
       "workspace_id              Long, " & _
       "parameter_id              Long, " & _
       "step_id                   Long, " & _
       "constraint_id             Long, " & _
       "run_id                    Long, " & _
       "connection_id             Long " & _
       ", " & FLD_ID_CONN_NAME & gstrBlank &
DATA_TYPE_LONG & _
");"

sCreateTables(1) = "Create table att_steps (step_id   Long, " & _
       "version_no                Text(255), " & _
       "step_label                Text(255), " & _
       "step_file_name            Text(255), " & _
       "step_text                 Memo, " & _
       "start_directory           Text(255), " & _
       "workspace_id              Long, " & _
       "parent_step_id            Long, " & _
       "parent_version_no         Text(255), " & _
       "step_level                Long, " & _
       "sequence_no               Integer, " & _
       "enabled_flag              Bit, " & _
       "degree_parallelism        Text(255), " & _
```

```
        "execution_mechanism        Text(50), " & _
        "failure_details            Text(255), " & _
        "continuation_criteria      Text(50), " & _
        "global_flag                Long, " & _
        "archived_flag              Bit, " & _
        "output_file_name           Text(255), " & _
        "error_file_name            Text(255), " & _
        "iterator_name              Text(255), " & _
        "CONSTRAINT pk_steps PRIMARY KEY (step_id, version_no)
" & _
");"

'       "log_file_name              Text(255), " & _

sCreateTables(2) = "Create table att_workspaces (" & _
        "workspace_id               Long, " & _
        "workspace_name             Text(255), " & _
        "archived_flag              Bit, " & _
        "CONSTRAINT pk_workspaces PRIMARY KEY (workspace_id)
" & _
");"

sCreateTables(3) = "Create table iterator_values (" & _
        "step_id                    Long, " & _
        "version_no                 Text(255), " & _
        "type                       Integer, " & _
        "iterator_value             Text(255), " & _
        "sequence_no                Integer " & _
");"

sCreateTables(4) = "Create table run_header (" & _
        "run_id                     Long, " & _
        "workspace_id               Long, " & _
        "start_time                 Currency, " & _
        "end_time                   Currency, " & _
        "CONSTRAINT pk_run_header PRIMARY KEY (run_id) " & _
");"

sCreateTables(5) = "Create table run_parameters (" & _
        "run_id                     Long, " & _
        "parameter_name             Text(255), " & _
        "parameter_value            Text(255) " & _
");"

sCreateTables(6) = "Create table run_step_details (" & _
        "run_id                     Long, " & _
        "step_id                    Long, " & _
        "version_no                 Text(255), " & _
        "instance_id                Long, " & _
        "parent_instance_id         Long, " & _
        "command                    Memo, " & _
        "iterator_value             Text(255), " & _
        "start_time                 Currency, " & _
        "end_time                   Currency, " & _
        "elapsed_time               Long " & _
");"

sCreateTables(7) = "Create table step_constraints (" & _
        "constraint_id              Long, " & _
        "step_id                    Long, " & _
        "version_no                 Text(255), " & _
        "constraint_type            Integer, " & _
        "global_step_id             Long, " & _
        "global_version_no          Text(255), " & _
        "sequence_no                Integer " & _
");"

sCreateTables(8) = "Create table workspace_parameters (" & _
        "workspace_id               Long, " & _
        "parameter_id               Long, " & _
        "parameter_name             Text(255), " & _
        "parameter_value            Text(255), " & _
        "description                Text(255), " & _
        "parameter_type             Integer, " & _
        "CONSTRAINT pk_parameters PRIMARY KEY (parameter_id) "
& _
");"

sCreateTables(9) = "Create table db_details (" & _
        "db_version                 Text(50) " & _
");"

sCreateTables(10) = "Create table " &
TBL_CONNECTION_STRINGS & " (" & _
        "workspace_id               Long, " & _
        "connection_id              Long, " & _
        "connection_name            Text(255), " & _
        "connection_value           Text(255), " & _
        "description                Text(255), " & _
        "no_count_display           Bit, " & _
        "no_execute                 Bit, " & _
        "parse_query_only           Bit, " & _
        "ANSI_quoted_identifiers    Bit, " & _
        "ANSI_nulls                 Bit, " & _
        "show_query_plan            Bit, " & _
        "show_stats_time            Bit, " & _
        "show_stats_io              Bit, " & _
        "parse_odbc_msg_prefixes    Bit, " & _
        "row_count                  long, " & _
        "tsql_batch_separator       Text(255), " & _
        "query_time_out             long, " & _
        "server_language            Text(255), " & _
        "character_translation      Bit, " & _
        "regional_settings          Bit, " & _
        "CONSTRAINT pk_connections PRIMARY KEY
(connection_id) " & _
");"

' This table has been added in order to satisfy the TPC-H requirement
that
' all the queries in a stream need to be executed on a single connection.
' Specify a connection for each odbc step. If the connection is of type,
' static, it should be kept open till the step execution is complete.
sCreateTables(11) = "Create table " & TBL_CONNECTION_DTLS &
" (" & _
        FLD_ID_WORKSPACE & gstrBlank & DATA_TYPE_LONG &
", " & _
        FLD_ID_CONN_NAME & gstrBlank & DATA_TYPE_LONG &
", " & _
        FLD_CONN_DTL_CONNECTION_NAME & gstrBlank &
DATA_TYPE_TEXT255 & ", " & _
        FLD_CONN_DTL_CONNECTION_STRING & gstrBlank &
DATA_TYPE_TEXT255 & ", " & _
        FLD_CONN_DTL_CONNECTION_TYPE & gstrBlank &
DATA_TYPE_INTEGER & ", " & _
        "CONSTRAINT pk_connection_name PRIMARY KEY (" &
FLD_ID_CONN_NAME & ") " & _
");"

End Sub
```

WindowsApiCommon.bas

```
Attribute VB_Name = "WindowsApiCommon"
'  FILE:      WindowsApiCommon.bas
'             Microsoft TPC-H Kit Ver. 1.00
'             Copyright Microsoft, 1999
'             All Rights Reserved
'
'
```

```
'  PURPOSE:    This module contains functions that are wrappers around
the
'              Windows API and are used by both StepMaster and
SMRunOnly.
'  Contact:    Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

' Used to indicate the source module name when errors
' are raised by this module
Private Const mstrModuleName As String = "WindowsApiCommon."

Public Type PROCESS_INFORMATION
   hProcess    As Long
   hThread     As Long
   dwProcessID As Long
   dwThreadID  As Long
End Type

' Used by GetShortName to return the short file name for a given file
Private Declare Function GetShortPathName Lib "kernel32" _
     Alias "GetShortPathNameA" (ByVal lpszLongPath As String, _
     ByVal lpszShortPath As String, ByVal cchBuffer As Long) As
Long

Public Declare Function GetExitCodeProcess Lib "kernel32" ( _
   ByVal hProcess As Long, lpExitCode As Long) As Long
Public Declare Function TerminateProcess Lib "kernel32" ( _
       hProcess As Long, uExitCode As Long) As Long
Public Declare Function CloseHandle Lib "kernel32" ( _
   ByVal hObject As Long) As Long

Public Const NORMAL_PRIORITY_CLASS      As Long = &H20&
Public Const INFINITE                   As Long = -1&

Public Const STATUS_WAIT_0              As Long = &H0
Public Const STATUS_ABANDONED_WAIT_0    As Long = &H80
Public Const STATUS_USER_APC            As Long = &HC0
Public Const STATUS_TIMEOUT             As Long = &H102
Public Const STATUS_PENDING             As Long = &H103

Public Const WAIT_FAILED                As Long = &HFFFFFFFF
Public Const WAIT_OBJECT_0              As Long = STATUS_WAIT_0
Public Const WAIT_TIMEOUT               As Long =
STATUS_TIMEOUT

Public Const WAIT_ABANDONED             As Long =
STATUS_ABANDONED_WAIT_0
Public Const WAIT_ABANDONED_0           As Long =
STATUS_ABANDONED_WAIT_0

Public Const WAIT_IO_COMPLETION         As Long =
STATUS_USER_APC
Public Const STILL_ACTIVE               As Long =
STATUS_PENDING

Public Const PROCESS_QUERY_INFORMATION  As Long =
&H400
Public Const STANDARD_RIGHTS_REQUIRED   As Long =
&HF0000

'-----------------------------------------------------------------------------
'Declarations for shelling:

Public Type STARTUPINFO
   cb             As Long
   lpReserved     As String
   lpDesktop      As String
   lpTitle        As String
   dwX            As Long
   dwY            As Long
   dwXSize        As Long
   dwYSize        As Long
   dwXCountChars  As Long
   dwYCountChars  As Long
   dwFillAttribute As Long
   dwFlags        As Long
   wShowWindow    As Integer
   cbReserved2    As Integer
   lpReserved2    As Long
   hStdInput      As Long
   hStdOutput     As Long
   hStdError      As Long
End Type

Public Declare Function WaitForSingleObject Lib "kernel32" ( _
   ByVal hProcess As Long, ByVal dwMilliseconds As Long) As Long

Public Declare Function InputIdle Lib "user32" Alias
"WaitForInputIdle" ( _
   ByVal hProcess As Long, ByVal dwMilliseconds As Long) As Long

Public Declare Function CreateProcessA Lib "kernel32" ( _
   ByVal lpApplicationName As Long, ByVal lpCommandLine As
String, _
   ByVal lpProcessAttributes As Long, ByVal lpThreadAttributes As
Long, _
   ByVal bInheritHandles As Long, ByVal dwCreationFlags As Long, _
   ByVal lpEnvironment As Long, ByVal lpCurrentDirectory As Long,
_
   lpStartupInfo As STARTUPINFO, lpProcessInformation As _
   PROCESS_INFORMATION) As Long

Public Declare Function GetLastError Lib "kernel32" () As Long

Private Type OPENFILENAME
   lStructSize As Long
   hwndOwner As Long
   hInstance As Long
   lpstrFilter As String
   lpstrCustomFilter As String
   nMaxCustFilter As Long
   nFilterIndex As Long
   lpstrFile As String
   nMaxFile As Long
   lpstrFileTitle As String
   nMaxFileTitle As Long
   lpstrInitialDir As String
   lpstrTitle As String
   Flags As Long
   nFileOffset As Integer
   nFileExtension As Integer
   lpstrDefExt As String
   lCustData As Long
   lpfnHook As Long
   lpTemplateName As Long
End Type

Private Declare Function GetOpenFileName Lib "COMDLG32" _
       Alias "GetOpenFileNameA" (file As OPENFILENAME) As Long

Private Declare Function lstrlen Lib "kernel32" (lpsz As String) As
Long

Public Const MAX_PATH = 255

' Used when creating a process
Public Const SW_SHOWMINNOACTIVE = 7
Public Const STARTF_USESHOWWINDOW = &H1
```

```
Public Const MB_YESNOCANCEL = &H3&
Public Const MB_ABORTRETRYIGNORE = &H2&
Public Const MB_OK = &H0&

Public Const MB_APPLMODAL = &H0&

Public Const MB_ICONQUESTION = &H20&
Public Const MB_ICONEXCLAMATION = &H30&

Public Const IDABORT = 3
Public Const IDRETRY = 4
Public Const IDIGNORE = 5
Public Const IDYES = 6
Public Const IDNO = 7
Public Const IDCANCEL = 2

Private Declare Function MessageBox Lib "user32" Alias
"MessageBoxA" ( _
      ByVal hWnd As Long, ByVal lpText As String, _
      ByVal lpCaption As String, ByVal wType As Long) As Long

Private Type SYSTEMTIME
      wYear As Integer
      wMonth As Integer
      wDayOfWeek As Integer
      wDay As Integer
      wHour As Integer
      wMinute As Integer
      wSecond As Integer
      wMilliseconds As Integer
End Type

Private Declare Function Get64BitTime Lib "smtime.dll" ( _
      ByVal lpInitTime As Any) As Currency

Public Function ShowMessageBox(hWnd As Long, strText As String, _
      strTitle As String, wType As Integer) As Long
   ' Using the Windows MessageBox Api since the VB Msgbox function
suppresses
   ' all events
   ShowMessageBox = MessageBox(hWnd, ByVal strText, ByVal
strTitle, wType)

   If ShowMessageBox = 0 Then
      LogSystemError
      Err.Raise vbObjectError + errConfirmFailed, App.EXEName, _
            LoadResString(errConfirmFailed)
   End If

End Function
Public Function ShowFileOpenDialog(ByVal strFilter As String, _
      ByVal strDialogTitle As String, ByVal lngFlags As Long, _
      Optional ByVal strOldFile As String = gstrEmptyString) As String
   ' Returns the file name selected by the user
   Dim strInitDir As String
   Dim intPos As Integer
   Dim opfile As OPENFILENAME
   Dim sFile As String

   On Error GoTo ShowFileOpenDialogErr

   If Not StringEmpty(strOldFile) Then
      intPos = InstrR(strOldFile, gstrFileSeparator)
      If intPos > 0 Then
         strInitDir = Left$(strOldFile, intPos - 1)
      End If
   End If

   With opfile
      .lStructSize = Len(opfile)
      .Flags = lngFlags
      .lpstrInitialDir = strInitDir
      .lpstrTitle = strDialogTitle
      .lpstrFilter = MakeWindowsFilter(strFilter)
      sFile = strOldFile & String$(MAX_PATH - Len(strOldFile), 0)
      .lpstrFile = sFile
      .nMaxFile = MAX_PATH
   End With

   If GetOpenFileName(opfile) Then
      ShowFileOpenDialog = Left$(opfile.lpstrFile,
InStr(opfile.lpstrFile, vbNullChar) - 1)
   Else
      ShowFileOpenDialog = strOldFile
   End If

   Exit Function

ShowFileOpenDialogErr:
   Call LogErrors(Errors)
   ' Reset the selection to the passed in file, if any
   ShowFileOpenDialog = strOldFile

End Function

Private Function MakeWindowsFilter(sFilter As String) As String

   Dim s As String, ch As String, iTemp As Integer

   On Error GoTo MakeWindowsFilterErr

   ' To make Windows-style filter, replace | and : with nulls
   For iTemp = 1 To Len(sFilter)
      ch = Mid$(sFilter, iTemp, 1)
      If ch = "|" Then
         s = s & vbNullChar
      Else
         s = s & ch
      End If
   Next iTemp

   ' Put double null at end
   s = s & vbNullChar & vbNullChar
   MakeWindowsFilter = s

   Exit Function

MakeWindowsFilterErr:
   Call LogErrors(Errors)
   gstrSource = mstrModuleName & "MakeWindowsFilter"
   On Error GoTo 0
   Err.Raise vbObjectError + errApiFailed, gstrSource, _
         LoadResString(errApiFailed)

End Function


Public Function GetShortName(ByVal sLongFileName As String) As
String
   ' Returns the short name for the passed in file - will only work
   ' if the passed in path/file exists

   Dim lRetVal As Long, sShortPathName As String, iLen As Integer
   Dim sLongFile As String
   Dim sDir As String
   Dim sFile As String
   Dim intPos As Integer

   On Error GoTo GetShortNameErr
```

```
    sFile = gstrEmptyString
    sLongFile = MakePathValid(sLongFileName)
    If StringEmpty(Dir$(sLongFile, vbNormal + vbDirectory)) Then
        ' The passed in path is a file that does not exist - since
        ' the GetShortPathName api does not work on non-existent files
        ' on Win2K, use the directory as an argument to the api and
        ' then append the file
        intPos = InstrR(sLongFile, gstrFileSeparator)
        sDir = Mid$(sLongFile, 1, intPos - 1)
        sFile = Right(sLongFile, Len(sLongFile) - intPos + 1)
        sLongFile = sDir
    End If

    'Set up buffer area for API function call return
    sShortPathName = Space(MAX_PATH)
    iLen = Len(sShortPathName)

    'Call the function
    lRetVal = GetShortPathName(sLongFile, sShortPathName, iLen)
    If lRetVal = 0 Then
        Call LogSystemError
    End If

    GetShortName = IIf(lRetVal = 0, sLongFile, Left(sShortPathName,
lRetVal))
    If Not StringEmpty(sFile) Then
        GetShortName = GetShortName & sFile
    End If

    Exit Function

GetShortNameErr:
    Call LogErrors(Errors)
    gstrSource = mstrModuleName & "GetShortName"
    On Error GoTo 0
    Err.Raise vbObjectError + errApiFailed, gstrSource, _
            LoadResString(errApiFailed)

End Function
Public Function Determine64BitTime() As Currency

    Determine64BitTime = Get64BitTime(ByVal 0&)

End Function
```

WorkspaceCommon.bas

```
Attribute VB_Name = "WorkspaceCommon"
'  FILE:      WorkspaceCommon.bas
'             Microsoft TPC-H Kit Ver. 1.00
'             Copyright Microsoft, 1999
'             All Rights Reserved
'
'
'  PURPOSE:   Contains functionality common across StepMaster and
'             SMRunOnly, pertaining to workspaces
'             Specifically, functions to read workspace records from
'             the database and so on.
'  Contact:   Reshma Tharamal (reshmat@microsoft.com)
'
Option Explicit

' Used to indicate the source module name when errors
' are raised by this module
Private Const mstrModuleName As String = "WorkspaceCommon."


Public Function GetWorkspaceDetails( _
    Optional ByVal WorkspaceId As Long, _
    Optional WorkspaceName As String = gstrEmptyString _
    ) As Variant
    ' Depending on the passed in parameter, it returns
    ' either the workspace name or the workspace identifier
    ' in a variant. The calling function must convert the
    ' return value to the appropriate type

    Dim rstWorkspace As Recordset
    Dim qyWsp As DAO.QueryDef
    Dim strSql As String
    Dim cTempStr As cStringSM

    On Error GoTo GetWorkspaceDetailsErr
    gstrSource = mstrModuleName & "GetWorkspaceDetails"

    If WorkspaceId = 0 And _
            WorkspaceName = gstrEmptyString Then
        On Error GoTo 0
        Err.Raise vbObjectError + errMandatoryParameterMissing, _
                gstrSource, _
                LoadResString(errMandatoryParameterMissing)
    End If

    Set cTempStr = New cStringSM

    If WorkspaceId = 0 Then
        strSql = " Select workspace_id from att_workspaces " & _
                " where workspace_name = [w_name] "
        Set qyWsp = dbsAttTool.CreateQueryDef(gstrEmptyString, strSql)
        qyWsp.Parameters("w_name").Value = WorkspaceName
    Else
        strSql = " Select workspace_name from att_workspaces " & _
                " where workspace_id = [w_id] "
        Set qyWsp = dbsAttTool.CreateQueryDef(gstrEmptyString, strSql)
        qyWsp.Parameters("w_id").Value = WorkspaceId
    End If

    Set cTempStr = Nothing

    Set rstWorkspace = qyWsp.OpenRecordset(dbOpenForwardOnly)

    If rstWorkspace.RecordCount <> 0 Then
        GetWorkspaceDetails = rstWorkspace.Fields(0)
    Else
        rstWorkspace.Close
        qyWsp.Close
        On Error GoTo 0
        Err.Raise vbObjectError + errInvalidWorkspaceData, _
                gstrSource, _
                LoadResString(errInvalidWorkspaceData)
    End If

    rstWorkspace.Close
    qyWsp.Close
    Exit Function

GetWorkspaceDetailsErr:
    Call LogErrors(Errors)
    gstrSource = mstrModuleName & "GetWorkspaceDetails"
    On Error GoTo 0
    Err.Raise vbObjectError + errGetWorkspaceDetailsFailed, _
            gstrSource, _
            LoadResString(errGetWorkspaceDetailsFailed)

End Function

Public Sub ReadStepsInWorkspace(rstStepsInWorkSpace As Recordset,
_
        qySteps As DAO.QueryDef, _
        Optional lngWorkspaceId As Long = glInvalidId, _
        Optional dbLoad As DAO.Database = Nothing, _
```

```
        Optional ByVal bSelectArchivedRecords As Boolean = False)

    ' This function will populate the passed in recordset with
    ' all the steps for a given workspace (if one is passed in, else all
workspaces)

    Dim strSql As String

    On Error GoTo ReadStepsInWorkspaceErr

    ' Create a recordset object to retrieve all steps for
    ' the given workspace
    strSql = "Select step_id, step_label, step_file_name, step_text, " & _
        " start_directory, version_no, workspace_id, " & _
        " parent_step_id, parent_version_no, " & _
        " sequence_no, step_level, " & _
        " enabled_flag, degree_parallelism, " & _
        " execution_mechanism, " & _
        " failure_details, continuation_criteria, " & _
        " global_flag, archived_flag, " & _
        " output_file_name, " & _
        " error_file_name, iterator_name " & _
        " from att_steps a " & _
        " where "

        ' log_file_name,

    If lngWorkspaceId <> glInvalidId Then
        strSql = strSql & " workspace_id = [w_id] AND "
    End If

    If Not bSelectArchivedRecords Then
        strSql = strSql & " archived_flag = [archived] AND "
    End If

    ' Find the highest X-component of the version number
    strSql = strSql & " cint( mid( version_no, 1, instr( version_no, " &
gstrDQ & gstrVerSeparator & gstrDQ & " ) - 1 ) ) = " & _
        " ( select max( cint( mid( version_no, 1, instr( version_no, " &
gstrDQ & gstrVerSeparator & gstrDQ & " ) - 1 ) ) ) " & _
        " from att_steps AS d " & _
        " WHERE a.step_id = d.step_id ) "

    ' Find the highest Y-component of the version number for the highest
X-component
    strSql = strSql & " AND cint( mid( version_no, instr( version_no, " &
gstrDQ & gstrVerSeparator & gstrDQ & " ) + 1 ) ) = " & _
        " ( select max( cint( mid( version_no, instr( version_no, " &
gstrDQ & gstrVerSeparator & gstrDQ & " ) + 1 ) ) ) " & _
        " from att_steps AS b " & _
        " Where a.step_id = b.step_id " & _
        " AND cint( mid( version_no, 1, instr( version_no, " & gstrDQ &
gstrVerSeparator & gstrDQ & " ) - 1 ) ) = " & _
        " ( select max( cint( mid( version_no, 1, instr( version_no, " &
gstrDQ & gstrVerSeparator & gstrDQ & " ) - 1 ) ) ) " & _
        " from att_steps AS c " & _
        " WHERE a.step_id = c.step_id ) ) "

    ' Append the order clause as follows
    ' First, separate all global/non-global steps
    ' Order the worker and manager steps by step_level to
    ' ensure that the parent steps are populated before
    ' any sub-steps within it
    ' Further ordering by parent_step_id and sequence_no
    ' ensures that all the children within a parent are
    ' selected in the necessary order
    strSql = strSql & " order by global_flag, step_level, " & _
        " parent_step_id, sequence_no "

    If dbLoad Is Nothing Then Set dbLoad = dbsAttTool

    ' Create a temporary Querydef object
    Set qySteps = dbLoad.CreateQueryDef(gstrEmptyString, strSql)

    ' Initialize the parameter values
    If lngWorkspaceId <> glInvalidId Then
        qySteps.Parameters("w_id").Value = lngWorkspaceId
    End If

    If Not bSelectArchivedRecords Then
        qySteps.Parameters("archived").Value = False
    End If

    Set rstStepsInWorkSpace =
qySteps.OpenRecordset(dbOpenSnapshot)

    Exit Sub

ReadStepsInWorkspaceErr:

    LogErrors Errors
    gstrSource = mstrModuleName & "ReadStepsInWorkspace"
    On Error GoTo 0
    Err.Raise vbObjectError + errReadWorkspaceDataFailed, _
            gstrSource, _
            LoadResString(errReadWorkspaceDataFailed)

End Sub
Public Sub ReadWorkspaces(dbLoad As Database, rstWsp As
Recordset, _
        qyWsp As DAO.QueryDef, _
        Optional ByVal bSelectArchivedRecords As Boolean = False)

    ' This function will populate the passed in recordset with all
workspace records

    Dim strSql As String

    On Error GoTo ReadWorkspacesErr

    ' Create a recordset object containing all the workspaces
    ' (that haven't been archived) in the database
    strSql = " Select workspace_id, workspace_name, archived_flag " &
_
            " from att_workspaces "

    If Not bSelectArchivedRecords Then
        strSql = strSql & " where archived_flag = [archived]"
    End If
    strSql = strSql & " order by workspace_name"

    Set qyWsp = dbLoad.CreateQueryDef(gstrEmptyString, strSql)
    If Not bSelectArchivedRecords Then
        qyWsp.Parameters("archived").Value = False
    End If

    Set rstWsp = qyWsp.OpenRecordset(dbOpenForwardOnly)

    Exit Sub

ReadWorkspacesErr:

    LogErrors Errors
    gstrSource = mstrModuleName & "ReadWorkspaces"
    On Error GoTo 0
    Err.Raise vbObjectError + errReadWorkspaceDataFailed, _
            gstrSource, _
            LoadResString(errReadWorkspaceDataFailed)

End Sub
```

```
Public Sub ShowWorkspacesInDb(dbLoad As Database)

   Dim recWorkspaces As Recordset
   Dim qryAllWsp As QueryDef

   On Error GoTo ShowWorkspacesInDbErr

   ' Set the mousepointer to indicate Busy
   Call ShowBusy

   Load frmWorkspaceOpen

   Call ReadWorkspaces(dbLoad, recWorkspaces, qryAllWsp)

   frmWorkspaceOpen.lstWorkspaces.Clear

   ' Load all the workspaces into the listbox
   If recWorkspaces.RecordCount <> 0 Then
      Do
         ' Add the workspace name to the list and store
         ' the corresponding workspace id as the ItemData
         ' property of the item.
         ' The workspace id will be used for all further
         ' processing of the workspace
         frmWorkspaceOpen.lstWorkspaces.AddItem
recWorkspaces![workspace_name]

frmWorkspaceOpen.lstWorkspaces.ItemData(frmWorkspaceOpen.lstW
orkspaces.NewIndex) = _
               recWorkspaces![workspace_id]
         recWorkspaces.MoveNext

      Loop Until recWorkspaces.EOF
   End If
   recWorkspaces.Close
   qryAllWsp.Close

   ' Reset the mousepointer
   ShowFree

   #If RUN_ONLY Then
      frmWorkspaceOpen.Show vbModal
   #Else
      frmWorkspaceOpen.Show vbModal, frmMain
   #End If

   Exit Sub

ShowWorkspacesInDbErr:
   LogErrors Errors
   Call ShowFree
   Err.Raise vbObjectError + errProgramError, mstrModuleName &
"ShowWorkspacesInDb", _
         LoadResString(errProgramError)

End Sub
Private Sub ReadWorkspaceParameters(lngWorkspaceId As Long, _
   rstWorkSpaceParameters As Recordset, _
   qyWspParams As DAO.QueryDef)

   ' Will populate the recordset with all the parameters for
   ' a given workspace

   Dim strSql As String

   On Error GoTo ReadWorkspaceParametersErr

   strSql = "Select parameter_id, parameter_name, " & _
         " parameter_value, workspace_id, parameter_type, description "
& _
         " from workspace_parameters " & _
         " where workspace_id = [w_id] " & _
         " order by parameter_name, parameter_value "

   ' Create a temporary Querydef object and initialize
   ' it's parameter values
   Set qyWspParams = dbsAttTool.CreateQueryDef(gstrEmptyString,
strSql)
   qyWspParams.Parameters("w_id").Value = lngWorkspaceId

   Set rstWorkSpaceParameters =
qyWspParams.OpenRecordset(dbOpenSnapshot)

   Exit Sub

ReadWorkspaceParametersErr:

   LogErrors Errors
   gstrSource = mstrModuleName & "ReadWorkspaceParameters"
   On Error GoTo 0
   Err.Raise vbObjectError + errReadWorkspaceDataFailed, _
         gstrSource, _
         LoadResString(errReadWorkspaceDataFailed)

End Sub
Private Sub ReadConnections(lngWorkspaceId As Long, rstConns As
Recordset, _
   qyConns As DAO.QueryDef)

   ' Will populate the recordset with all the parameters for
   ' a given workspace

   Dim strSql As String

   On Error GoTo ReadWorkspaceParametersErr

   strSql = "Select connection_id, " & _
         " connection_name, connection_value, workspace_id,
description, " & _
         " no_count_display, no_execute, parse_query_only,
ANSI_quoted_identifiers, " & _
         " ANSI_nulls, show_query_plan, show_stats_time,
show_stats_io, " & _
         " parse_odbc_msg_prefixes, row_count, tsql_batch_separator,
query_time_out, " & _
         " server_language, character_translation, regional_settings " & _
         " from workspace_connections " & _
         " where workspace_id = [w_id] " & _
         " order by connection_name, connection_value "

   ' Create a temporary Querydef object and initialize
   ' it's parameter values
   Set qyConns = dbsAttTool.CreateQueryDef(gstrEmptyString, strSql)
   qyConns.Parameters("w_id").Value = lngWorkspaceId

   Set rstConns = qyConns.OpenRecordset(dbOpenSnapshot)

   Exit Sub

ReadWorkspaceParametersErr:

   LogErrors Errors
   On Error GoTo 0
   Err.Raise vbObjectError + errReadWorkspaceDataFailed, _
         mstrModuleName & "ReadConnections",
LoadResString(errReadWorkspaceDataFailed)

End Sub
Private Sub ReadConnectionDtls(lngWorkspaceId As Long, rstConns
As Recordset, _
```

```
    qyConns As DAO.QueryDef)

    ' Will populate the recordset with all the connection_dtls records for
    ' a given workspace

    Dim strSql As String

    On Error GoTo ReadWorkspaceParametersErr

    strSql = "Select " & FLD_ID_CONN_NAME & ", " & _
            FLD_CONN_DTL_CONNECTION_NAME & ", " & _
            FLD_CONN_DTL_CONNECTION_STRING & ", " & _
            FLD_ID_WORKSPACE & ", " & _
            FLD_CONN_DTL_CONNECTION_TYPE & _
            " from " & TBL_CONNECTION_DTLS & _
            " where " & FLD_ID_WORKSPACE & " = [w_id] " & _
            " order by " & FLD_CONN_DTL_CONNECTION_NAME

    ' Create a temporary Querydef object and initialize
    ' it's parameter values
    Set qyConns = dbsAttTool.CreateQueryDef(gstrEmptyString, strSql)
    qyConns.Parameters("w_id").Value = lngWorkspaceId

    Set rstConns = qyConns.OpenRecordset(dbOpenSnapshot)

    Exit Sub

ReadWorkspaceParametersErr:

    LogErrors Errors
    On Error GoTo 0
    Err.Raise vbObjectError + errReadWorkspaceDataFailed, _
            mstrModuleName & "ReadConnectionDtls",
LoadResString(errReadWorkspaceDataFailed)

End Sub

Public Sub ReadWorkspaceData(lngWorkspaceId As Long, _
        cStepsCol As cArrSteps, _
        cParamsCol As cArrParameters, _
        cConsCol As cArrConstraints, _
        cConns As cConnections, _
        cConnDetails As cConnDtls, _
        rstStepsInWsp As Recordset, _
        qyStepsInWsp As DAO.QueryDef, _
        rstParamsInWsp As Recordset, _
        qyParamsInWsp As DAO.QueryDef, _
        rstConns As Recordset, _
        qyConns As DAO.QueryDef, _
        rstConnDtls As Recordset, _
        qyConnDtls As DAO.QueryDef)
    ' Loads the passed in structures with all the data for
    ' the workspace. It also initializes the recordsets
    ' with the step and parameter records for the workspace.

    On Error GoTo ReadWorkspaceDataErr

    ShowBusy

    Call ReadStepsInWorkspace(rstStepsInWsp, qyStepsInWsp,
lngWorkspaceId)

    ' Load all the steps in the array
    LoadRecordsetInStepsArray rstStepsInWsp, cStepsCol

    ' Initialize the steps with all the iterator
    ' records for each step
    Call LoadIteratorsForWsp(cStepsCol, lngWorkspaceId,
rstStepsInWsp)

    ReadWorkspaceParameters lngWorkspaceId, rstParamsInWsp,
qyParamsInWsp

    ' Load all the workspace parameters in the array
    LoadRecordsetInParameterArray rstParamsInWsp, cParamsCol

    ' Read and load connection strings
    ReadConnections lngWorkspaceId, rstConns, qyConns

    LoadRecordsetInConnectionArray rstConns, cConns

    ' Read and load connection information
    ReadConnectionDtls lngWorkspaceId, rstConnDtls, qyConnDtls

    LoadRSInConnDtlArray rstConnDtls, cConnDetails

    ' Finally, load the step constraints collection class with
    ' all the constraints for the steps in the workspace
    cConsCol.LoadConstraints lngWorkspaceId, rstStepsInWsp

    ShowFree
    Exit Sub

ReadWorkspaceDataErr:
    ' Log the error code raised by Visual Basic
    ShowFree
    Call LogErrors(Errors)
    On Error GoTo 0
    gstrSource = mstrModuleName & "ReadWorkspaceData"
    Err.Raise vbObjectError + errReadWorkspaceDataFailed, _
            gstrSource, _
            LoadResString(errReadWorkspaceDataFailed)

End Sub
```

The listings in this section implement the executedll module

Execute.cpp

```
//  FILE:      Execute.cpp
//             Microsoft TPC-H Kit Ver. 1.00
//             Copyright Microsoft, 1999
//             All Rights Reserved
//
//
//  PURPOSE:    Implementation of CExecute.
//  Contact:    Reshma Tharamal (reshmat@microsoft.com)
//
#include "stdafx.h"

#include "ExecuteDll.h"
#include "SMExecute.h"
#include "Execute.h"

extern SQLHENV henv;

extern SM_Connection_Info       *p_Connections;
                                // Pointer to open connections
extern int
                iConnectionCount;                       // Number of
open connections
extern CRITICAL_SECTION                 hConnections;
                                // Critical section to serialize access to
available connections

#ifdef _TPCH_AUDIT
```

```
	extern FILE *pfLogFile;
	//
Log file containing timestamps
	extern CRITICAL_SECTION hLogFileWrite;
	// Handle to critical section
#endif

////////////////////////////////////////////////////////////////////////////
// CExecute

char * g_szOdbcOps[] = {
		"SQLAllocHandle",
		"SQLDriverConnect",
		"SQLExecDirect",
		"SQLSetStmtAttr",
		"SQLCancel",
		"SQLNumResultCols",
		"SQLDescribeCol",
		"SQLColAttribute",
		"SQLFetch",
		"SQLGetData",
		"SQLRowCount",
		"SQLMoreResults",
		"SQLBindCol"
	};

char * CExecError::m_szExecErrorDesc[] = {
		"Connection is already in use."
	};

STDMETHODIMP CExecute::InterfaceSupportsErrorInfo(REFIID riid)
{
	static const IID* arr[] =
	{
		&IID_IExecute
	};
	for (int i=0; i < sizeof(arr) / sizeof(arr[0]); i++)
	{
		if (InlineIsEqualGUID(*arr[i],riid))
			return S_OK;
	}
	return S_FALSE;
}

STDMETHODIMP CExecute::put_OutputFile(BSTR newVal)
{
	assert(m_pOutputFile);
	m_OutputFile = newVal;

	HRESULT		hr = m_pOutputFile-
>put_FileName(newVal);
	if FAILED(hr)
	{
		m_pOutputFile->Release();
		m_pOutputFile = NULL;
	}
	return hr;
}

//DEL STDMETHODIMP CExecute::put_LogFile(BSTR newVal)
//DEL {
//DEL	assert(m_pLogFile);
//DEL
//DEL	m_pLogFile->put_FileName(newVal);
//DEL	return S_OK;
//DEL }

STDMETHODIMP CExecute::put_ErrorFile(BSTR newVal)
{
	assert(m_pErrorFile);
	m_ErrorFile = newVal;

	HRESULT		hr = m_pErrorFile-
>put_FileName(newVal);
	if FAILED(hr)
	{
		m_pErrorFile->Release();
		m_pErrorFile = NULL;
	}
	return hr;
}

STDMETHODIMP CExecute::DoExecute(BSTR szCommand, BSTR
szExecutionDtls, ExecutionType ExecMethod, \

		BOOL bNoCount, BOOL bNoExecute, BOOL
bParseOnly, BOOL bQuotedIds, \

		BOOL bAnsiNulls, BOOL bShowQP, BOOL
bStatsTime, BOOL bStatsIO, \

		long lRowCount, long lQueryTmout, BSTR
szConnection)
{
  HANDLE		hThrd;
  DWORD		tid;

  _CrtSetReportFile(_CRT_WARN, _CRTDBG_FILE_STDOUT);

	m_szCommand = szCommand;
	m_szExecDtls = szExecutionDtls;

	m_ExecMthd = ExecMethod;
	if (m_ExecMthd == execODBC)
  {
    m_bNoCount = bNoCount;
		m_bNoExecute = bNoExecute;
		m_bParseOnly = bParseOnly;
		m_bQuotedIds = bQuotedIds;
		m_bAnsiNulls = bAnsiNulls;
		m_bShowQP = bShowQP;
		m_bStatsTime = bStatsTime;
		m_bStatsIO = bStatsIO;
		m_lRowCount = lRowCount;
		m_lQueryTmout = lQueryTmout;
		m_szConnection = szConnection;
  }

	if((hThrd = CreateThread( 0, 0,
(LPTHREAD_START_ROUTINE)ExecutionThread,
		this, 0, &tid)) == NULL)
		return(RaiseSystemError());

	CloseHandle(hThrd);

	return S_OK;
}

STDMETHODIMP CExecute::Abort()
{
	if (m_ExecMthd == execShell)
		return(AbortShell());
	else
		return(AbortODBC());
}

void ExecutionThread(LPVOID lpParameter)
{

	CExecute  *MyExecute = (CExecute*)lpParameter;
```


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```
	MyExecute->m_tElapsedTime = 0;

	GetLocalTime(&MyExecute->m_tStartTime);
	MyExecute->PostMessage(WM_TASK_START, 0, 0);

#ifdef _TPCH_AUDIT
	char		szBuffer[MAXLOGCMDBUF];
	char		szFmt[MAXBUFLEN];

	sprintf(szFmt, "Start Step: '%%.%ds' at '%d/%d/%d
%d:%d:%d:%d'\n",
			MAXLOGCMDLEN,
			MyExecute->m_tStartTime.wMonth,
MyExecute->m_tStartTime.wDay,
			MyExecute->m_tStartTime.wYear, MyExecute-
>m_tStartTime.wHour,
			MyExecute->m_tStartTime.wMinute,
MyExecute->m_tStartTime.wSecond,
			MyExecute->m_tStartTime.wMilliseconds);
	if (MyExecute->m_ExecMthd == execShell)
			WriteFileToTpchLog((LPSTR)MyExecute-
>m_szCommand, szFmt);
	else
	{
			sprintf(szBuffer, szFmt, (LPSTR)MyExecute-
>m_szCommand);
			WriteToTpchLog(szBuffer);
	}
#endif

	// Initialize the run status for the step to running. The
completion status for
	// the step will be initialized by the Shell and ODBC
execution functions.
   MyExecute->m_StepStatus = gintRunning;

	if (MyExecute->m_ExecMthd == execShell)
			MyExecute->m_tElapsedTime = MyExecute-
>ExecuteShell();
	else
			MyExecute->m_tElapsedTime = MyExecute-
>ExecuteODBC();

	// Close the output, log and error files
	if (MyExecute->m_pOutputFile)
			MyExecute->m_pOutputFile->Release();
	MyExecute->m_pOutputFile = NULL;

	MyExecute->m_ExecTime = NULL;

	GetLocalTime(&MyExecute->m_tEndTime);

#ifdef _TPCH_AUDIT
	sprintf(szFmt, "Complete Step: '%%.%ds' at '%d/%d/%d
%d:%d:%d:%d'\n",
			MAXLOGCMDLEN,
			MyExecute->m_tEndTime.wMonth, MyExecute-
>m_tEndTime.wDay,
			MyExecute->m_tEndTime.wYear, MyExecute-
>m_tEndTime.wHour,
			MyExecute->m_tEndTime.wMinute, MyExecute-
>m_tEndTime.wSecond,
			MyExecute->m_tEndTime.wMilliseconds);
	if (MyExecute->m_ExecMthd == execShell)
			WriteFileToTpchLog((LPSTR)MyExecute-
>m_szCommand, szFmt);
	else
	{
			sprintf(szBuffer, szFmt, (LPSTR)MyExecute-
>m_szCommand);
			WriteToTpchLog(szBuffer);
	}
#endif

	MyExecute->PostMessage(WM_TASK_FINISH, 0, 0);

	return;
}

#ifdef _TPCH_AUDIT

void WriteFileToTpchLog(LPSTR szFile, LPSTR szFmt)
{
	// Reads a maximum of MAXLOGCMDBUF characters
from the command file and writes it to the log
	FILE	*fpCmd;
	int		iRead;
	char	szBuf[MAXLOGCMDBUF];
	char	szCmd[MAXLOGCMDLEN];

	if ( pfLogFile != NULL )
	{
		if ( (fpCmd = fopen(szFile,
FILE_ACCESS_READ)) != NULL)
		{
			iRead = fread(szCmd, sizeof(char),
sizeof(szCmd) / sizeof(char), fpCmd);
			if (iRead < MAXLOGCMDLEN)
				szCmd[iRead] = '\0';
			else

	szCmd[MAXLOGCMDLEN - 1] = '\0';
			sprintf(szBuf, szFmt, szCmd);
			WriteToTpchLog(szBuf);
			fclose(fpCmd);
		}
	}
}

void WriteToTpchLog(char *szMsg)
{
	if (pfLogFile != NULL)
	{
		EnterCriticalSection(&hLogFileWrite);
		fprintf(pfLogFile, szMsg);
		LeaveCriticalSection(&hLogFileWrite);
	}

	return;
}
#endif

TC_TIME CExecute::ExecuteShell()
{
	STARTUPINFOA			Start;
	PROCESS_INFORMATION		proc;
	DWORD
	exitCode;
	TC_TIME
	tElapsed = 0;
	_bstr_t
	szCommand("cmd /c ");
	LPSTR
	szStartDir;
	CURRENCY
	Elapsed;

	szCommand += m_szCommand;
```

```
	// Redirect output and error information
	szCommand += " > " + m_OutputFile + " 2> " +
m_ErrorFile;

	// Initialize the STARTUPINFO structure:
	memset(&Start, 0, sizeof(STARTUPINFOA)) ;
	Start.cb		= sizeof(Start);
	Start.dwFlags		= STARTF_USESHOWWINDOW;
	Start.wShowWindow	= SW_SHOWMINNOACTIVE;

	memset(&proc, 0, sizeof(PROCESS_INFORMATION)) ;

	szStartDir = strcmp((LPCTSTR)m_szExecDtls, "") == 0 ?
NULL : (LPSTR)m_szExecDtls;

	m_ExecTime->Start();

	// Start the shelled application:
	if (!CreateProcessA( NULL, (LPSTR)szCommand, NULL,
NULL, FALSE,
		NORMAL_PRIORITY_CLASS, NULL,
szStartDir, &Start, &proc ))
	{
		m_StepStatus = gintFailed;
		LogSystemError(m_pErrorFile);

		m_ExecTime->Stop(&Elapsed);
		return((TC_TIME)Elapsed.int64);
	}

	m_hHandle = proc.hProcess;
	// Give the process time to execute and finish
	WaitForSingleObject(m_hHandle, INFINITE);
	m_ExecTime->Stop(&Elapsed);

	if (!GetExitCodeProcess(m_hHandle, &exitCode))
	{
		m_StepStatus = gintFailed;
		LogSystemError(m_pErrorFile);
	}
	else
		m_StepStatus = gintComplete;

	// Close all open handles to the shelled process
	CloseHandle(m_hHandle);

	return((TC_TIME)Elapsed.int64);
}

STDMETHODIMP CExecute::AbortShell()
{
	if (m_hHandle != SQL_NULL_HSTMT)
		if (!TerminateProcess(m_hHandle, 0))
			return(RaiseSystemError());

	return(S_OK);
}

TC_TIME CExecute::ExecuteODBC()
{
	TC_TIME			tElapsed = 0;
	HDBC			m_hdbc;
	SQLRETURN		rc;
	LPSTR			szCmd;
	CURRENCY		Elapsed;
	BOOL			bDoConnect =
FALSE;

	// ODBC specific initialization
	m_hdbc = SQL_NULL_HDBC;

	try
	{
		// Allocate a new connection if we are creating a
dynamic connection or if
		// the named connection doesn't exist
		InitializeConnection(&m_hdbc, &bDoConnect);

		// Ensure that the connection is valid.
#ifdef _DEBUG
		_CrtDbgReport(_CRT_WARN, NULL, 0,
NULL, "Executing SQLDriverConnect.\n");
#endif

		if (bDoConnect)
		{
			// Allocate connection handle, open a
connection and set connection attributes.
#ifdef _DEBUG
			_CrtDbgReport(_CRT_WARN,
NULL, 0, NULL, "Executing SQLDriverConnect.\n");
#endif

			if (m_bAbort)
				return(tElapsed);

			// Connect to the server using the
passed in connection string
			rc = SQLDriverConnect(m_hdbc,
NULL,
				(unsigned char
*)(LPSTR)m_szExecDtls, SQL_NTS,
				NULL, 0, NULL,
SQL_DRIVER_NOPROMPT);
			HandleODBCError(rc,
SQL_HANDLE_DBC, m_hdbc, SMSQLDriverConnect);
		}

		ReConnectDeadConnection(&m_hdbc);

#ifdef _DEBUG
		_CrtDbgReport(_CRT_WARN, NULL, 0,
NULL, "Executing SQLAllocHandle for hdbc.\n");
#endif

		if (!m_bAbort && (rc =
SQLAllocHandle(SQL_HANDLE_STMT, m_hdbc, &m_hHandle)) !=
SQL_SUCCESS)
			HandleODBCError(rc,
SQL_HANDLE_DBC, m_hdbc, SMSQLAllocHandle);

		// Set connection attributes if any have been
modified from the default values
		if (m_lRowCount > 0)
		{
			char
	szConnOptions[512];

			sprintf(szConnOptions, "SET
ROWCOUNT %d ", m_lRowCount);
			SetConnectionOption(szConnOptions,
&m_hdbc);
		}

		if (m_bQuotedIds)
			SetConnectionOption("SET
QUOTED_IDENTIFIER ON ", &m_hdbc);

		if (!m_bAnsiNulls)
```

```
                                SetConnectionOption("SET
ANSI_NULL_DFLT_OFF ON ", &m_hdbc);

                        if (!m_bAbort && m_lQueryTmout > 0)
                        {
#ifdef _DEBUG
                                _CrtDbgReport(_CRT_WARN,
NULL, 0, NULL, "Executing SQLSetStmtAttr.\n");
#endif

                                // Set the query timeout on the
statement handle
                                rc = SQLSetStmtAttr(m_hHandle,
SQL_ATTR_QUERY_TIMEOUT, &m_lQueryTmout,
                                        SQL_IS_UINTEGER);
                                HandleODBCError(rc,
SQL_HANDLE_STMT, m_hHandle, SMSQLSetStmtAttr);
                        }

                        if (m_bNoExecute)
                                SetConnectionOption("SET NOEXEC
ON ", &m_hdbc);
                        else if (m_bParseOnly)
                                SetConnectionOption("SET
PARSEONLY ON ", &m_hdbc);
                        else if (m_bShowQP)
                                // Important to ensure that this is the
last connection attributes being set -
                                // otherwise showplans are generated
for all remaining SET statements
                                SetConnectionOption("SET
SHOWPLAN_TEXT ON ", &m_hdbc);
                        else
                        {
                                if (m_bNoCount)

                SetConnectionOption("SET NOCOUNT ON ", &m_hdbc);

                                if (m_bStatsIO)

                SetConnectionOption("SET STATISTICS IO ON ",
&m_hdbc);

                                // Important to ensure that this is the
last connection attributes being set -
                                // otherwise timing statistics are
generated for all remaining SET statements
                                if (m_bStatsTime)

                SetConnectionOption("SET STATISTICS TIME ON ",
&m_hdbc);
                        }

                        m_szCmd = (LPSTR)m_szCommand;
                        m_ExecTime->Start();

                        while ((szCmd =
NextCmdInBatch((LPSTR)m_szCommand)) != NULL && !m_bAbort)
                        {
#ifdef _DEBUG
                                _CrtDbgReport(_CRT_WARN,
NULL, 0, NULL, "Executing SQLExecDirect.\n");
#endif

                                // Execute the ODBC command
                                rc = SQLExecDirect(m_hHandle,
(unsigned char *)szCmd, SQL_NTS);
                                HandleODBCError(rc,
SQL_HANDLE_STMT, m_hHandle, SMSQLExecDirect);
                                free(szCmd);

                                // Call a procedure to log the results to
the output file
                                ProcessResultsets();

                        }
                        m_ExecTime->Stop(&Elapsed);

                        ResetConnectionProperties(&m_hdbc);
                }
                catch(CODBCError *pErr)
                {
                        m_StepStatus = gintFailed;
                        delete pErr;
                }
                catch(CExecError *pErr)
                {
                        m_StepStatus = gintFailed;
                        pErr->LogErrors(this);
                        delete pErr;
                }

                ODBCCleanup(&m_hdbc, &m_hHandle);

                if (m_StepStatus != gintFailed)
                        m_StepStatus = gintComplete;

                return((DWORD)Elapsed.int64);
}

void CExecute::InitializeConnection(HDBC *phdbc, BOOL
*pbDoConnect)
{
                SQLRETURN                       rc;

                *pbDoConnect = TRUE;

                if (IsDynamicConnection())
                {
#ifdef _DEBUG
                        _CrtDbgReport(_CRT_WARN, NULL, 0,
NULL, "Executing SQLAllocHandle for m_hdbc.\n");
#endif

                        rc = SQLAllocHandle(SQL_HANDLE_DBC,
henv, phdbc);
                        HandleODBCError(rc, SQL_HANDLE_ENV,
henv, SMSQLAllocHandle);

                        return;
                }

                EnterCriticalSection(&hConnections);
                // Returns the connection handle if the connection,
m_szConnection, exists
                for (m_iConnectionIndex = iConnectionCount - 1;
m_iConnectionIndex >= 0; m_iConnectionIndex--)
                {
                        if (!strcmp( (p_Connections +
m_iConnectionIndex)->szConnectionName, (LPSTR)m_szConnection))
                        {
                                if (!(p_Connections +
m_iConnectionIndex)->bInUse)
                                {
                                        *phdbc = (p_Connections
+ m_iConnectionIndex)->hdbc;
                                        (p_Connections +
m_iConnectionIndex)->bInUse = TRUE;
```

```
                                        *pbDoConnect = FALSE;
                                        break;
                                }
                                else
                                {

        LeaveCriticalSection(&hConnections);

                                        throw new
CExecError(CExecError::SM_ERR_CONN_IN_USE);
                                }
                        }
        }

        if (m_iConnectionIndex < 0)
        {
                        // Connection was not found. Allocate connection
handle and add it to list of
                        // available connections.
#ifdef _DEBUG
                        _CrtDbgReport(_CRT_WARN, NULL, 0,
NULL, "Executing SQLAllocHandle for m_hdbc.\n");
#endif

                        rc = SQLAllocHandle(SQL_HANDLE_DBC,
henv, phdbc);
                        HandleODBCError(rc, SQL_HANDLE_ENV,
henv, SMSQLAllocHandle);

                        m_iConnectionIndex = iConnectionCount++;

                        p_Connections = (SM_Connection_Info
*)realloc(p_Connections, iConnectionCount *
sizeof(SM_Connection_Info));

                        strcpy((p_Connections + m_iConnectionIndex)-
>szConnectionName, (LPSTR)m_szConnection);
                        (p_Connections + m_iConnectionIndex)->hdbc =
*phdbc;
                        (p_Connections + m_iConnectionIndex)->bInUse
= TRUE;
        }

        LeaveCriticalSection(&hConnections);

        return;
}

void CExecute::ReConnectDeadConnection(HDBC *phdbc)
{
        SQLRETURN               rc;
        SQLUINTEGER             uConnDead;

        // Connect to the server using the passed in connection string
        rc = SQLGetConnectAttr(*phdbc,
SQL_ATTR_CONNECTION_DEAD,
                        &uConnDead, SQL_IS_UINTEGER, NULL);
        HandleODBCError(rc, SQL_HANDLE_DBC, *phdbc,
SMSQLDriverConnect);

        if (uConnDead == SQL_CD_TRUE)
        {
                        // Cleanup the old connection and re-connect.
#ifdef _DEBUG
                        _CrtDbgReport(_CRT_WARN, NULL, 0,
NULL, "Executing SQLDisconnect.\n");
#endif
                        rc = SQLDisconnect(*phdbc);
#ifdef _DEBUG
                        _CrtDbgReport(_CRT_WARN, NULL, 0,
NULL, "Executing SQLFreeHandle for hdbc.\n");
#endif
                        SQLFreeHandle(SQL_HANDLE_DBC, *phdbc);
                        *phdbc = SQL_NULL_HDBC;

#ifdef _DEBUG
                        _CrtDbgReport(_CRT_WARN, NULL, 0,
NULL, "Executing SQLDriverConnect.\n");
#endif

                        rc = SQLAllocHandle(SQL_HANDLE_DBC,
henv, phdbc);
                        HandleODBCError(rc, SQL_HANDLE_ENV,
henv, SMSQLAllocHandle);

                        // Connect to the server using the passed in
connection string
                        rc = SQLDriverConnect(*phdbc, NULL,
                                (unsigned char
*)(LPSTR)m_szExecDtls, SQL_NTS,
                                NULL, 0, NULL,
SQL_DRIVER_NOPROMPT);
                        HandleODBCError(rc, SQL_HANDLE_DBC,
*phdbc, SMSQLDriverConnect);
        }

        return;
}

void CExecute::ResetConnectionUsage()
{
        if(m_iConnectionIndex >= 0 && m_iConnectionIndex <
iConnectionCount)
        {
                        EnterCriticalSection(&hConnections);
                        (p_Connections + m_iConnectionIndex)->bInUse
= FALSE;
                        LeaveCriticalSection(&hConnections);
        }

        return;
}

void CExecute::ResetConnectionProperties(HDBC *p_hdbc)
{
        SQLRETURN                       rc;

        // Reset connection attributes if any have been modified from
the default values

        if (m_bNoExecute)
                        SetConnectionOption("SET NOEXEC OFF ",
p_hdbc);
        else if (m_bParseOnly)
                        SetConnectionOption("SET PARSEONLY OFF
", p_hdbc);
        else if (m_bShowQP)
                        // Reset connection attributes in reverse order
                        SetConnectionOption("SET SHOWPLAN_TEXT
OFF ", p_hdbc);
        else
        {
                        // Reset connection attributes in reverse order
                        if (m_bStatsTime)
                                SetConnectionOption("SET
STATISTICS TIME OFF ", p_hdbc);

                        if (m_bNoCount)
```

```
                        SetConnectionOption("SET
NOCOUNT OFF ", p_hdbc);

                if (m_bStatsIO)
                        SetConnectionOption("SET
STATISTICS IO OFF ", p_hdbc);
        }

        if (m_lRowCount > 0)
        {
                char
        szConnOptions[512];

                sprintf(szConnOptions, "SET ROWCOUNT 0 ");
                SetConnectionOption(szConnOptions, p_hdbc);
        }

        if (m_bQuotedIds)
                SetConnectionOption("SET
QUOTED_IDENTIFIER OFF ", p_hdbc);

        if (!m_bAnsiNulls)
                SetConnectionOption("SET
ANSI_NULL_DFLT_OFF OFF ", p_hdbc);

        if (m_lQueryTmout > 0)
        {
                SQLUINTEGER             lQueryTmout =
0;

#ifdef _DEBUG
                _CrtDbgReport(_CRT_WARN, NULL, 0,
NULL, "Executing SQLSetStmtAttr.\n");
#endif

                // Set the query timeout on the statement handle
                rc = SQLSetStmtAttr(m_hHandle,
SQL_ATTR_QUERY_TIMEOUT, &lQueryTmout,
                        SQL_IS_UINTEGER);
                HandleODBCError(rc, SQL_HANDLE_STMT,
m_hHandle, SMSQLSetStmtAttr);
        }

        return;
}

LPSTR CExecute::NextCmdInBatch(LPSTR szBatch)
{
        LPSTR   szCmd, szSeparator, szStart;
        char    szNext;

        szStart = m_szCmd;

        while ( (szSeparator = strstr(szStart, CMD_SEPARATOR))
!= NULL)
        {
                szNext = *(szSeparator +
strlen(CMD_SEPARATOR));
                if ( szNext == '\n' || szNext == '\r' || szNext == '\0')
                        break;
                else
                        szStart = szSeparator +
strlen(CMD_SEPARATOR);
        }

        if (!szSeparator)
        {
                // No more GO's
                if (strlen(m_szCmd) > 0)
                {
                        szCmd =
(LPSTR)malloc(strlen(m_szCmd) + 1);
                        strcpy(szCmd, m_szCmd);
                        m_szCmd += strlen(m_szCmd);
                }
                else
                        szCmd = NULL;
        }
        else if (szSeparator - m_szCmd > 0)
        {
                // Strip the succeeding newline
                szCmd = (LPSTR)malloc(szSeparator -
m_szCmd);
                strncpy(szCmd, m_szCmd, szSeparator -
m_szCmd - 1);
                *(szCmd + (szSeparator - m_szCmd - 1)) = '\0';
                m_szCmd += szSeparator - m_szCmd +
strlen(CMD_SEPARATOR);
                if ( szNext == '\n' || szNext == '\r')
                        m_szCmd += 1;
        }
        else
                szCmd = NULL;

        return(szCmd);
}

void CExecute::SetConnectionOption(LPSTR szConn, HDBC *pHdbc)
{
        // Executes the passed in connection options 'set' statement.
Returns True if it succeeded
        char                    szConnOptions[512];
        SQLRETURN               rc;

        sprintf(szConnOptions, szConn);

#ifdef _DEBUG
        _CrtDbgReport(_CRT_WARN, NULL, 0, NULL,
"Executing SQLExecDirect for connection option.\n");
#endif

        if (m_bAbort)
                return;

        rc = SQLExecDirect(m_hHandle, (unsigned char
*)szConnOptions, SQL_NTS);
        HandleODBCError(rc, SQL_HANDLE_STMT, m_hHandle,
SMSQLExecDirect);

        return;
}

STDMETHODIMP CExecute::AbortODBC()
{
        m_bAbort = TRUE;

        try
        {
                if (m_hHandle != SQL_NULL_HSTMT)
                {
#ifdef _DEBUG
                        _CrtDbgReport(_CRT_WARN,
NULL, 0, NULL, "Executing SQLCancel.\n");
#endif

                        SQLRETURN rc =
SQLCancel(m_hHandle);
                        HandleODBCError(rc,
SQL_HANDLE_STMT, m_hHandle, SMSQLCancel);
                }
```

```
		}
		catch(CODBCError *pErr)
		{
			delete pErr;
		}

		return(S_OK);
}

void CExecute::ProcessResultsets()
{
	SQLSMALLINT		*CTypeArray, *CScaleArray;
	SQLINTEGER		*ColLenArray, *DispLenArray,
*OffsetArray;
		SQLSMALLINT		iColNameLen, SQLType,
iColNull, i, NumCols = 0;
		SQLINTEGER		iDispLen, iRowCount;
	SQLRETURN		rc;
		char
		szColName[MAX_DATA_LEN + 1];
	void			*DataPtr;
		SQLINTEGER		iLenOrInd =
ALIGNBUF(sizeof(SQLINTEGER));
		SQLUINTEGER		iRowArraySize,
iArrayElementSize;
//		SQLUINTEGER		NumRowsFetched;
//		SQLUSMALLINT	*RowStatusArray;


		if (!m_pOutputFile || m_bAbort)
			return;

		do
		{
#ifdef _DEBUG
			_CrtDbgReport(_CRT_WARN, NULL, 0,
NULL, "Executing SQLNumResultCols.\n");
#endif

			// Determine the number of result set columns.
			rc = SQLNumResultCols(m_hHandle,
&NumCols);
			HandleODBCError(rc, SQL_HANDLE_STMT,
m_hHandle, SMSQLNumResultCols);

			if (NumCols > 0)
			{

				// Allocate arrays to hold the C type,
scale, column and display length of the data
				CTypeArray = (SQLSMALLINT *)
malloc(NumCols * sizeof(SQLSMALLINT));
				CScaleArray = (SQLSMALLINT *)
malloc(NumCols * sizeof(SQLSMALLINT));
				ColLenArray = (SQLINTEGER *)
malloc(NumCols * sizeof(SQLINTEGER));
				DispLenArray = (SQLINTEGER *)
malloc(NumCols * sizeof(SQLINTEGER));

				OffsetArray = (SQLINTEGER *)
malloc(NumCols * sizeof(SQLINTEGER));
				OffsetArray[0] = 0;

				for (i = 0; i < NumCols &&
!m_bAbort; i++)
				{
#ifdef _DEBUG

		_CrtDbgReport(_CRT_WARN, NULL, 0, NULL,
"Executing SQLDescribeCol.\n");
#endif

						// Get the column
description, include the SQL type
						// Determine the column's
byte length. Calculate the offset in the buffer to the
						// data as the offset to the
previous column, plus the byte length of the previous
						// column, plus the byte
length of the previous column's length/indicator buffer.
						// Note that the byte length
of the column and the length/indicator buffer are increased
						// so that, assuming they
start on an alignment boundary, they will end on the byte
						// before the next alignment
boundary. Although this might leave some holes in the
						// buffer, it is a relatively
inexpensive way to guarantee alignment.
						rc =
SQLDescribeCol(m_hHandle, ((SQLUSMALLINT) i)+1,
							(unsigned char
*)szColName, sizeof(szColName), &iColNameLen,
							&SQLType,
(unsigned long *)&ColLenArray[i], &CScaleArray[i], &iColNull);
						HandleODBCError(rc,
SQL_HANDLE_STMT, m_hHandle, SMSQLDescribeCol);

#ifdef _DEBUG

		_CrtDbgReport(_CRT_WARN, NULL, 0, NULL,
"Executing SQLColAttribute.\n");
#endif

						if (m_bAbort)
							return;

						rc =
SQLColAttribute(m_hHandle, ((SQLUSMALLINT) i)+1,
SQL_DESC_DISPLAY_SIZE, NULL, 0, NULL, &iDispLen);
						HandleODBCError(rc,
SQL_HANDLE_STMT, m_hHandle, SMSQLColAttribute);

						// GetDefaultCType
contains a switch statement that returns the default C type
						// for each SQL type.
						CTypeArray[i] =
GetDefaultCType(SQLType);
						if ( (CTypeArray[i] ==
SQL_C_CHAR || CTypeArray[i] == SQL_C_BINARY) &&
ColLenArray[i] > MAX_DATA_LEN)
						{
							ColLenArray[i]
= MAX_DATA_LEN;
							iDispLen =
MAX_DATA_LEN;
						}

						DispLenArray[i] =
max(iColNameLen, iDispLen);
						DispLenArray[i] =
max(DispLenArray[i], sizeof(S_NULL));

						// Print the column names
in the header
						PrintData(szColName,
SQL_C_CHAR, DispLenArray[i], 0, m_pOutputFile);

						// Add a byte for the null-
termination character
						ColLenArray[i] += 1;
```

```
                                        ColLenArray[i] =
ALIGNBUF(ColLenArray[i]);

                                        // Calculate the offset in the
buffer to the data as the offset to the previous column,
                                        // plus the byte length of
the previous column, plus the byte length of the previous
                                        // column's length/indicator
buffer.
                                        if (i)
                                                OffsetArray[i] =
OffsetArray[i-1] + ColLenArray[i-1] + iLenOrInd;
                                }
                                m_pOutputFile->WriteLine(NULL);

                                iArrayElementSize =
OffsetArray[NumCols-1] + ColLenArray[NumCols-1] + iLenOrInd;
                                iRowArraySize = 1;
                                // Allocate the data buffer. The size of
the buffer is equal to the offset to the data
                                // buffer for the final column, plus the
byte length of the data buffer and length/indicator
                                // buffer for the last column.
                                DataPtr = malloc(iRowArraySize *
iArrayElementSize);

                                // Specify the size of the structure with
the SQL_ATTR_ROW_BIND_TYPE
                                // statement attribute. This also
declares that row-wise binding will
                                // be used. Declare the rowset size
with the SQL_ATTR_ROW_ARRAY_SIZE
                                // statement attribute. Set the
SQL_ATTR_ROW_STATUS_PTR statement
                                // attribute to point to the row status
array. Set the
                                //
SQL_ATTR_ROWS_FETCHED_PTR statement attribute to point to
                                // NumRowsFetched.
                                /*
                                RowStatusArray =
(SQLUSMALLINT *)malloc(iRowArraySize *
sizeof(SQLUSMALLINT));

                                SQLSetStmtAttr(m_hHandle,
SQL_ATTR_ROW_BIND_TYPE, &iArrayElementSize,
SQL_IS_UINTEGER);
                                SQLSetStmtAttr(m_hHandle,
SQL_ATTR_ROW_ARRAY_SIZE, &iRowArraySize,
SQL_IS_UINTEGER);
                                SQLSetStmtAttr(m_hHandle,
SQL_ATTR_ROW_STATUS_PTR, RowStatusArray,
SQL_IS_POINTER);
                                SQLSetStmtAttr(m_hHandle,
SQL_ATTR_ROWS_FETCHED_PTR, &NumRowsFetched,
SQL_IS_POINTER);
                                */

                                // For each column, bind the address in
the buffer at the start of the memory allocated
                                // for that column's data and the
address at the start of the memory allocated for that
                                // column's length/indicator buffer.
                                for (i = 0; i < NumCols; i++)
                                {
                                        SQLBindCol(m_hHandle, i
+ 1, CTypeArray[i], (SQLPOINTER)((SQLCHAR *)DataPtr +
OffsetArray[i]),
        ColLenArray[i], (SQLINTEGER *)((SQLCHAR *)DataPtr
+ OffsetArray[i] + ColLenArray[i]));
                                        HandleODBCError(rc,
SQL_HANDLE_STMT, m_hHandle, SMSQLBindCol);

                                        // Underline each column
name
                                        memset(szColName, '-',
DispLenArray[i]);
                                        *(szColName +
DispLenArray[i]) = '\0';
                                        PrintData(szColName,
SQL_C_CHAR, DispLenArray[i], 0, m_pOutputFile);
                                }
                                m_pOutputFile->WriteLine(NULL);

#ifdef _DEBUG
                                _CrtDbgReport(_CRT_WARN,
NULL, 0, NULL, "Executing SQLFetch.\n");
#endif

                                while (!m_bAbort && (rc =
SQLFetch(m_hHandle)) != SQL_NO_DATA)
                                {
                                        HandleODBCError(rc,
SQL_HANDLE_STMT, m_hHandle, SMSQLFetch);

                                        /*
                                        for (i = 0; i <
NumRowsFetched; i++)
                                        {
                                                if
(RowStatusArray[i] == SQL_ROW_SUCCESS|| RowStatusArray[i] ==
SQL_ROW_SUCCESS_WITH_INFO)
                                                {
                                                */
                                                        for (i
= 0; i < NumCols; i++)
                                                        {

        // Retrieve and print each row. PrintData accepts a pointer to
the data, its C type,

        // and its byte length/indicator.

        if ( *((SQLINTEGER *)((SQLCHAR *)DataPtr +
OffsetArray[i] + ColLenArray[i])) == SQL_NULL_DATA)

                PrintData(S_NULL, SQL_C_CHAR,
DispLenArray[i], 0, m_pOutputFile);

        else

                PrintData((LPVOID)((SQLCHAR *)DataPtr +
OffsetArray[i]), CTypeArray[i],

                                        DispLenArray[i],
CScaleArray[i], m_pOutputFile);
                                                        }

        m_pOutputFile->WriteLine(NULL);
                                                        /*
                                                }
                                        }
                                        */
                                }
                                m_pOutputFile->WriteLine(NULL);

                                /*
```

```
				free(RowStatusArray);
				*/

				free(DataPtr);

				free(CTypeArray);
				free(CScaleArray);
				free(ColLenArray);
				free(DispLenArray);
			}

			// Write io statistics, if applicable
			LogODBCErrors(rc, SQL_HANDLE_STMT,
m_hHandle, SMSQLFetch);

#ifdef _DEBUG
			_CrtDbgReport(_CRT_WARN, NULL, 0,
NULL, "Executing SQLRowCount.\n");
#endif

			if (m_bAbort)
				break;

			// action (insert, update, delete) query
			rc = SQLRowCount(m_hHandle, &iRowCount);
			HandleODBCError(rc, SQL_HANDLE_STMT,
m_hHandle, SMSQLRowCount);

			if (!m_bNoCount && iRowCount != -1)
			{
				sprintf(szColName, "(%d row(s)
affected)", iRowCount);
				_bstr_t temp(szColName);
				m_pOutputFile-
>WriteLine((BSTR)temp);
				m_pOutputFile->WriteLine(NULL);
			}

#ifdef _DEBUG
			_CrtDbgReport(_CRT_WARN, NULL, 0,
NULL, "Executing SQLFreeStmt.\n");
#endif

			if (m_bAbort)
				break;

			SQLFreeStmt(m_hHandle, SQL_UNBIND);

#ifdef _DEBUG
			_CrtDbgReport(_CRT_WARN, NULL, 0,
NULL, "Executing SQLMoreResults.\n");
#endif

			if (m_bAbort)
				break;

			// Process the next resultset. This function returns
'success with info' even
			// if there is no other resultset and there are
statistics messages to be printed.
			// Hence the check for -1 rows before printing.
			rc=SQLMoreResults(m_hHandle);
			if (rc != SQL_NO_DATA)
				HandleODBCError(rc,
SQL_HANDLE_STMT, m_hHandle, SMSQLMoreResults);

    } while (rc != SQL_NO_DATA);

	return;
}

void CExecute::PrintData(void *vData, SQLSMALLINT CType,
SQLINTEGER IndPtr, SQLSMALLINT iScale, ISMLog *pOutput)
{
	// PrintData accepts a pointer to the data, its C type,
	// and its byte length/indicator. It contains a switch statement
that casts and prints
	// the data according to its type.

	char			*s;
	char			fmt[MAXBUFLEN];
	int				j = 0;
	SQLINTEGER		iColLen = IndPtr + 1;

	assert(iColLen);
	s = (LPSTR)malloc(iColLen + 1);

	if (s)
	{
		if (vData)
		{
			switch(CType)
			{
			case SQL_C_CHAR:
			case SQL_C_WCHAR:
			case SQL_C_TYPE_DATE:
			case SQL_C_TYPE_TIME:
			case SQL_C_TYPE_TIMESTAMP:
			case SQL_C_INTERVAL_YEAR:
			case SQL_C_INTERVAL_MONTH:
			case
SQL_C_INTERVAL_YEAR_TO_MONTH:
			case SQL_C_INTERVAL_DAY:
			case SQL_C_INTERVAL_HOUR:
			case SQL_C_INTERVAL_MINUTE:
			case SQL_C_INTERVAL_SECOND:
			case
SQL_C_INTERVAL_DAY_TO_HOUR:
			case
SQL_C_INTERVAL_DAY_TO_MINUTE:
			case
SQL_C_INTERVAL_DAY_TO_SECOND:
			case
SQL_C_INTERVAL_HOUR_TO_MINUTE:
			case
SQL_C_INTERVAL_HOUR_TO_SECOND:
			case
SQL_C_INTERVAL_MINUTE_TO_SECOND:
			case SQL_C_BINARY:
				sprintf(fmt, "%%.%ds",
iColLen);
				j = sprintf(s, fmt, (char
*)vData);
				break;

			case SQL_C_SHORT:
				j = sprintf(s, "%d", *(short
*)vData);
				break;

			case SQL_C_LONG:
				j = sprintf(s, "%ld", *(long
*)vData);
				break;

			case SQL_C_UBIGINT:
				j = sprintf(s, "%I64d",
*(__int64 *)vData);
				break;
```


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```
                                        case SQL_C_FLOAT:
//                                              sprintf(fmt, "%%.0%df",
iScale);
                                                j = sprintf(s, "%f", *(float
*)vData);
                                                break;

                                        case SQL_C_DOUBLE:
//                                              sprintf(fmt, "%%.0%df",
iScale);
                                                j = sprintf(s, "%f",
*(double *)vData);
                                                break;

                                        case SQL_C_NUMERIC:
                                                sprintf(fmt, "%%.0%df",
iScale);
                                                j = sprintf(s, fmt, *(double
*)vData);
                                                break;

                                        default:
                                                j = sprintf(s, "%s", vData);
                                                break;
                                        }
                                }

                                // Strip off terminating null character and pad the
string with blanks
                                if (iColLen - j > 0)
                                        memset(s + j, ' ', iColLen - j);

                                *(s + iColLen) = '\0';

                                // Write the field to the output file
                                _bstr_t temp(s);
                                pOutput->WriteField((BSTR)temp);
                                free(s);
                        }

                return;
}

SQLSMALLINT CExecute::GetDefaultCType(SQLINTEGER
SQLType)
{
                // GetDefaultCType returns the C type for the passed in SQL
datatype.

        switch(SQLType)
        {
        case SQL_CHAR:
                case SQL_VARCHAR:
                case SQL_LONGVARCHAR:
                case SQL_WCHAR:
                case SQL_WVARCHAR:
                case SQL_WLONGVARCHAR:
            return(SQL_C_CHAR);

        case SQL_TINYINT:
                                        return(SQL_C_CHAR);

        case SQL_SMALLINT:
                                        return(SQL_C_SHORT);

        case SQL_INTEGER:
                                        return(SQL_C_LONG);

        case SQL_BIGINT:
                                        return(SQL_C_UBIGINT);

        case SQL_REAL:
                                                return(SQL_C_FLOAT);

        case SQL_FLOAT:
        case SQL_DOUBLE:
//              case SQL_DECIMAL:
                                                return(SQL_C_DOUBLE);

                case SQL_DECIMAL:
                                                return(SQL_C_CHAR);

                case SQL_BIT:
                                                return(SQL_C_CHAR);

        case SQL_BINARY:
                case SQL_VARBINARY:
                case SQL_LONGVARBINARY:
                                                return(SQL_C_CHAR);
//                                              return(SQL_C_BINARY);

        case SQL_TYPE_DATE:
                                                return(SQL_C_CHAR);
//                                              return(SQL_C_TYPE_DATE);

        case SQL_TYPE_TIME:
                                                return(SQL_C_CHAR);
//                                              return(SQL_C_TYPE_TIME);

        case SQL_TYPE_TIMESTAMP:
                                                return(SQL_C_CHAR);
//
                return(SQL_C_TYPE_TIMESTAMP);

                case SQL_NUMERIC:
            return(SQL_C_FLOAT);

        case SQL_INTERVAL_YEAR:
                                                return(SQL_C_CHAR);
//                                              return(SQL_C_INTERVAL_YEAR);

        case SQL_INTERVAL_MONTH:
                                                return(SQL_C_CHAR);
//
                return(SQL_C_INTERVAL_MONTH);

        case SQL_INTERVAL_YEAR_TO_MONTH:
                                                return(SQL_C_CHAR);
//
                return(SQL_C_INTERVAL_YEAR_TO_MONTH);

        case SQL_INTERVAL_DAY:
                                                return(SQL_C_CHAR);
//                                              return(SQL_C_INTERVAL_DAY);

        case SQL_INTERVAL_HOUR:
                                                return(SQL_C_CHAR);
//                                              return(SQL_C_INTERVAL_HOUR);

        case SQL_INTERVAL_MINUTE:
                                                return(SQL_C_CHAR);
//
                return(SQL_C_INTERVAL_MINUTE);

        case SQL_INTERVAL_SECOND:
                                                return(SQL_C_CHAR);
//
                return(SQL_C_INTERVAL_SECOND);

        case SQL_INTERVAL_DAY_TO_HOUR:
```


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```
                                return(SQL_C_CHAR);
//
            return(SQL_C_INTERVAL_DAY_TO_HOUR);

   case SQL_INTERVAL_DAY_TO_MINUTE:
                                return(SQL_C_CHAR);
//
            return(SQL_C_INTERVAL_DAY_TO_MINUTE);

   case SQL_INTERVAL_DAY_TO_SECOND:
                                return(SQL_C_CHAR);
//
            return(SQL_C_INTERVAL_DAY_TO_SECOND);

   case SQL_INTERVAL_HOUR_TO_MINUTE:
                                return(SQL_C_CHAR);
//
            return(SQL_C_INTERVAL_HOUR_TO_MINUTE);

   case SQL_INTERVAL_HOUR_TO_SECOND:
                                return(SQL_C_CHAR);
//
            return(SQL_C_INTERVAL_HOUR_TO_SECOND);

   case SQL_INTERVAL_MINUTE_TO_SECOND:
                                return(SQL_C_CHAR);
//
            return(SQL_C_INTERVAL_MINUTE_TO_SECOND);

            default:
                        assert(TRUE);
                        return(SQL_C_CHAR);
                        break;
   }
}

/*
   FUNCTION: LogODBCErrors(SQLRETURN rc, SWORD
fHandleType, SQLHANDLE handle)
   COMMENTS: Formats ODBC errors or warnings and logs them.
Also initializes the
                                 completion status for the step to
failure, if an ODBC error has occurred.
*/

void CExecute::LogODBCErrors(SQLRETURN nResult, SWORD
fHandleType, SQLHANDLE handle, OdbcOperations FailedOp)
{
            // Messages returned by the server (e.g. Print statements) will
be logged to the output file
            // ODBC warnings will be logged to the log file
            // All other ODBC errors will be logged to the error file.

            UCHAR
            szErrState[SQL_SQLSTATE_SIZE+1];                    //
SQL Error State string
            UCHAR
            szErrText[SQL_MAX_MESSAGE_LENGTH+1];    // SQL
Error Text string
            char
            szBuffer[SQL_SQLSTATE_SIZE+SQL_MAX_MESSAGE
_LENGTH+MAXBUFLEN+1] = "";


                        // formatted Error text Buffer
            SWORD               wErrMsgLen;
                                                                        //
Error message length
            SQLINTEGER          dwErrCode;
                                                                        //
Native Error code
            SQLRETURN           nErrResult;
                                                                        //
Return Code from SQLGetDiagRec
            SWORD               sMsgNum = 1;
                                                        // Error
sequence number
            _bstr_t             temp;

            if (IsErrorReturn(nResult))
            {
                        sprintf(szBuffer, "ODBC Operation: '%s' returned
error code: %d",
                                    g_szOdbcOps[FailedOp], nResult);
                        temp = szBuffer;
                        m_pErrorFile->WriteLine((BSTR) temp);
                        m_StepStatus = gintFailed;
            }

            if (handle == SQL_NULL_HSTMT)
                        return;

#ifdef _DEBUG
            _CrtDbgReport(_CRT_WARN, NULL, 0, NULL,
"Executing SQLGetDiagRec.\n");
#endif

            // call SQLGetDiagRec function with proper ODBC handles,
repeatedly until
            // function returns SQL_NO_DATA.
            while (!m_bAbort && (nErrResult =
SQLGetDiagRec(fHandleType, handle, sMsgNum++,
                        szErrState, &dwErrCode, szErrText,
SQL_MAX_MESSAGE_LENGTH-1, &wErrMsgLen))
                        != SQL_NO_DATA)
            {
                        if (!SQL_SUCCEEDED(nErrResult))
                                    break;

                        if (m_pOutputFile &&
IsServerMessage(dwErrCode, szErrText))
                        {
                                    wsprintf(szBuffer,
SM_SQLMSG_FORMAT, (LPSTR)szErrText);
                                    temp = szBuffer;
                                    m_pOutputFile->WriteLine((BSTR)
temp);
                        }
                        else if (IsODBCWarning(szErrState) &&
dwErrCode != SM_SQL_ERR_CHANGED_DB && dwErrCode !=
SM_SQL_ERR_CHANGED_LANG)
                        {
                                    // Suppress warnings - 'Changed
database context to...' and 'Changed language setting to...'
                                    wsprintf(szBuffer,
SM_SQLMSG_FORMAT,
ParseOdbcMsgPrefixes((LPCSTR)szErrText));
                                    temp = szBuffer;
                                    m_pOutputFile->WriteLine((BSTR)
temp);
                        }
                        else if (m_pErrorFile &&
!IsODBCWarning(szErrState))
                        {
                                    wsprintf(szBuffer,
SM_SQLERR_FORMAT, (LPSTR)szErrState, dwErrCode,
(LPSTR)szErrText);
                                    temp = szBuffer;
```

```
                                m_pErrorFile->WriteLine((BSTR)
temp);
                        }
                }
}

/*
   FUNCTION: LogErrors(SQLRETURN rc, SWORD fHandleType,
SQLHANDLE handle)
   COMMENTS: Writes the error message to the error log
*/

void CExecError::LogErrors(CExecute *p)
{
                _bstr_t temp(m_szExecErrorDesc[m_iErrCode]);

                if (p->m_pErrorFile)
                        p->m_pErrorFile->WriteLine((BSTR)temp);

                return;
}

/*
   FUNCTION: ODBCCleanup(HDBC *hdbc, HSTMT *hstmt)
   COMMENTS: Cleanup of all ODBC structures
*/

void CExecute::ODBCCleanup(HDBC *hdbc, HSTMT *hstmt)
{
                SQLRETURN           lReturn;

#ifdef _DEBUG
                _CrtDbgReport(_CRT_WARN, NULL, 0, NULL,
"Executing ODBCCleanup.\n");
#endif

                if (*hstmt != SQL_NULL_HSTMT)
                {
#ifdef _DEBUG
                        _CrtDbgReport(_CRT_WARN, NULL, 0,
NULL, "Executing SQLCloseCursor.\n");
#endif
                        SQLCloseCursor(hstmt);
#ifdef _DEBUG
                        _CrtDbgReport(_CRT_WARN, NULL, 0,
NULL, "Executing SQLFreeHandle for hstmt.\n");
#endif
                        SQLFreeHandle(SQL_HANDLE_STMT, hstmt);
                        *hstmt = SQL_NULL_HSTMT;
                }

                // Cleanup connection if it is a dynamic connection
                if (IsDynamicConnection())
                {
                        if (*hdbc != SQL_NULL_HDBC)
                        {
#ifdef _DEBUG
                                _CrtDbgReport(_CRT_WARN,
NULL, 0, NULL, "Executing SQLDisconnect.\n");
#endif
                                lReturn = SQLDisconnect(*hdbc);
#ifdef _DEBUG
                                _CrtDbgReport(_CRT_WARN,
NULL, 0, NULL, "Executing SQLFreeHandle for hdbc.\n");
#endif

                SQLFreeHandle(SQL_HANDLE_DBC, hdbc);
                                *hdbc = SQL_NULL_HDBC;
                        }
                }
                else
                        ResetConnectionUsage();

                return;
}

// Wrapper function that raises an error if a Windows Api fails
STDMETHODIMP CExecute::RaiseSystemError(void)
{
                char s[MAXBUFLEN];

                GetSystemError(s);
                return Error(s, 0, NULL, GUID_NULL);
}

// Wrapper function that logs the error raised by an Api function to the
passed in file
void CExecute::LogSystemError(ISMLog *pFile)
{
                if (pFile)
                {
                        char s[MAXBUFLEN];
                        GetSystemError(s);

                        _bstr_t temp(s);
                        pFile->WriteLine((BSTR)temp);
                }
}

// Populates the passed in string with the last Windows Api error that
occurred
void CExecute::GetSystemError(LPSTR s)
{
                long c;
                DWORD e;

                e = GetLastError();

                c = sprintf(s, "Error code: %ld. ", e);
                c =
FormatMessage(FORMAT_MESSAGE_FROM_SYSTEM |
FORMAT_MESSAGE_IGNORE_INSERTS,
                        NULL, e, 0, s + c, MAXBUFLEN - c, NULL);

                return;
}

STDMETHODIMP CExecute::get_StepStatus(InstanceStatus *pVal)
{
                *pVal = m_StepStatus;
                return S_OK;
}

STDMETHODIMP CExecute::WriteError(BSTR szMsg)
{
                if (m_pErrorFile)
                        return(m_pErrorFile->WriteLine(szMsg));

                return S_OK;
}
```

Execute.h

```
//  FILE:       Execute.h
//              Microsoft TPC-H Kit Ver. 1.00
//              Copyright Microsoft, 1999
//              All Rights Reserved
//
//
//  PURPOSE:    Declaration of the CExecute
```

```
//  Contact:    Reshma Tharamal (reshmat@microsoft.com)
//
// Execute.h : Declaration of the CExecute

#ifndef __EXECUTE_H_
#define __EXECUTE_H_

#include <atlwin.h>
#include <comdef.h>
#include <stdio.h>
#include "resource.h"       // main symbols
#include "ExecuteDllCP.h"
#include "..\LogWriter\LogWriter.h"
#include "..\LogWriter\SMLog.h"
#include "..\common\SMTime\SMTime.h"
#include "..\common\SMTime\SMTimer.h"

// ODBC-specific includes
#define DBNTWIN32
#include <sqltypes.h>
#include <sql.h>
#include <sqlext.h>

/////////////////////////////////////////////////////////////////////////////
// CExecute

#define WM_TASK_START  (WM_USER + 101)
#define WM_TASK_FINISH  (WM_USER + 102)

#define SM_SQLERR_FORMAT                        "SQL Error
State:%s, Native Error Code: %ld\r\nODBC Error: %s"


            // format for ODBC error messages
#define SM_SQLWARN_FORMAT
            SM_SQLERR_FORMAT            // format for ODBC
warnings
#define SM_SQLMSG_FORMAT                        "%s"
                                    // format for messages from the server

#define SM_SQL_STATE_WARNING        "01000"
#define SM_MSG_SERVER
            "[Microsoft][ODBC SQL Server Driver][SQL Server]"

#define SM_SQL_ERR_CHANGED_DB    5701
#define SM_SQL_ERR_CHANGED_LANG                 5703

#define SM_STEPMASTER_ERROR                     "StepMaster
Error: "

#define CMD_SEPARATOR                           "\nGO"

#define INV_ARRAY_INDEX     -1                          //
invalid index into an array

#define MAXBUFLEN           256         // display buffer size
#define MAXLOGCMDLEN        256         // maximum characters in
command that will be

                                        // printed to log
#define MAXLOGCMDBUF        512         // maximum characters in
command that will be

                                        // printed to log
#define MAX_DATA_LEN        4000        // maximum buffer size for
variable-length data types

                                        // viz. character and binary
fields

#define FILE_ACCESS_READ    "r"                         //
Open file for read access

#define S_NULL        "NULL"

// Define a macro to increase the size of a buffer so it is a multiple of teh
alignment size.
// Thus, if a buffer starts on an alignment boundary, it will end just
before the next
// alignment boundary. Here, an alignment size of 4 is used because this
is the size of the
// largest data type used in the application's buffer - the size of an
SDWORD and of the largest
// default C data type are both 4. If a larger data type (such as __int64) is
used, it will be
// necessary to align for that size.
#define ALIGNSIZE 4
#define ALIGNBUF(Length) ((Length) % ALIGNSIZE) ? \
   ((Length) + ALIGNSIZE - ((Length) % ALIGNSIZE)) : (Length)

#define MAX_BUFFER_SIZE                 64000

typedef enum OdbcOperations
{
            SMSQLAllocHandle,
            SMSQLDriverConnect,
            SMSQLExecDirect,
            SMSQLSetStmtAttr,
            SMSQLCancel,
            SMSQLNumResultCols,
            SMSQLDescribeCol,
            SMSQLColAttribute,
            SMSQLFetch,
            SMSQLGetData,
            SMSQLRowCount,
            SMSQLMoreResults,
            SMSQLBindCol,
};

class CODBCError
{
public:
            CODBCError(SQLRETURN nResult, SWORD
fHandleType, SQLHANDLE      handle, OdbcOperations FailedOp)
            {
                        m_fHandleType       = fHandleType;
                        m_handle            = handle;
                        m_FailedOp                  = FailedOp;
                        m_nResult           = nResult;
            };

private:
            SWORD                       m_fHandleType;
            SQLHANDLE                   m_handle;
            OdbcOperations      m_FailedOp;
            SQLRETURN                   m_nResult;

private:
inline BOOL IsServerMessage(SQLINTEGER lNativeError, UCHAR
*szErr){
            return( (strstr((LPCTSTR)szErr, SM_MSG_SERVER) !=
NULL) ? (lNativeError == 0) : FALSE); }
inline BOOL IsODBCWarning(UCHAR *szSqlState){
            return(strcmp((LPCSTR)szSqlState,
SM_SQL_STATE_WARNING) == 0);}
inline LPCSTR ParseOdbcMsgPrefixes(LPCSTR szMsg){ char *pDest;
            return( (pDest = strstr(szMsg, SM_MSG_SERVER)) ==
NULL ? szMsg : pDest + strlen(SM_MSG_SERVER));}
};
```

```
class ATL_NO_VTABLE CExecute :
	public CWindowImpl<CExecute>,
	public CComObjectRootEx<CComSingleThreadModel>,
	public CComCoClass<CExecute, &CLSID_Execute>,
	public IConnectionPointContainerImpl<CExecute>,
	public ISupportErrorInfo,
	public IDispatchImpl<IExecute, &IID_IExecute,
&LIBID_EXECUTEDLLLib>,
	public CProxy_IExecuteEvents< CExecute >
{
public:
	CExecute()
	{
		m_pErrorFile = NULL;
		//m_pLogFile = NULL;
		m_pOutputFile = NULL;

		// Initialize the elapsed time for the step
		m_tElapsedTime = 0;

		// Initialize the run status for the step
		m_StepStatus = gintPending;

		m_hHandle = SQL_NULL_HSTMT;
		m_bAbort = FALSE;

		m_iConnectionIndex = INV_ARRAY_INDEX;
	}

	~CExecute()
	{
	}

	friend class CExecError;

public:
	DECLARE_WND_CLASS("Execute")

		BEGIN_MSG_MAP(CExecute)
		MESSAGE_HANDLER(WM_TASK_FINISH,
OnTaskFinished)
		MESSAGE_HANDLER(WM_TASK_START,
OnTaskStarted)
		END_MSG_MAP()
public:

	LRESULT OnTaskStarted(UINT uMsg, WPARAM
wParam,
		LPARAM lParam, BOOL& bHandled)
	{
		CURRENCY		CStartTime =
Get64BitTime(&m_tStartTime);

		Fire_Start(CStartTime);
		return 0;
	}

	LRESULT OnTaskFinished(UINT uMsg, WPARAM
wParam,
		LPARAM lParam, BOOL& bHandled)
	{
		CURRENCY		CEndTime =
Get64BitTime(&m_tEndTime);

		Fire_Complete(CEndTime,
(long)m_tElapsedTime);
		return 0;
	}

	HRESULT FinalConstruct()
	{
		HRESULT			hr;
		RECT		rect;

		rect.left=0;
		rect.right=100;
		rect.top=0;
		rect.bottom=100;

		HWND hwnd = Create( NULL, rect,
"ExecuteWindow", WS_POPUP);

		if (!hwnd)
			return
HRESULT_FROM_WIN32(GetLastError());

		hr = CoCreateInstance(CLSID_SMLog, NULL,
CLSCTX_INPROC,
			IID_ISMLog, (void
**)&m_pErrorFile);
		if FAILED(hr)
			return(hr);
		m_pErrorFile->put_Append(TRUE);

		//hr = CoCreateInstance(CLSID_SMLog, NULL,
CLSCTX_INPROC,
		//		IID_ISMLog, (void
**)&m_pLogFile);
		//if FAILED(hr)
		//		return(hr);

		hr = CoCreateInstance(CLSID_SMLog, NULL,
CLSCTX_INPROC,
			IID_ISMLog, (void
**)&m_pOutputFile);
		if FAILED(hr)
			return(hr);
		m_pOutputFile->put_Append(TRUE);

		hr = CoCreateInstance(CLSID_SMTimer, NULL,
CLSCTX_INPROC,
			IID_ISMTimer, (void
**)&m_ExecTime);
		if FAILED(hr)
			return(hr);

		return S_OK;
	}

	void FinalRelease()
	{
		if (m_hWnd != NULL)
			DestroyWindow();

		// Close the log and error files
		if (m_pErrorFile)
			m_pErrorFile->Release();
		m_pErrorFile = NULL;

		//if (m_pLogFile)
		//		m_pLogFile->Release();
		//m_pLogFile = NULL;

		if (m_ExecTime)
			m_ExecTime->Release();
		m_ExecTime = NULL;
	}

DECLARE_REGISTRY_RESOURCEID(IDR_EXECUTE)
```

```
DECLARE_PROTECT_FINAL_CONSTRUCT()

BEGIN_COM_MAP(CExecute)
	COM_INTERFACE_ENTRY(IExecute)
	COM_INTERFACE_ENTRY(ISupportErrorInfo)
	COM_INTERFACE_ENTRY(IDispatch)
	COM_INTERFACE_ENTRY(IConnectionPointContainer)
	COM_INTERFACE_ENTRY_IMPL(IConnectionPointCont
ainer)
END_COM_MAP()
BEGIN_CONNECTION_POINT_MAP(CExecute)
CONNECTION_POINT_ENTRY(DIID__IExecuteEvents)
END_CONNECTION_POINT_MAP()

// ISupportsErrorInfo
STDMETHOD(InterfaceSupportsErrorInfo)(REFIID riid);

// IExecute
public:
	STDMETHOD(put_ErrorFile)(/*[in]*/ BSTR newVal);
	STDMETHOD(put_OutputFile)(/*[in]*/ BSTR newVal);
	STDMETHOD(WriteError)(BSTR szMsg);
	STDMETHOD(Abort)();
	STDMETHOD(get_StepStatus)(/*[out, retval]*/
InstanceStatus *pVal);
	STDMETHOD(DoExecute)(/*[in]*/ BSTR szCommand,
/*[in]*/ BSTR szExecutionDtls, /*[in]*/ ExecutionType ExecMethod,
		/*[in]*/ BOOL bNoCount, /*[in]*/ BOOL
bNoExecute, /*[in]*/ BOOL bParseOnly,
		/*[in]*/ BOOL bQuotedIds, /*[in]*/ BOOL
bAnsiNulls, /*[in]*/ BOOL bShowQP,
		/*[in]*/ BOOL bStatsTime, /*[in]*/ BOOL
bStatsIO, /*[in]*/ long lRowCount,
		/*[in]*/ long lQueryTmout, /*[in]*/ BSTR
szConnection);

	TC_TIME			ExecuteShell();
	TC_TIME			ExecuteODBC();
	STDMETHODIMP	AbortShell();
	STDMETHODIMP	AbortODBC();

	_bstr_t			m_szCommand;
	_bstr_t			m_szExecDtls;
	_bstr_t			m_szConnection;
	DWORD			m_lMode;
	//DATE			m_CurTime;
	SYSTEMTIME		m_tStartTime;
	SYSTEMTIME		m_tEndTime;
	TC_TIME			m_tElapsedTime;
	ISMLog			*m_pErrorFile;
	//ILog			*m_pLogFile;
	ISMLog			*m_pOutputFile;
	ISMTimer		*m_ExecTime;
	ExecutionType		m_ExecMthd;
	InstanceStatus		m_StepStatus;
	HANDLE			m_hHandle;
	// Process handle for shell commands and

				// Statement handle for ODBC
commands
	LPSTR			m_szCmd;

private:
	LPSTR			NextCmdInBatch(LPSTR
szBatch);
	void			ProcessResultsets();
	SQLSMALLINT
	GetDefaultCType(SQLINTEGER SQLType);
	void			PrintData(void *vData,
SQLSMALLINT CType, SQLINTEGER IndPtr, SQLSMALLINT
iScale, ISMLog *pOutput);
	void
	LogODBCErrors(SQLRETURN nResult, SWORD
fHandleType, SQLHANDLE handle, OdbcOperations FailedOp);
	void			ODBCCleanup(HDBC
*hdbc, HSTMT *hstmt);
	STDMETHODIMP	RaiseSystemError(void);
	void			LogSystemError(ISMLog
*pFile);
	void			GetSystemError(LPSTR s);
	void
	SetConnectionOption(LPSTR szConn, HDBC *pHdbc);
	void
	ResetConnectionProperties(HDBC *p_hdbc);

	void
	InitializeConnection(HDBC *phdbc, BOOL
*pbDoConnect);
	void
	ReConnectDeadConnection(HDBC *phdbc);

	void			ResetConnectionUsage();

	int
	m_iConnectionIndex;

	BOOL			m_bNoCount,
m_bNoExecute, m_bParseOnly, m_bQuotedIds, m_bAnsiNulls, \
								m_bShowQP,
m_bStatsTime, m_bStatsIO;
	long			m_lRowCount;
	SQLUINTEGER		m_lQueryTmout;
	_bstr_t			m_ErrorFile,
m_OutputFile;
	BOOL			m_bAbort;

private:
inline BOOL IsServerMessage(SQLINTEGER lNativeError, UCHAR
*szErr){
	return( (strstr((LPCTSTR)szErr, SM_MSG_SERVER) !=
NULL) ? (lNativeError == 0) : FALSE); }
inline BOOL IsODBCWarning(UCHAR *szSqlState){
	return(strcmp((LPCSTR)szSqlState,
SM_SQL_STATE_WARNING) == 0);}
inline BOOL IsErrorReturn(SQLRETURN iRetCode){
	return( (!SQL_SUCCEEDED(iRetCode)) && (iRetCode !=
SQL_NO_DATA) );}
inline LPCSTR ParseOdbcMsgPrefixes(LPCSTR szMsg){ char *pDest;
	return( (pDest = strstr(szMsg, SM_MSG_SERVER)) ==
NULL ? szMsg : pDest + strlen(SM_MSG_SERVER));}
inline BOOL IsDynamicConnection(){
return(!strcmp((LPSTR)m_szConnection, ""));}
inline void HandleODBCError(SQLRETURN rc, SWORD
fHandleType, SQLHANDLE handle, OdbcOperations OdbcOp)
{
	if (rc != SQL_SUCCESS)
   {
		LogODBCErrors(rc, fHandleType, handle,
OdbcOp);
		if (IsErrorReturn(rc))
			throw new CODBCError(rc,
fHandleType, handle, OdbcOp);
   }
	return;
}

};
```

```
class CExecError
{
public:
	typedef enum ExecErrorCodes
	{
		SM_ERR_CONN_IN_USE,
	};

	CExecError(int iError)
	{
		m_iErrCode		= iError;
	};

	void				LogErrors(CExecute *p);

private:
	int				m_iErrCode;
	static char		*m_szExecErrorDesc[];
};

void		ExecutionThread(LPVOID
lpParameter);

#ifdef _TPCH_AUDIT
	void
	WriteFileToTpchLog(LPSTR szFile, LPSTR szFmt);
	void		WriteToTpchLog(char
*szMsg);
#endif

#endif //__EXECUTE_H_
```

ExecuteDll.cpp

```
//  FILE:	ExecuteDll.cpp
//		Microsoft TPC-H Kit Ver. 1.00
//		Copyright Microsoft, 1999
//		All Rights Reserved
//
//
//  PURPOSE:	Implementation of DLL Exports.
//  Contact:	Reshma Tharamal (reshmat@microsoft.com)
//


// Note: Proxy/Stub Information
//	To build a separate proxy/stub DLL,
//	run nmake -f ExecuteDllps.mk in the project directory.

#include "stdafx.h"
#include "resource.h"
#include <initguid.h>

#include "..\LogWriter\LogWriter.h"
#include "..\LogWriter\LogWriter_i.c"

#include "..\common\SMTime\SMTime.h"
#include "..\common\SMTime\SMTime_i.c"

#include "ExecuteDll.h"
#include "SMExecute.h"

#include "ExecuteDll_i.c"
#include "Execute.h"

CComModule _Module;

BEGIN_OBJECT_MAP(ObjectMap)
OBJECT_ENTRY(CLSID_Execute, CExecute)
END_OBJECT_MAP()

SQLHENV henv = NULL;
		// ODBC
environment handle

static char szCaption[] = "StepMaster";
		// Message box caption

CRITICAL_SECTION hConnections;
		// Critical section to
serialize access to available connections
SM_Connection_Info *p_Connections = NULL;
		// Pointer to open connections
int
	iConnectionCount = 0;
	// Number of open connections

#ifdef _TPCH_AUDIT
	FILE *pfLogFile = NULL;
		// Log file
containing timestamps
	CRITICAL_SECTION hLogFileWrite;
		// Critical section to
serialize writes to log

	static char szFileOpenModeAppend[] = "a+";
		// Log file open mode

	static char szEnvVarLogFile[] = "TPCH_LOG_FILE";  //
Environment variable - initialized to


		// log file name if timing information


		// is to be logged
#endif

void ShowODBCErrors(SWORD fHandleType, SQLHANDLE handle);
void CloseOpenConnections();

//////////////////////////////////////////////////////////////////////////////
// DLL Entry Point

extern "C"
BOOL WINAPI DllMain(HINSTANCE hInstance, DWORD
dwReason, LPVOID /*lpReserved*/)
{

   if (dwReason == DLL_PROCESS_ATTACH)
   {
      _Module.Init(ObjectMap, hInstance,
&LIBID_EXECUTEDLLLib);
      DisableThreadLibraryCalls(hInstance);

#ifdef _TPCH_AUDIT
		char szMsg[MAXBUFLEN];
		LPSTR szLogFileName =
getenv(szEnvVarLogFile);

		if (szLogFileName == NULL)
		{
			sprintf(szMsg, "The environment
variable '%s' does not exist. "
			"Step timing information
will not be written to a log.", szEnvVarLogFile);
			MessageBox(NULL, szMsg,
szCaption, MB_OK);
		}
		else
```

```
		{
			if ( (pfLogFile =
fopen(szLogFileName, szFileOpenModeAppend)) == NULL )
			{
				sprintf(szMsg, "The file
'%s' does not exist. "
					"Step timing
information will not be written to log.", szLogFileName);
				MessageBox(NULL,
szMsg, szCaption, MB_OK);
			}
			else

	InitializeCriticalSection(&hLogFileWrite);
		}
#endif

		InitializeCriticalSection(&hConnections);

		p_Connections = NULL;
		iConnectionCount = 0;

		if (!SQL_SUCCEEDED(SQLSetEnvAttr(NULL,
SQL_ATTR_CONNECTION_POOLING,
(SQLPOINTER)SQL_CP_ONE_PER_HENV , 0)))

	ShowODBCErrors(SQL_HANDLE_ENV, henv);

		if
(!SQL_SUCCEEDED(SQLAllocHandle(SQL_HANDLE_ENV,
SQL_NULL_HANDLE, &henv)))
		{

	ShowODBCErrors(SQL_HANDLE_ENV, henv);
			return FALSE;
		}

		if (!SQL_SUCCEEDED(SQLSetEnvAttr(henv,
SQL_ATTR_ODBC_VERSION, (LPVOID)SQL_OV_ODBC3, 0)))

	ShowODBCErrors(SQL_HANDLE_ENV, henv);

		SQLUINTEGER CpMatch;
		if (!SQL_SUCCEEDED(SQLGetEnvAttr(henv,
SQL_ATTR_CP_MATCH, &CpMatch, 0, NULL)))

	ShowODBCErrors(SQL_HANDLE_ENV, henv);

		if (!SQL_SUCCEEDED(SQLSetEnvAttr(henv,
SQL_ATTR_CP_MATCH,
(SQLPOINTER)SQL_CP_STRICT_MATCH, SQL_IS_INTEGER)))

	ShowODBCErrors(SQL_HANDLE_ENV, henv);

  }
  else if (dwReason == DLL_PROCESS_DETACH)
	{

#ifdef _TPCH_AUDIT
		if (pfLogFile != NULL)
		{
			fclose(pfLogFile);


	DeleteCriticalSection(&hLogFileWrite);
		}
#endif

		CloseOpenConnections();

		if (henv != NULL)
			SQLFreeEnv(henv);

		DeleteCriticalSection(&hConnections);

	_Module.Term();
	}
  return TRUE;	// ok
}

void ShowODBCErrors(SWORD fHandleType, SQLHANDLE handle)
{
	UCHAR
	szErrState[SQL_SQLSTATE_SIZE+1];		//
SQL Error State string
	UCHAR
	szErrText[SQL_MAX_MESSAGE_LENGTH+1];	// SQL
Error Text string
	char
	szBuffer[SQL_SQLSTATE_SIZE+SQL_MAX_MESSAGE
_LENGTH+MAXBUFLEN+1] = "";


		// formatted Error text Buffer
	SWORD		wErrMsgLen;
								//
Error message length
	SQLINTEGER	dwErrCode;
								//
Native Error code
	SQLRETURN	nErrResult;
								//
Return Code from SQLGetDiagRec
	SWORD		sMsgNum = 1;
						// Error
sequence number

	// call SQLGetDiagRec function with proper ODBC handles,
repeatedly until
	// function returns SQL_NO_DATA.
	while ((nErrResult = SQLGetDiagRec(fHandleType, handle,
sMsgNum++,
		szErrState, &dwErrCode, szErrText,
SQL_MAX_MESSAGE_LENGTH-1, &wErrMsgLen))
		!= SQL_NO_DATA)
	{
		if (!SQL_SUCCEEDED(nErrResult))
			break;

		wsprintf(szBuffer, SM_SQLERR_FORMAT,
(LPSTR)szErrState, dwErrCode, (LPSTR)szErrText);

		MessageBox(NULL, szBuffer, szCaption,
MB_OK);
	}
}

void CloseOpenConnections()
{
	// Closes all open connections

	if (p_Connections)
	{
		for (int iConnIndex = iConnectionCount - 1;
iConnIndex >= 0; iConnIndex--)
		{
			if ((p_Connections + iConnIndex)-
>hdbc != SQL_NULL_HDBC)
			{
#ifdef _DEBUG
```

```
		_CrtDbgReport(_CRT_WARN, NULL, 0, NULL,
"Executing SQLDisconnect.\n");
#endif

		SQLDisconnect((p_Connections + iConnIndex)->hdbc);
#ifdef _DEBUG

		_CrtDbgReport(_CRT_WARN, NULL, 0, NULL,
"Executing SQLFreeHandle for hdbc.\n");
#endif

		SQLFreeHandle(SQL_HANDLE_DBC, (p_Connections +
iConnIndex)->hdbc );
						(p_Connections +
iConnIndex)->hdbc = SQL_NULL_HDBC;
					}

				}

				free(p_Connections);
		}
		p_Connections = NULL;

		return;
}

/////////////////////////////////////////////////////////////////////////////
// Used to determine whether the DLL can be unloaded by OLE

STDAPI DllCanUnloadNow(void)
{
	return (_Module.GetLockCount()==0) ? S_OK : S_FALSE;
}

/////////////////////////////////////////////////////////////////////////////
// Returns a class factory to create an object of the requested type

STDAPI DllGetClassObject(REFCLSID rclsid, REFIID riid, LPVOID*
ppv)
{
	return _Module.GetClassObject(rclsid, riid, ppv);
}

/////////////////////////////////////////////////////////////////////////////
// DllRegisterServer - Adds entries to the system registry

STDAPI DllRegisterServer(void)
{
	// registers object, typelib and all interfaces in typelib
	return _Module.RegisterServer(TRUE);
}

/////////////////////////////////////////////////////////////////////////////
// DllUnregisterServer - Removes entries from the system registry

STDAPI DllUnregisterServer(void)
{
	return _Module.UnregisterServer(TRUE);
}
```

ExecuteDll.h

```
/* this ALWAYS GENERATED file contains the definitions for the
interfaces */


/* File created by MIDL compiler version 5.01.0164 */
/* at Mon Jun 09 19:33:03 2003
 */
/* Compiler settings for
C:\charles\Stepmaster\ExecuteDll\ExecuteDll.idl:
	Oicf (OptLev=i2), W1, Zp8, env=Win32, ms_ext, c_ext
	error checks: allocation ref bounds_check enum stub_data
*/
//@@MIDL_FILE_HEADING(  )


/* verify that the <rpcndr.h> version is high enough to compile this
file*/
#ifndef __REQUIRED_RPCNDR_H_VERSION__
#define __REQUIRED_RPCNDR_H_VERSION__ 440
#endif

#include "rpc.h"
#include "rpcndr.h"

#ifndef __ExecuteDll_h__
#define __ExecuteDll_h__

#ifdef __cplusplus
extern "C"{
#endif

/* Forward Declarations */

#ifndef ___IExecuteEvents_FWD_DEFINED__
#define ___IExecuteEvents_FWD_DEFINED__
typedef interface _IExecuteEvents _IExecuteEvents;
#endif	/* ___IExecuteEvents_FWD_DEFINED__ */


#ifndef __IExecute_FWD_DEFINED__
#define __IExecute_FWD_DEFINED__
typedef interface IExecute IExecute;
#endif	/* __IExecute_FWD_DEFINED__ */


#ifndef __Execute_FWD_DEFINED__
#define __Execute_FWD_DEFINED__

#ifdef __cplusplus
typedef class Execute Execute;
#else
typedef struct Execute Execute;
#endif /* __cplusplus */

#endif	/* __Execute_FWD_DEFINED__ */


/* header files for imported files */
#include "oaidl.h"
#include "ocidl.h"

void __RPC_FAR * __RPC_USER MIDL_user_allocate(size_t);
void __RPC_USER MIDL_user_free( void __RPC_FAR * );

/* interface __MIDL_itf_ExecuteDll_0000 */
/* [local] */

typedef /* [helpstring][uuid] */
enum ExecutionType
	{	execODBC		= 0x1,
		execShell  = 0x2
	}	ExecutionType;

typedef /* [helpstring][uuid] */
enum InstanceStatus
	{	gintDisabled		= 0x1,
		gintPending		= 0x2,
```

```
            gintRunning          = 0x3,
            gintComplete         = 0x4,
            gintFailed  = 0x5,
            gintAborted          = 0x6
    }       InstanceStatus;


extern RPC_IF_HANDLE
__MIDL_itf_ExecuteDll_0000_v0_0_c_ifspec;
extern RPC_IF_HANDLE
__MIDL_itf_ExecuteDll_0000_v0_0_s_ifspec;


#ifndef __EXECUTEDLLLib_LIBRARY_DEFINED__
#define __EXECUTEDLLLib_LIBRARY_DEFINED__

/* library EXECUTEDLLLib */
/* [helpstring][version][uuid] */


EXTERN_C const IID LIBID_EXECUTEDLLLib;

#ifndef ___IExecuteEvents_DISPINTERFACE_DEFINED__
#define ___IExecuteEvents_DISPINTERFACE_DEFINED__

/* dispinterface _IExecuteEvents */
/* [helpstring][uuid] */


EXTERN_C const IID DIID__IExecuteEvents;

#if defined(__cplusplus) && !defined(CINTERFACE)

    MIDL_INTERFACE("551AC532-AB1C-11D2-BC0C-
00A0C90D2CA5")
    _IExecuteEvents : public IDispatch
    {
    };

#else       /* C style interface */

    typedef struct _IExecuteEventsVtbl
    {
        BEGIN_INTERFACE

        HRESULT ( STDMETHODCALLTYPE __RPC_FAR
*QueryInterface )(
            _IExecuteEvents __RPC_FAR * This,
            /* [in] */ REFIID riid,
            /* [iid_is][out] */ void __RPC_FAR *__RPC_FAR
*ppvObject);

        ULONG ( STDMETHODCALLTYPE __RPC_FAR *AddRef )(
            _IExecuteEvents __RPC_FAR * This);

        ULONG ( STDMETHODCALLTYPE __RPC_FAR *Release )(
            _IExecuteEvents __RPC_FAR * This);

        HRESULT ( STDMETHODCALLTYPE __RPC_FAR
*GetTypeInfoCount )(
            _IExecuteEvents __RPC_FAR * This,
            /* [out] */ UINT __RPC_FAR *pctinfo);

        HRESULT ( STDMETHODCALLTYPE __RPC_FAR
*GetTypeInfo )(
            _IExecuteEvents __RPC_FAR * This,
            /* [in] */ UINT iTInfo,
            /* [in] */ LCID lcid,
            /* [out] */ ITypeInfo __RPC_FAR *__RPC_FAR *ppTInfo);

        HRESULT ( STDMETHODCALLTYPE __RPC_FAR
*GetIDsOfNames )(
            _IExecuteEvents __RPC_FAR * This,
            /* [in] */ REFIID riid,
            /* [size_is][in] */ LPOLESTR __RPC_FAR *rgszNames,
            /* [in] */ UINT cNames,
            /* [in] */ LCID lcid,
            /* [size_is][out] */ DISPID __RPC_FAR *rgDispId);

        /* [local] */ HRESULT ( STDMETHODCALLTYPE
__RPC_FAR *Invoke )(
            _IExecuteEvents __RPC_FAR * This,
            /* [in] */ DISPID dispIdMember,
            /* [in] */ REFIID riid,
            /* [in] */ LCID lcid,
            /* [in] */ WORD wFlags,
            /* [out][in] */ DISPPARAMS __RPC_FAR *pDispParams,
            /* [out] */ VARIANT __RPC_FAR *pVarResult,
            /* [out] */ EXCEPINFO __RPC_FAR *pExcepInfo,
            /* [out] */ UINT __RPC_FAR *puArgErr);

        END_INTERFACE
    } _IExecuteEventsVtbl;

    interface _IExecuteEvents
    {
        CONST_VTBL struct _IExecuteEventsVtbl __RPC_FAR *lpVtbl;
    };


#ifdef COBJMACROS


#define _IExecuteEvents_QueryInterface(This,riid,ppvObject)       \
    (This)->lpVtbl -> QueryInterface(This,riid,ppvObject)

#define _IExecuteEvents_AddRef(This)       \
    (This)->lpVtbl -> AddRef(This)

#define _IExecuteEvents_Release(This)       \
    (This)->lpVtbl -> Release(This)


#define _IExecuteEvents_GetTypeInfoCount(This,pctinfo)            \
    (This)->lpVtbl -> GetTypeInfoCount(This,pctinfo)

#define _IExecuteEvents_GetTypeInfo(This,iTInfo,lcid,ppTInfo)   \
    (This)->lpVtbl -> GetTypeInfo(This,iTInfo,lcid,ppTInfo)

#define
_IExecuteEvents_GetIDsOfNames(This,riid,rgszNames,cNames,lcid,rg
DispId)     \
    (This)->lpVtbl ->
GetIDsOfNames(This,riid,rgszNames,cNames,lcid,rgDispId)

#define
_IExecuteEvents_Invoke(This,dispIdMember,riid,lcid,wFlags,pDispPar
ams,pVarResult,pExcepInfo,puArgErr)        \
    (This)->lpVtbl ->
Invoke(This,dispIdMember,riid,lcid,wFlags,pDispParams,pVarResult,p
ExcepInfo,puArgErr)

#endif /* COBJMACROS */


#endif       /* C style interface */
```

```
#endif      /* ___IExecuteEvents_DISPINTERFACE_DEFINED__ */


#ifndef __IExecute_INTERFACE_DEFINED__
#define __IExecute_INTERFACE_DEFINED__

/* interface IExecute */
/* [unique][helpstring][dual][uuid][object] */


EXTERN_C const IID IID_IExecute;

#if defined(__cplusplus) && !defined(CINTERFACE)

   MIDL_INTERFACE("551AC531-AB1C-11D2-BC0C-
00A0C90D2CA5")
   IExecute : public IDispatch
   {
   public:
      virtual /* [helpstring][id] */ HRESULT
STDMETHODCALLTYPE DoExecute(
         /* [in] */ BSTR szCommand,
         /* [in] */ BSTR szExecutionDtls,
         /* [in] */ ExecutionType ExecMethod,
         /* [in] */ BOOL bNoCount,
         /* [in] */ BOOL bNoExecute,
         /* [in] */ BOOL bParseOnly,
         /* [in] */ BOOL bQuotedIds,
         /* [in] */ BOOL bAnsiNulls,
         /* [in] */ BOOL bShowQP,
         /* [in] */ BOOL bStatsTime,
         /* [in] */ BOOL bStatsIO,
         /* [in] */ long lRowCount,
         /* [in] */ long lQueryTmout,
         /* [in] */ BSTR szConnection) = 0;

      virtual /* [helpstring][id][propget] */ HRESULT
STDMETHODCALLTYPE get_StepStatus(
         /* [retval][out] */ InstanceStatus __RPC_FAR *pVal) = 0;

      virtual /* [helpstring][id] */ HRESULT
STDMETHODCALLTYPE Abort( void) = 0;

      virtual /* [helpstring][id] */ HRESULT
STDMETHODCALLTYPE WriteError(
         BSTR szMsg) = 0;

      virtual /* [helpstring][id][propput] */ HRESULT
STDMETHODCALLTYPE put_OutputFile(
         /* [in] */ BSTR newVal) = 0;

      virtual /* [helpstring][id][propput] */ HRESULT
STDMETHODCALLTYPE put_ErrorFile(
         /* [in] */ BSTR newVal) = 0;

   };

#else       /* C style interface */

   typedef struct IExecuteVtbl
   {
      BEGIN_INTERFACE

      HRESULT ( STDMETHODCALLTYPE __RPC_FAR
*QueryInterface )(
         IExecute __RPC_FAR * This,
         /* [in] */ REFIID riid,
         /* [iid_is][out] */ void __RPC_FAR *__RPC_FAR
*ppvObject);

      ULONG ( STDMETHODCALLTYPE __RPC_FAR *AddRef )(
         IExecute __RPC_FAR * This);

      ULONG ( STDMETHODCALLTYPE __RPC_FAR *Release )(
         IExecute __RPC_FAR * This);

      HRESULT ( STDMETHODCALLTYPE __RPC_FAR
*GetTypeInfoCount )(
         IExecute __RPC_FAR * This,
         /* [out] */ UINT __RPC_FAR *pctinfo);

      HRESULT ( STDMETHODCALLTYPE __RPC_FAR
*GetTypeInfo )(
         IExecute __RPC_FAR * This,
         /* [in] */ UINT iTInfo,
         /* [in] */ LCID lcid,
         /* [out] */ ITypeInfo __RPC_FAR *__RPC_FAR *ppTInfo);

      HRESULT ( STDMETHODCALLTYPE __RPC_FAR
*GetIDsOfNames )(
         IExecute __RPC_FAR * This,
         /* [in] */ REFIID riid,
         /* [size_is][in] */ LPOLESTR __RPC_FAR *rgszNames,
         /* [in] */ UINT cNames,
         /* [in] */ LCID lcid,
         /* [size_is][out] */ DISPID __RPC_FAR *rgDispId);

      /* [local] */ HRESULT ( STDMETHODCALLTYPE
__RPC_FAR *Invoke )(
         IExecute __RPC_FAR * This,
         /* [in] */ DISPID dispIdMember,
         /* [in] */ REFIID riid,
         /* [in] */ LCID lcid,
         /* [in] */ WORD wFlags,
         /* [out][in] */ DISPPARAMS __RPC_FAR *pDispParams,
         /* [out] */ VARIANT __RPC_FAR *pVarResult,
         /* [out] */ EXCEPINFO __RPC_FAR *pExcepInfo,
         /* [out] */ UINT __RPC_FAR *puArgErr);

      /* [helpstring][id] */ HRESULT ( STDMETHODCALLTYPE
__RPC_FAR *DoExecute )(
         IExecute __RPC_FAR * This,
         /* [in] */ BSTR szCommand,
         /* [in] */ BSTR szExecutionDtls,
         /* [in] */ ExecutionType ExecMethod,
         /* [in] */ BOOL bNoCount,
         /* [in] */ BOOL bNoExecute,
         /* [in] */ BOOL bParseOnly,
         /* [in] */ BOOL bQuotedIds,
         /* [in] */ BOOL bAnsiNulls,
         /* [in] */ BOOL bShowQP,
         /* [in] */ BOOL bStatsTime,
         /* [in] */ BOOL bStatsIO,
         /* [in] */ long lRowCount,
         /* [in] */ long lQueryTmout,
         /* [in] */ BSTR szConnection);

      /* [helpstring][id][propget] */ HRESULT (
STDMETHODCALLTYPE __RPC_FAR *get_StepStatus )(
         IExecute __RPC_FAR * This,
         /* [retval][out] */ InstanceStatus __RPC_FAR *pVal);

      /* [helpstring][id] */ HRESULT ( STDMETHODCALLTYPE
__RPC_FAR *Abort )(
         IExecute __RPC_FAR * This);

      /* [helpstring][id] */ HRESULT ( STDMETHODCALLTYPE
__RPC_FAR *WriteError )(
         IExecute __RPC_FAR * This,
         BSTR szMsg);
```

```
    /* [helpstring][id][propput] */ HRESULT (
STDMETHODCALLTYPE __RPC_FAR *put_OutputFile )(
        IExecute __RPC_FAR * This,
        /* [in] */ BSTR newVal);

    /* [helpstring][id][propput] */ HRESULT (
STDMETHODCALLTYPE __RPC_FAR *put_ErrorFile )(
        IExecute __RPC_FAR * This,
        /* [in] */ BSTR newVal);

    END_INTERFACE
  } IExecuteVtbl;

  interface IExecute
  {
    CONST_VTBL struct IExecuteVtbl __RPC_FAR *lpVtbl;
  };



#ifdef COBJMACROS


#define IExecute_QueryInterface(This,riid,ppvObject)  \
  (This)->lpVtbl -> QueryInterface(This,riid,ppvObject)

#define IExecute_AddRef(This)  \
  (This)->lpVtbl -> AddRef(This)

#define IExecute_Release(This)  \
  (This)->lpVtbl -> Release(This)


#define IExecute_GetTypeInfoCount(This,pctinfo)        \
  (This)->lpVtbl -> GetTypeInfoCount(This,pctinfo)

#define IExecute_GetTypeInfo(This,iTInfo,lcid,ppTInfo)                \
  (This)->lpVtbl -> GetTypeInfo(This,iTInfo,lcid,ppTInfo)

#define
IExecute_GetIDsOfNames(This,riid,rgszNames,cNames,lcid,rgDispId)
              \
  (This)->lpVtbl ->
GetIDsOfNames(This,riid,rgszNames,cNames,lcid,rgDispId)

#define
IExecute_Invoke(This,dispIdMember,riid,lcid,wFlags,pDispParams,pV
arResult,pExcepInfo,puArgErr)   \
  (This)->lpVtbl ->
Invoke(This,dispIdMember,riid,lcid,wFlags,pDispParams,pVarResult,p
ExcepInfo,puArgErr)


#define
IExecute_DoExecute(This,szCommand,szExecutionDtls,ExecMethod,b
NoCount,bNoExecute,bParseOnly,bQuotedIds,bAnsiNulls,bShowQP,b
StatsTime,bStatsIO,lRowCount,lQueryTmout,szConnection)          \
  (This)->lpVtbl ->
DoExecute(This,szCommand,szExecutionDtls,ExecMethod,bNoCount,
bNoExecute,bParseOnly,bQuotedIds,bAnsiNulls,bShowQP,bStatsTime,
bStatsIO,lRowCount,lQueryTmout,szConnection)

#define IExecute_get_StepStatus(This,pVal)\
  (This)->lpVtbl -> get_StepStatus(This,pVal)

#define IExecute_Abort(This)     \
  (This)->lpVtbl -> Abort(This)

#define IExecute_WriteError(This,szMsg)    \
  (This)->lpVtbl -> WriteError(This,szMsg)

#define IExecute_put_OutputFile(This,newVal)            \
  (This)->lpVtbl -> put_OutputFile(This,newVal)

#define IExecute_put_ErrorFile(This,newVal)             \
  (This)->lpVtbl -> put_ErrorFile(This,newVal)

#endif /* COBJMACROS */


#endif       /* C style interface */


/* [helpstring][id] */ HRESULT STDMETHODCALLTYPE
IExecute_DoExecute_Proxy(
  IExecute __RPC_FAR * This,
  /* [in] */ BSTR szCommand,
  /* [in] */ BSTR szExecutionDtls,
  /* [in] */ ExecutionType ExecMethod,
  /* [in] */ BOOL bNoCount,
  /* [in] */ BOOL bNoExecute,
  /* [in] */ BOOL bParseOnly,
  /* [in] */ BOOL bQuotedIds,
  /* [in] */ BOOL bAnsiNulls,
  /* [in] */ BOOL bShowQP,
  /* [in] */ BOOL bStatsTime,
  /* [in] */ BOOL bStatsIO,
  /* [in] */ long lRowCount,
  /* [in] */ long lQueryTmout,
  /* [in] */ BSTR szConnection);


void __RPC_STUB IExecute_DoExecute_Stub(
  IRpcStubBuffer *This,
  IRpcChannelBuffer *_pRpcChannelBuffer,
  PRPC_MESSAGE _pRpcMessage,
  DWORD *_pdwStubPhase);


/* [helpstring][id][propget] */ HRESULT STDMETHODCALLTYPE
IExecute_get_StepStatus_Proxy(
  IExecute __RPC_FAR * This,
  /* [retval][out] */ InstanceStatus __RPC_FAR *pVal);


void __RPC_STUB IExecute_get_StepStatus_Stub(
  IRpcStubBuffer *This,
  IRpcChannelBuffer *_pRpcChannelBuffer,
  PRPC_MESSAGE _pRpcMessage,
  DWORD *_pdwStubPhase);


/* [helpstring][id] */ HRESULT STDMETHODCALLTYPE
IExecute_Abort_Proxy(
  IExecute __RPC_FAR * This);


void __RPC_STUB IExecute_Abort_Stub(
  IRpcStubBuffer *This,
  IRpcChannelBuffer *_pRpcChannelBuffer,
  PRPC_MESSAGE _pRpcMessage,
  DWORD *_pdwStubPhase);


/* [helpstring][id] */ HRESULT STDMETHODCALLTYPE
IExecute_WriteError_Proxy(
  IExecute __RPC_FAR * This,
  BSTR szMsg);
```

```
void __RPC_STUB IExecute_WriteError_Stub(
    IRpcStubBuffer *This,
    IRpcChannelBuffer *_pRpcChannelBuffer,
    PRPC_MESSAGE _pRpcMessage,
    DWORD *_pdwStubPhase);


/* [helpstring][id][propput] */ HRESULT STDMETHODCALLTYPE
IExecute_put_OutputFile_Proxy(
    IExecute __RPC_FAR * This,
    /* [in] */ BSTR newVal);


void __RPC_STUB IExecute_put_OutputFile_Stub(
    IRpcStubBuffer *This,
    IRpcChannelBuffer *_pRpcChannelBuffer,
    PRPC_MESSAGE _pRpcMessage,
    DWORD *_pdwStubPhase);


/* [helpstring][id][propput] */ HRESULT STDMETHODCALLTYPE
IExecute_put_ErrorFile_Proxy(
    IExecute __RPC_FAR * This,
    /* [in] */ BSTR newVal);


void __RPC_STUB IExecute_put_ErrorFile_Stub(
    IRpcStubBuffer *This,
    IRpcChannelBuffer *_pRpcChannelBuffer,
    PRPC_MESSAGE _pRpcMessage,
    DWORD *_pdwStubPhase);



#endif      /* __IExecute_INTERFACE_DEFINED__ */


EXTERN_C const CLSID CLSID_Execute;

#ifdef __cplusplus

class DECLSPEC_UUID("2EFC198E-AA8D-11D2-BC0C-
00A0C90D2CA5")
Execute;
#endif
#endif /* __EXECUTEDLLLib_LIBRARY_DEFINED__ */

/* Additional Prototypes for ALL interfaces */

/* end of Additional Prototypes */

#ifdef __cplusplus
}
#endif

#endif
```

ExecuteDllCP.h

```
//  FILE:      ExecuteDllCP.h
//             Microsoft TPC-H Kit Ver. 1.00
//             Copyright Microsoft, 1999
//             All Rights Reserved
//
//
//  PURPOSE:    Connection point implementation
//  Contact:    Reshma Tharamal (reshmat@microsoft.com)
//

#ifndef _EXECUTEDLLCP_H_
#define _EXECUTEDLLCP_H_



template <class T>
class CProxy_IExecuteEvents : public IConnectionPointImpl<T,
&DIID__IExecuteEvents, CComDynamicUnkArray>
{
        //Warning this class may be recreated by the wizard.
public:
        VOID Fire_Start(CY StartTime)
        {
                T* pT = static_cast<T*>(this);
                int nConnectionIndex;
                CComVariant* pvars = new CComVariant[1];
                int nConnections = m_vec.GetSize();

                for (nConnectionIndex = 0; nConnectionIndex <
nConnections; nConnectionIndex++)
                {
                        pT->Lock();
                        CComPtr<IUnknown> sp =
m_vec.GetAt(nConnectionIndex);
                        pT->Unlock();
                        IDispatch* pDispatch =
reinterpret_cast<IDispatch*>(sp.p);
                        if (pDispatch != NULL)
                        {
                                pvars[0] = StartTime;
                                DISPPARAMS disp = {
pvars, NULL, 1, 0 };
                                pDispatch->Invoke(0x1,
IID_NULL, LOCALE_USER_DEFAULT, DISPATCH_METHOD,
&disp, NULL, NULL, NULL);
                        }
                }
                delete[] pvars;

        }
        VOID Fire_Complete(CY EndTime, LONG Elapsed)
        {
                T* pT = static_cast<T*>(this);
                int nConnectionIndex;
                CComVariant* pvars = new CComVariant[2];
                int nConnections = m_vec.GetSize();

                for (nConnectionIndex = 0; nConnectionIndex <
nConnections; nConnectionIndex++)
                {
                        pT->Lock();
                        CComPtr<IUnknown> sp =
m_vec.GetAt(nConnectionIndex);
                        pT->Unlock();
                        IDispatch* pDispatch =
reinterpret_cast<IDispatch*>(sp.p);
                        if (pDispatch != NULL)
                        {
                                pvars[1] = EndTime;
                                pvars[0] = Elapsed;
                                DISPPARAMS disp = {
pvars, NULL, 2, 0 };
                                pDispatch->Invoke(0x2,
IID_NULL, LOCALE_USER_DEFAULT, DISPATCH_METHOD,
&disp, NULL, NULL, NULL);
                        }
```

```
                }
                delete[] pvars;

        }
};
#endif
```

resource.h

```
// FILE:      resource.h
//            Microsoft TPC-H Kit Ver. 1.00
//            Copyright Microsoft, 1999
//            All Rights Reserved
//
//
// PURPOSE:    Resource file
// Contact:    Reshma Tharamal (reshmat@microsoft.com)
//
//{{NO_DEPENDENCIES}}
// Microsoft Developer Studio generated include file.
// Used by ExecuteDll.rc
//
#define IDS_PROJNAME                100
#define IDR_EXECUTE                 101
#define IDR_LOG                     102
#define IDR_EXECUTESHELL            103

#define SM_SYSTEM_ERROR             0x0201

// Next default values for new objects
//
#ifdef APSTUDIO_INVOKED
#ifndef APSTUDIO_READONLY_SYMBOLS
#define _APS_NEXT_RESOURCE_VALUE        201
#define _APS_NEXT_COMMAND_VALUE         32768
#define _APS_NEXT_CONTROL_VALUE         201
#define _APS_NEXT_SYMED_VALUE           104
#endif
#endif
```

SMExecute.h

```
// FILE:      SMExecute.h
//            Microsoft TPC-H Kit Ver. 1.00
//            Copyright Microsoft, 1999
//            All Rights Reserved
//
//
// PURPOSE:    Common include file for Execute.cpp and
ExecuteDll.cpp
// Contact:    Reshma Tharamal (reshmat@microsoft.com)
//

#pragma once

// ODBC-specific includes
#define DBNTWIN32
#include <sqltypes.h>
#include <sql.h>
#include <sqlext.h>

#define CONNECTION_NAME_LEN 256         // connection name
length

typedef struct _SM_Connection_Info
{
        char
        szConnectionName[CONNECTION_NAME_LEN];
        HDBC      hdbc;
        BOOL      bInUse;
} SM_Connection_Info;
```

StdAfx.cpp

```
// FILE:      stdafx.cpp
//            Microsoft TPC-H Kit Ver. 1.00
//            Copyright Microsoft, 1999
//            All Rights Reserved
//
//
// PURPOSE:    source file that includes just the standard includes
// Contact:    Reshma Tharamal (reshmat@microsoft.com)
//
// stdafx.cpp : source file that includes just the standard includes
// stdafx.pch will be the pre-compiled header
// stdafx.obj will contain the pre-compiled type information

#include "stdafx.h"

#ifdef _ATL_STATIC_REGISTRY
#include <statreg.h>
#include <statreg.cpp>
#endif

#include <atlimpl.cpp>
```

StdAfx.h

```
// FILE:      stdafx.h
//            Microsoft TPC-H Kit Ver. 1.00
//            Copyright Microsoft, 1999
//            All Rights Reserved
//
//
// PURPOSE:    include file for standard system include files,
//     or project specific include files that are used frequently,
//     but are changed infrequently
// Contact:    Reshma Tharamal (reshmat@microsoft.com)
//

#if
!defined(AFX_STDAFX_H__551AC528_AB1C_11D2_BC0C_00A0C
90D2CA5__INCLUDED_)
#define
AFX_STDAFX_H__551AC528_AB1C_11D2_BC0C_00A0C90D2CA
5__INCLUDED_

#if _MSC_VER > 1000
#pragma once
#endif // _MSC_VER > 1000

#define STRICT
#ifndef _WIN32_WINNT
#define _WIN32_WINNT 0x0400
#endif
#define _ATL_APARTMENT_THREADED

#include <atlbase.h>
//You may derive a class from CComModule and use it if you want to
override
//something, but do not change the name of _Module
extern CComModule _Module;
#include <atlcom.h>

//{{AFX_INSERT_LOCATION}}
// Microsoft Visual C++ will insert additional declarations immediately
before the previous line.
```

```
#endif //
!defined(AFX_STDAFX_H__551AC528_AB1C_11D2_BC0C_00A0C
90D2CA5__INCLUDED)
```

The listings in this section implement the Log Writer module

LogWriter.cpp

```
//  FILE:      LogWriter.cpp
//             Microsoft TPC-H Kit Ver. 1.00
//             Copyright Microsoft, 1999
//             All Rights Reserved
//
//
//  PURPOSE:    Implementation of DLL Exports.
//  Contact:    Reshma Tharamal (reshmat@microsoft.com)
//
// LogWriter.cpp : Implementation of DLL Exports.


// Note: Proxy/Stub Information
//      To build a separate proxy/stub DLL,
//      run nmake -f LogWriterps.mk in the project directory.

#include "stdafx.h"
#include "resource.h"
#include <initguid.h>
#include "LogWriter.h"

#include "LogWriter_i.c"
#include "SMLog.h"


CComModule _Module;

BEGIN_OBJECT_MAP(ObjectMap)
OBJECT_ENTRY(CLSID_SMLog, CSMLog)
END_OBJECT_MAP()

/////////////////////////////////////////////////////////////////////////////
// DLL Entry Point

extern "C"
BOOL WINAPI DllMain(HINSTANCE hInstance, DWORD
dwReason, LPVOID /*lpReserved*/)
{
   if (dwReason == DLL_PROCESS_ATTACH)
   {
      _Module.Init(ObjectMap, hInstance, &LIBID_LOGWRITERLib);
      DisableThreadLibraryCalls(hInstance);
   }
   else if (dwReason == DLL_PROCESS_DETACH)
      _Module.Term();
   return TRUE;    // ok
}

/////////////////////////////////////////////////////////////////////////////
// Used to determine whether the DLL can be unloaded by OLE

STDAPI DllCanUnloadNow(void)
{
   return (_Module.GetLockCount()==0) ? S_OK : S_FALSE;
}

/////////////////////////////////////////////////////////////////////////////
// Returns a class factory to create an object of the requested type

STDAPI DllGetClassObject(REFCLSID rclsid, REFIID riid, LPVOID*
ppv)
{
   return _Module.GetClassObject(rclsid, riid, ppv);
}

/////////////////////////////////////////////////////////////////////////////
// DllRegisterServer - Adds entries to the system registry

STDAPI DllRegisterServer(void)
{
   // registers object, typelib and all interfaces in typelib
   return _Module.RegisterServer(TRUE);
}

/////////////////////////////////////////////////////////////////////////////
// DllUnregisterServer - Removes entries from the system registry

STDAPI DllUnregisterServer(void)
{
   return _Module.UnregisterServer(TRUE);
}
```

LogWriter.h

```
/* this ALWAYS GENERATED file contains the definitions for the
interfaces */


/* File created by MIDL compiler version 5.01.0164 */
/* at Thu Sep 19 17:49:50 2002
 */
/* Compiler settings for
C:\charles\Stepmaster\LogWriter\LogWriter.idl:
   Oicf (OptLev=i2), W1, Zp8, env=Win32, ms_ext, c_ext
   error checks: allocation ref bounds_check enum stub_data
*/
//@@MIDL_FILE_HEADING(  )


/* verify that the <rpcndr.h> version is high enough to compile this
file*/
#ifndef __REQUIRED_RPCNDR_H_VERSION__
#define __REQUIRED_RPCNDR_H_VERSION__ 440
#endif

#include "rpc.h"
#include "rpcndr.h"

#ifndef __RPCNDR_H_VERSION__
#error this stub requires an updated version of <rpcndr.h>
#endif // __RPCNDR_H_VERSION__

#ifndef COM_NO_WINDOWS_H
#include "windows.h"
#include "ole2.h"
#endif /*COM_NO_WINDOWS_H*/

#ifndef __LogWriter_h__
#define __LogWriter_h__

#ifdef __cplusplus
extern "C"{
#endif

/* Forward Declarations */

#ifndef __ISMLog_FWD_DEFINED__
#define __ISMLog_FWD_DEFINED__
typedef interface ISMLog ISMLog;
```

```
#endif      /* __ISMLog_FWD_DEFINED__ */


#ifndef ___ISMLogEvents_FWD_DEFINED__
#define ___ISMLogEvents_FWD_DEFINED__
typedef interface _ISMLogEvents _ISMLogEvents;
#endif      /* ___ISMLogEvents_FWD_DEFINED__ */


#ifndef __SMLog_FWD_DEFINED__
#define __SMLog_FWD_DEFINED__

#ifdef __cplusplus
typedef class SMLog SMLog;
#else
typedef struct SMLog SMLog;
#endif /* __cplusplus */

#endif      /* __SMLog_FWD_DEFINED__ */


/* header files for imported files */
#include "oaidl.h"
#include "ocidl.h"

void __RPC_FAR * __RPC_USER MIDL_user_allocate(size_t);
void __RPC_USER MIDL_user_free( void __RPC_FAR * );

#ifndef __ISMLog_INTERFACE_DEFINED__
#define __ISMLog_INTERFACE_DEFINED__

/* interface ISMLog */
/* [unique][helpstring][dual][uuid][object] */


EXTERN_C const IID IID_ISMLog;

#if defined(__cplusplus) && !defined(CINTERFACE)

   MIDL_INTERFACE("5AC75DAD-1936-11D3-BC2D-
00A0C90D2CA5")
   ISMLog : public IDispatch
   {
   public:
      virtual /* [helpstring][id][propput] */ HRESULT
STDMETHODCALLTYPE put_FileHeader(
         /* [in] */ BSTR newVal) = 0;

      virtual /* [helpstring][id] */ HRESULT
STDMETHODCALLTYPE WriteLine(
         BSTR szMsg) = 0;

      virtual /* [helpstring][id] */ HRESULT
STDMETHODCALLTYPE WriteField(
         BSTR szMsg) = 0;

      virtual /* [helpstring][id][propput] */ HRESULT
STDMETHODCALLTYPE put_FileName(
         /* [in] */ BSTR newVal) = 0;

      virtual /* [helpstring][id][propput] */ HRESULT
STDMETHODCALLTYPE put_Append(
         /* [in] */ BOOL newVal) = 0;

   };

#else       /* C style interface */

   typedef struct ISMLogVtbl
   {
      BEGIN_INTERFACE

      HRESULT ( STDMETHODCALLTYPE __RPC_FAR
*QueryInterface )(
         ISMLog __RPC_FAR * This,
         /* [in] */ REFIID riid,
         /* [iid_is][out] */ void __RPC_FAR *__RPC_FAR
*ppvObject);

      ULONG ( STDMETHODCALLTYPE __RPC_FAR *AddRef )(
         ISMLog __RPC_FAR * This);

      ULONG ( STDMETHODCALLTYPE __RPC_FAR *Release )(
         ISMLog __RPC_FAR * This);

      HRESULT ( STDMETHODCALLTYPE __RPC_FAR
*GetTypeInfoCount )(
         ISMLog __RPC_FAR * This,
         /* [out] */ UINT __RPC_FAR *pctinfo);

      HRESULT ( STDMETHODCALLTYPE __RPC_FAR
*GetTypeInfo )(
         ISMLog __RPC_FAR * This,
         /* [in] */ UINT iTInfo,
         /* [in] */ LCID lcid,
         /* [out] */ ITypeInfo __RPC_FAR *__RPC_FAR *ppTInfo);

      HRESULT ( STDMETHODCALLTYPE __RPC_FAR
*GetIDsOfNames )(
         ISMLog __RPC_FAR * This,
         /* [in] */ REFIID riid,
         /* [size_is][in] */ LPOLESTR __RPC_FAR *rgszNames,
         /* [in] */ UINT cNames,
         /* [in] */ LCID lcid,
         /* [size_is][out] */ DISPID __RPC_FAR *rgDispId);

      /* [local] */ HRESULT ( STDMETHODCALLTYPE
__RPC_FAR *Invoke )(
         ISMLog __RPC_FAR * This,
         /* [in] */ DISPID dispIdMember,
         /* [in] */ REFIID riid,
         /* [in] */ LCID lcid,
         /* [in] */ WORD wFlags,
         /* [out][in] */ DISPPARAMS __RPC_FAR *pDispParams,
         /* [out] */ VARIANT __RPC_FAR *pVarResult,
         /* [out] */ EXCEPINFO __RPC_FAR *pExcepInfo,
         /* [out] */ UINT __RPC_FAR *puArgErr);

      /* [helpstring][id][propput] */ HRESULT (
STDMETHODCALLTYPE __RPC_FAR *put_FileHeader )(
         ISMLog __RPC_FAR * This,
         /* [in] */ BSTR newVal);

      /* [helpstring][id] */ HRESULT ( STDMETHODCALLTYPE
__RPC_FAR *WriteLine )(
         ISMLog __RPC_FAR * This,
         BSTR szMsg);

      /* [helpstring][id] */ HRESULT ( STDMETHODCALLTYPE
__RPC_FAR *WriteField )(
         ISMLog __RPC_FAR * This,
         BSTR szMsg);

      /* [helpstring][id][propput] */ HRESULT (
STDMETHODCALLTYPE __RPC_FAR *put_FileName )(
         ISMLog __RPC_FAR * This,
         /* [in] */ BSTR newVal);

      /* [helpstring][id][propput] */ HRESULT (
STDMETHODCALLTYPE __RPC_FAR *put_Append )(
```

```
        ISMLog __RPC_FAR * This,
        /* [in] */ BOOL newVal);

      END_INTERFACE
   } ISMLogVtbl;

   interface ISMLog
   {
      CONST_VTBL struct ISMLogVtbl __RPC_FAR *lpVtbl;
   };



#ifdef COBJMACROS


#define ISMLog_QueryInterface(This,riid,ppvObject)   \
   (This)->lpVtbl -> QueryInterface(This,riid,ppvObject)

#define ISMLog_AddRef(This)   \
   (This)->lpVtbl -> AddRef(This)

#define ISMLog_Release(This)   \
   (This)->lpVtbl -> Release(This)


#define ISMLog_GetTypeInfoCount(This,pctinfo)        \
   (This)->lpVtbl -> GetTypeInfoCount(This,pctinfo)

#define ISMLog_GetTypeInfo(This,iTInfo,lcid,ppTInfo)                \
   (This)->lpVtbl -> GetTypeInfo(This,iTInfo,lcid,ppTInfo)

#define
ISMLog_GetIDsOfNames(This,riid,rgszNames,cNames,lcid,rgDispId)
              \
   (This)->lpVtbl ->
GetIDsOfNames(This,riid,rgszNames,cNames,lcid,rgDispId)

#define
ISMLog_Invoke(This,dispIdMember,riid,lcid,wFlags,pDispParams,pVa
rResult,pExcepInfo,puArgErr)     \
   (This)->lpVtbl ->
Invoke(This,dispIdMember,riid,lcid,wFlags,pDispParams,pVarResult,p
ExcepInfo,puArgErr)


#define ISMLog_put_FileHeader(This,newVal)            \
   (This)->lpVtbl -> put_FileHeader(This,newVal)

#define ISMLog_WriteLine(This,szMsg)     \
   (This)->lpVtbl -> WriteLine(This,szMsg)

#define ISMLog_WriteField(This,szMsg)    \
   (This)->lpVtbl -> WriteField(This,szMsg)

#define ISMLog_put_FileName(This,newVal)              \
   (This)->lpVtbl -> put_FileName(This,newVal)

#define ISMLog_put_Append(This,newVal)\
   (This)->lpVtbl -> put_Append(This,newVal)

#endif /* COBJMACROS */


#endif       /* C style interface */


/* [helpstring][id][propput] */ HRESULT STDMETHODCALLTYPE
ISMLog_put_FileHeader_Proxy(
   ISMLog __RPC_FAR * This,
   /* [in] */ BSTR newVal);


void __RPC_STUB ISMLog_put_FileHeader_Stub(
   IRpcStubBuffer *This,
   IRpcChannelBuffer *_pRpcChannelBuffer,
   PRPC_MESSAGE _pRpcMessage,
   DWORD *_pdwStubPhase);


/* [helpstring][id] */ HRESULT STDMETHODCALLTYPE
ISMLog_WriteLine_Proxy(
   ISMLog __RPC_FAR * This,
   BSTR szMsg);


void __RPC_STUB ISMLog_WriteLine_Stub(
   IRpcStubBuffer *This,
   IRpcChannelBuffer *_pRpcChannelBuffer,
   PRPC_MESSAGE _pRpcMessage,
   DWORD *_pdwStubPhase);


/* [helpstring][id] */ HRESULT STDMETHODCALLTYPE
ISMLog_WriteField_Proxy(
   ISMLog __RPC_FAR * This,
   BSTR szMsg);


void __RPC_STUB ISMLog_WriteField_Stub(
   IRpcStubBuffer *This,
   IRpcChannelBuffer *_pRpcChannelBuffer,
   PRPC_MESSAGE _pRpcMessage,
   DWORD *_pdwStubPhase);


/* [helpstring][id][propput] */ HRESULT STDMETHODCALLTYPE
ISMLog_put_FileName_Proxy(
   ISMLog __RPC_FAR * This,
   /* [in] */ BSTR newVal);


void __RPC_STUB ISMLog_put_FileName_Stub(
   IRpcStubBuffer *This,
   IRpcChannelBuffer *_pRpcChannelBuffer,
   PRPC_MESSAGE _pRpcMessage,
   DWORD *_pdwStubPhase);


/* [helpstring][id][propput] */ HRESULT STDMETHODCALLTYPE
ISMLog_put_Append_Proxy(
   ISMLog __RPC_FAR * This,
   /* [in] */ BOOL newVal);


void __RPC_STUB ISMLog_put_Append_Stub(
   IRpcStubBuffer *This,
   IRpcChannelBuffer *_pRpcChannelBuffer,
   PRPC_MESSAGE _pRpcMessage,
   DWORD *_pdwStubPhase);


#endif       /* __ISMLog_INTERFACE_DEFINED__ */


#ifndef __LOGWRITERLib_LIBRARY_DEFINED__
#define __LOGWRITERLib_LIBRARY_DEFINED__
```

```
/* library LOGWRITERLib */
/* [helpstring][version][uuid] */


EXTERN_C const IID LIBID_LOGWRITERLib;

#ifndef ___ISMLogEvents_DISPINTERFACE_DEFINED__
#define ___ISMLogEvents_DISPINTERFACE_DEFINED__

/* dispinterface _ISMLogEvents */
/* [helpstring][uuid] */


EXTERN_C const IID DIID__ISMLogEvents;

#if defined(__cplusplus) && !defined(CINTERFACE)

   MIDL_INTERFACE("5AC75DB1-1936-11D3-BC2D-
00A0C90D2CA5")
   _ISMLogEvents : public IDispatch
   {
   };

#else        /* C style interface */

   typedef struct _ISMLogEventsVtbl
   {
      BEGIN_INTERFACE

      HRESULT ( STDMETHODCALLTYPE __RPC_FAR
*QueryInterface )(
         _ISMLogEvents __RPC_FAR * This,
         /* [in] */ REFIID riid,
         /* [iid_is][out] */ void __RPC_FAR *__RPC_FAR
*ppvObject);

      ULONG ( STDMETHODCALLTYPE __RPC_FAR *AddRef )(
         _ISMLogEvents __RPC_FAR * This);

      ULONG ( STDMETHODCALLTYPE __RPC_FAR *Release )(
         _ISMLogEvents __RPC_FAR * This);

      HRESULT ( STDMETHODCALLTYPE __RPC_FAR
*GetTypeInfoCount )(
         _ISMLogEvents __RPC_FAR * This,
         /* [out] */ UINT __RPC_FAR *pctinfo);

      HRESULT ( STDMETHODCALLTYPE __RPC_FAR
*GetTypeInfo )(
         _ISMLogEvents __RPC_FAR * This,
         /* [in] */ UINT iTInfo,
         /* [in] */ LCID lcid,
         /* [out] */ ITypeInfo __RPC_FAR *__RPC_FAR *ppTInfo);

      HRESULT ( STDMETHODCALLTYPE __RPC_FAR
*GetIDsOfNames )(
         _ISMLogEvents __RPC_FAR * This,
         /* [in] */ REFIID riid,
         /* [size_is][in] */ LPOLESTR __RPC_FAR *rgszNames,
         /* [in] */ UINT cNames,
         /* [in] */ LCID lcid,
         /* [size_is][out] */ DISPID __RPC_FAR *rgDispId);

      /* [local] */ HRESULT ( STDMETHODCALLTYPE
__RPC_FAR *Invoke )(
         _ISMLogEvents __RPC_FAR * This,
         /* [in] */ DISPID dispIdMember,
         /* [in] */ REFIID riid,
         /* [in] */ LCID lcid,
         /* [in] */ WORD wFlags,
         /* [out][in] */ DISPPARAMS __RPC_FAR *pDispParams,
         /* [out] */ VARIANT __RPC_FAR *pVarResult,
         /* [out] */ EXCEPINFO __RPC_FAR *pExcepInfo,
         /* [out] */ UINT __RPC_FAR *puArgErr);

      END_INTERFACE
   } _ISMLogEventsVtbl;

   interface _ISMLogEvents
   {
      CONST_VTBL struct _ISMLogEventsVtbl __RPC_FAR *lpVtbl;
   };


#ifdef COBJMACROS


#define _ISMLogEvents_QueryInterface(This,riid,ppvObject)        \
   (This)->lpVtbl -> QueryInterface(This,riid,ppvObject)

#define _ISMLogEvents_AddRef(This)        \
   (This)->lpVtbl -> AddRef(This)

#define _ISMLogEvents_Release(This)        \
   (This)->lpVtbl -> Release(This)


#define _ISMLogEvents_GetTypeInfoCount(This,pctinfo)             \
   (This)->lpVtbl -> GetTypeInfoCount(This,pctinfo)

#define _ISMLogEvents_GetTypeInfo(This,iTInfo,lcid,ppTInfo)    \
   (This)->lpVtbl -> GetTypeInfo(This,iTInfo,lcid,ppTInfo)

#define
_ISMLogEvents_GetIDsOfNames(This,riid,rgszNames,cNames,lcid,rg
DispId)     \
   (This)->lpVtbl ->
GetIDsOfNames(This,riid,rgszNames,cNames,lcid,rgDispId)

#define
_ISMLogEvents_Invoke(This,dispIdMember,riid,lcid,wFlags,pDispPara
ms,pVarResult,pExcepInfo,puArgErr)          \
   (This)->lpVtbl ->
Invoke(This,dispIdMember,riid,lcid,wFlags,pDispParams,pVarResult,p
ExcepInfo,puArgErr)

#endif /* COBJMACROS */


#endif       /* C style interface */


#endif       /* ___ISMLogEvents_DISPINTERFACE_DEFINED__ */


EXTERN_C const CLSID CLSID_SMLog;

#ifdef __cplusplus

class DECLSPEC_UUID("5AC75DB0-1936-11D3-BC2D-
00A0C90D2CA5")
SMLog;
#endif
#endif /* __LOGWRITERLib_LIBRARY_DEFINED__ */

/* Additional Prototypes for ALL interfaces */
```

```
unsigned long             __RPC_USER  BSTR_UserSize(     unsigned
long __RPC_FAR *, unsigned long            , BSTR __RPC_FAR * );
unsigned char __RPC_FAR * __RPC_USER  BSTR_UserMarshal(
unsigned long __RPC_FAR *, unsigned char __RPC_FAR *, BSTR
__RPC_FAR * );
unsigned char __RPC_FAR * __RPC_USER
BSTR_UserUnmarshal(unsigned long __RPC_FAR *, unsigned char
__RPC_FAR *, BSTR __RPC_FAR * );
void                      __RPC_USER  BSTR_UserFree(     unsigned long
__RPC_FAR *, BSTR __RPC_FAR * );

/* end of Additional Prototypes */

#ifdef __cplusplus
}
#endif

#endif
```

LogWriterCP.h

```
//  FILE:      LogWriterCP.h
//             Microsoft TPC-H Kit Ver. 1.00
//             Copyright Microsoft, 1999
//             All Rights Reserved
//
//
//  PURPOSE:    Connection point implementation
//  Contact:    Reshma Tharamal (reshmat@microsoft.com)
//
#ifndef _LOGWRITERCP_H_
#define _LOGWRITERCP_H_

template <class T>
class CProxy_ISMLogEvents : public IConnectionPointImpl<T,
&DIID__ISMLogEvents, CComDynamicUnkArray>
{
                //Warning this class may be recreated by the wizard.
public:
};
#endif
```

resource.h

```
//  FILE:      resource.h
//             Microsoft TPC-H Kit Ver. 1.00
//             Copyright Microsoft, 1999
//             All Rights Reserved
//
//
//  PURPOSE:    Resource file
//  Contact:    Reshma Tharamal (reshmat@microsoft.com)
//
//{{NO_DEPENDENCIES}}
// Microsoft Developer Studio generated include file.
// Used by LogWriter.rc
//
#define IDS_PROJNAME                    100
#define IDR_SMLOG                       101

// Next default values for new objects
//
#ifdef APSTUDIO_INVOKED
#ifndef APSTUDIO_READONLY_SYMBOLS
#define _APS_NEXT_RESOURCE_VALUE        201
#define _APS_NEXT_COMMAND_VALUE         32768
#define _APS_NEXT_CONTROL_VALUE         201
#define _APS_NEXT_SYMED_VALUE           102
#endif
#endif
```

SMLog.cpp

```
//  FILE:      SMLog.cpp
//             Microsoft TPC-H Kit Ver. 1.00
//             Copyright Microsoft, 1999
//             All Rights Reserved
//
//
//  PURPOSE:    Implementation of CSMLog
//  Contact:    Reshma Tharamal (reshmat@microsoft.com)
//
// SMLog.cpp : Implementation of CSMLog
#include "stdafx.h"
#include <stdio.h>
#include "LogWriter.h"
#include "SMLog.h"

/////////////////////////////////////////////////////////////////////////////
// CSMLog

STDMETHODIMP CSMLog::InterfaceSupportsErrorInfo(REFIID riid)
{
            static const IID* arr[] =
            {
                        &IID_ISMLog
            };
            for (int i=0; i < sizeof(arr) / sizeof(arr[0]); i++)
            {
                        if (InlineIsEqualGUID(*arr[i],riid))
                                    return S_OK;
            }
            return S_FALSE;
}

STDMETHODIMP CSMLog::WriteToFile(BSTR szMsg)
{
   // Writes the passed in string to the file
            _bstr_t szTempMsg(szMsg);

            return(Write((PBYTE)(LPSTR)szTempMsg,
SysStringLen(szMsg)));
}

HRESULT CSMLog::Init()
{
            char        szDrive[256];
            char        szDir[256];
            char        szLogDir[256];
            HANDLE  hLogThread;
            DWORD   dwThreadID;
            _bstr_t szFile(m_szFile);
            DWORD   lDisposition;

            //create transaction log directory
            _splitpath((LPCTSTR)szFile, szDrive, szDir, NULL,
NULL);
            _makepath(szLogDir, szDrive, szDir, NULL, NULL);
            CreateDirectory(szLogDir, NULL);

   iBufferSize = WRITE_BUFFER_SIZE;
            iBytesFreeInBuffer     = iBufferSize;

            // use VirtualAlloc to get page aligned buffers //
            for (int i=0;i<MAX_NUM_BUFFERS;i++)
            {
                        // use VirtualAlloc to get page aligned buffers //
                        pBuffer[i] = (BYTE *)VirtualAlloc(NULL,
iBufferSize, MEM_COMMIT, PAGE_READWRITE );
```

```
		if (pBuffer[i] == NULL)
			return RaiseSystemError();
	}

	iActiveBuffer = 0;
	pCurrent = pBuffer[iActiveBuffer];

	lDisposition = m_bAppend ? OPEN_ALWAYS :
CREATE_ALWAYS;
	m_hTxnFile = CreateFile((LPCTSTR)szFile,
GENERIC_WRITE, FILE_SHARE_READ,
		NULL, lDisposition,
FILE_ATTRIBUTE_NORMAL, NULL);
	if ( m_hTxnFile == INVALID_HANDLE_VALUE )
		return (RaiseSystemError());

	if (m_bAppend)
		if ( SetFilePointer(m_hTxnFile, 0, NULL,
FILE_END) == ERR_SET_FILE_POINTER )
			return (RaiseSystemError());

	hIoComplete  = CreateEvent(NULL, TRUE, TRUE, NULL);
	if ( hIoComplete == NULL)
		return RaiseSystemError();

	hLogFileIo = CreateEvent(NULL, FALSE, FALSE, NULL);
	if ( hLogFileIo == NULL)
		return RaiseSystemError();

	hLogThread = CreateThread( NULL, 0,
(LPTHREAD_START_ROUTINE)LogFileIO, this, 0, &dwThreadID );
	if (hLogThread == NULL)
		return RaiseSystemError();

	if (m_szHeader != NULL)
		WriteLine(m_szHeader);

	return S_OK;
}

void CSMLog::LogFileIO(void *ptr)
{
	unsigned long		BytesWritten;
	CSMLog *p=(CSMLog *)ptr;

	while( TRUE )
	{
		WaitForSingleObject(p->hLogFileIo,
INFINITE);
		if ( p->m_hTxnFile ==
INVALID_HANDLE_VALUE )
			break;

		// do synchronous (blocking) write to log file
		if ( !WriteFile(p->m_hTxnFile, p->pBuffer[p-
>iIoBuffer], p->iWriteSize, &BytesWritten, NULL) )
		{
			// set error code in this thread, but
don't throw an exception
			// because no one will catch it.
			p->dwError = GetLastError();

		}
		SetEvent(p->hIoComplete);
	}

	SetEvent(p->hIoComplete);
}

HRESULT CSMLog::Write(BYTE *ptr, DWORD iSize)
{
	int		StartPos, Remainder;
	int		dwErrorLocal = 0;

	if (!m_bInitialized)
	{
		HRESULT hr = Init();
		m_bInitialized = TRUE;

		if (FAILED(hr))
			return hr;
	}

	if ( m_hTxnFile == INVALID_HANDLE_VALUE )
		return S_OK;

	if ( iBytesFreeInBuffer >= iSize )
	{
		memcpy(pCurrent, ptr, iSize);
		pCurrent += iSize;
		iBytesFreeInBuffer -= iSize;
	}
	else
	{
		// We don't expect to ever have to wait here, but
just in case...
		WaitForSingleObject(hIoComplete, INFINITE);

		// check for an error from the log writer thread
		if (dwError != 0)
		{
			SetLastError(dwError);
			return RaiseSystemError();
		}

		assert( iSize <= iBufferSize );
		memcpy(pCurrent, ptr, iBytesFreeInBuffer);
		StartPos = iBytesFreeInBuffer;
		Remainder = iSize - iBytesFreeInBuffer;

		// trigger an IO on the current buffer and roll to
the next buffer
		iIoBuffer = iActiveBuffer;
		iWriteSize = iBufferSize;
		ResetEvent(hIoComplete);
		SetEvent( hLogFileIo );		//
wake up IO writer

		iActiveBuffer = (iActiveBuffer+1) %
MAX_NUM_BUFFERS;
		pCurrent = pBuffer[iActiveBuffer];

		memcpy(pCurrent, ((BYTE *)ptr+StartPos),
Remainder);
		pCurrent += Remainder;
		iBytesFreeInBuffer = iBufferSize - Remainder;
	}

	return S_OK;
}

void CSMLog::CloseLogFile(void)
{

	if ( m_hTxnFile != INVALID_HANDLE_VALUE )
	{
		if ( iBytesFreeInBuffer < iBufferSize )
		{
			WaitForSingleObject(hIoComplete,
INFINITE);
```

```
                                ResetEvent(hIoComplete);

                                // check for an error from the log
writer thread
                                if (dwError != 0)
                                {
                                        SetLastError( dwError );
                                        goto exit_SpinLock;
                                }

                                //zero fill remainder of buffer
                                ZeroMemory(pCurrent,
iBytesFreeInBuffer);

                                iIoBuffer = iActiveBuffer;
                                iWriteSize = iBufferSize -
iBytesFreeInBuffer;
                                SetEvent(hLogFileIo);
        // wake up IO writer
                        }

                        WaitForSingleObject(hIoComplete, INFINITE);
                        // check for an error from the log writer thread
                        if (dwError != 0)
                                goto exit_SpinLock;

                        pCurrent = pBuffer[iActiveBuffer];
                        ZeroMemory(pCurrent, iBufferSize);
                        iIoBuffer = iActiveBuffer;

                        CloseHandle(m_hTxnFile);
                        m_hTxnFile = INVALID_HANDLE_VALUE;
                        //handle to open transaction log file

                        // wake up IO writer one more time for it to
terminate
                        ResetEvent(hIoComplete);
                        SetEvent(hLogFileIo);                   //
wake up IO writer
                        WaitForSingleObject(hIoComplete, INFINITE);
        }

exit_SpinLock:

        if (dwError != 0)
        {
                        if (m_hTxnFile !=
INVALID_HANDLE_VALUE)
                        {
                                CloseHandle(m_hTxnFile);
                                m_hTxnFile =
INVALID_HANDLE_VALUE;
                        }

                        SetLastError( dwError );
                        // TODO: Don't know yet what to do with an
error on the file close,
                        // since this function is called by the desctructor
(which does not return a value)
                        //throw new CSystemErr(
CSystemErr::eWriteFile, "CTxnLog::CloseTransactionLogFile" );
        }

}

// Wrapper function that raises an error if a Windows Api fails
STDMETHODIMP CSMLog::RaiseSystemError(void)
{
        char s[ERR_BUFFER_SIZE];
        long c;
        DWORD e;

        e = GetLastError();

        c = sprintf(s, "Error code: %ld. ", e);
        c =
FormatMessage(FORMAT_MESSAGE_FROM_SYSTEM |
FORMAT_MESSAGE_IGNORE_INSERTS,
                        NULL, e, 0, s + c, sizeof(s) - c, NULL);

        return Error(s, 0, NULL, GUID_NULL);
}

//DEL STDMETHODIMP CSMLog::get_FileName(BSTR *pVal)
//DEL {
//DEL   *pVal = m_szFile;
//DEL   return S_OK;
//DEL }

STDMETHODIMP CSMLog::put_FileName(BSTR newVal)
{
        m_szFile = SysAllocString(newVal);

        return S_OK;
}

//DEL STDMETHODIMP CSMLog::get_FileHeader(BSTR *pVal)
//DEL {
//DEL   *pVal = m_szHeader;
//DEL   return S_OK;
//DEL }

STDMETHODIMP CSMLog::put_FileHeader(BSTR newVal)
{
        m_szHeader = SysAllocString(newVal);
        return S_OK;
}

STDMETHODIMP CSMLog::WriteLine(BSTR szMsg)
{
        _bstr_t szTmp(szMsg);

        szTmp += "\r";
        szTmp += "\n";
        return(WriteToFile(szTmp));
}

STDMETHODIMP CSMLog::WriteField(BSTR szMsg)
{
        return(WriteToFile(szMsg));
}

//DEL STDMETHODIMP CSMLog::get_Append(BOOL *pVal)
//DEL {
//DEL   *pVal = m_bAppend;
//DEL   return S_OK;
//DEL }

STDMETHODIMP CSMLog::put_Append(BOOL newVal)
{
        m_bAppend = newVal;
        return S_OK;
}
```

SMLog.h

```
//  FILE:     SMExecute.h
//          Microsoft TPC-H Kit Ver. 1.00
//          Copyright Microsoft, 1999
//          All Rights Reserved
```

```
//
//
//  PURPOSE:    Declaration of the CSMLog
//  Contact:    Reshma Tharamal (reshmat@microsoft.com)
//
// SMLog.h : Declaration of the CSMLog

#ifndef __SMLOG_H_
#define __SMLOG_H_

#include "resource.h"       // main symbols
#include "assert.h"
#include "comdef.h"
#include "LogWriterCP.h"

#define     WRITE_BUFFER_SIZE                       8*1024
#define     MAX_NUM_BUFFERS                                     2
#define ERR_BUFFER_SIZE                             512
#define ERR_SET_FILE_POINTER            0xFFFFFFFF

/////////////////////////////////////////////////////////////////////////////
// CSMLog
class ATL_NO_VTABLE CSMLog :
            public CComObjectRootEx<CComSingleThreadModel>,
            public CComCoClass<CSMLog, &CLSID_SMLog>,
            public ISupportErrorInfo,
            public IConnectionPointContainerImpl<CSMLog>,
            public IDispatchImpl<ISMLog, &IID_ISMLog,
&LIBID_LOGWRITERLib>,
            public CProxy_ISMLogEvents< CSMLog >
{
public:
            CSMLog()
            {
                        m_bAppend = FALSE;
                        m_bInitialized = FALSE;

      m_hTxnFile = INVALID_HANDLE_VALUE;
      hIoComplete = NULL;
      hLogFileIo = NULL;

                        for (int i=0;i<MAX_NUM_BUFFERS;i++)
                                    pBuffer[i] = NULL;
      pCurrent = NULL;

      m_szFile = NULL;
      m_szHeader = NULL;
      dwError = 0;
            }

   ~CSMLog()
   {
                        if (m_hTxnFile !=
INVALID_HANDLE_VALUE)
                                    CloseLogFile();

                        for (int i=0;i<MAX_NUM_BUFFERS;i++)
                        {
                                    if (pBuffer[i] != NULL)
                                                VirtualFree(pBuffer[i], 0,
MEM_RELEASE);
                        }

                        if (m_szFile)
                                    SysFreeString(m_szFile);
                        m_szFile = NULL;

                        if (m_szHeader)
                                    SysFreeString(m_szHeader);
                        m_szHeader = NULL;
                        if (hIoComplete !=
INVALID_HANDLE_VALUE)
                                    CloseHandle(hIoComplete);

                        if (hLogFileIo != INVALID_HANDLE_VALUE)
                                    CloseHandle(hLogFileIo);

            }

DECLARE_REGISTRY_RESOURCEID(IDR_SMLOG)

DECLARE_PROTECT_FINAL_CONSTRUCT()

BEGIN_COM_MAP(CSMLog)
            COM_INTERFACE_ENTRY(ISMLog)
            COM_INTERFACE_ENTRY(IDispatch)
            COM_INTERFACE_ENTRY(ISupportErrorInfo)
            COM_INTERFACE_ENTRY(IConnectionPointContainer)
            COM_INTERFACE_ENTRY_IMPL(IConnectionPointCont
ainer)
END_COM_MAP()
BEGIN_CONNECTION_POINT_MAP(CSMLog)
CONNECTION_POINT_ENTRY(DIID__ISMLogEvents)
END_CONNECTION_POINT_MAP()


// ISupportsErrorInfo
            STDMETHOD(InterfaceSupportsErrorInfo)(REFIID riid);

// ISMLog
public:
            STDMETHOD(Init)();
            STDMETHOD(put_Append)(/*[in]*/ BOOL newVal);
            STDMETHOD(WriteField)(/*[in]*/ BSTR szMsg);
            STDMETHOD(WriteLine)(/*[in]*/ BSTR szMsg);
            STDMETHOD(put_FileHeader)(/*[in]*/ BSTR newVal);
            STDMETHOD(put_FileName)(/*[in]*/ BSTR newVal);

//          typedef enum err
private:

            BOOL                m_bAppend;
            BOOL                m_bInitialized;

            HANDLE              m_hTxnFile;
                        //handle to log file
            HANDLE              hIoComplete;
            //event to signify that there are no pending IOs
            HANDLE              hLogFileIo;
                        //event to signal the IO thread to write the
inactive buffer

            BYTE                *pBuffer[MAX_NUM_BUFFERS];
            BYTE                *pCurrent;
            //ptr to current buffer
            int                             iActiveBuffer;
                        //indicates which buffer is active: 0 or 1
            int                             iIoBuffer;
                        //buffer for any pending IO operation

            DWORD               dwError;

            DWORD               iBufferSize;
            //buffer allocated size
            DWORD               iBytesFreeInBuffer;
            //total bytes available for use in buffer
            DWORD               iWriteSize;
                        //bytes to write to file
```

```
        BSTR            m_szFile;
        //name of the file to write to
        BSTR            m_szHeader;
                //header to be printed to the file (optional)

private:
        static void     LogFileIO(void *p);
        HRESULT                 Write(BYTE *ptr,
DWORD iSize);
        STDMETHODIMP    WriteToFile(BSTR szMsg);
        void                    CloseLogFile(void);
        STDMETHODIMP    RaiseSystemError(void);
};

#endif //__SMLOG_H_
```

StdAfx.cpp

```
// FILE:      stdafx.cpp
//            Microsoft TPC-H Kit Ver. 1.00
//            Copyright Microsoft, 1999
//            All Rights Reserved
//
//
// PURPOSE:   source file that includes just the standard includes
// Contact:   Reshma Tharamal (reshmat@microsoft.com)
//
// stdafx.cpp : source file that includes just the standard includes
// stdafx.pch will be the pre-compiled header
// stdafx.obj will contain the pre-compiled type information

#include "stdafx.h"

#ifdef _ATL_STATIC_REGISTRY
#include <statreg.h>
#include <statreg.cpp>
#endif

#include <atlimpl.cpp>
```

StdAfx.h

```
// FILE:      stdafx.h
//            Microsoft TPC-H Kit Ver. 1.00
//            Copyright Microsoft, 1999
//            All Rights Reserved
//
//
// PURPOSE:   include file for standard system include files,
//      or project specific include files that are used frequently,
//      but are changed infrequently
// Contact:   Reshma Tharamal (reshmat@microsoft.com)
//

#if
!defined(AFX_STDAFX_H__5AC75DA4_1936_11D3_BC2D_00A0C
90D2CA5__INCLUDED_)
#define
AFX_STDAFX_H__5AC75DA4_1936_11D3_BC2D_00A0C90D2CA
5__INCLUDED_

#if _MSC_VER > 1000
#pragma once
#endif // _MSC_VER > 1000

#define STRICT
#ifndef _WIN32_WINNT
#define _WIN32_WINNT 0x0400
#endif
#define _ATL_APARTMENT_THREADED

#include <atlbase.h>
//You may derive a class from CComModule and use it if you want to
override
//something, but do not change the name of _Module
extern CComModule _Module;
#include <atlcom.h>

//{{AFX_INSERT_LOCATION}}
// Microsoft Visual C++ will insert additional declarations immediately
before the previous line.

#endif //
!defined(AFX_STDAFX_H__5AC75DA4_1936_11D3_BC2D_00A0C
90D2CA5__INCLUDED)
```

The listings in this section implement the SMTime module

resource.h

```
// FILE:      resource.h
//            Microsoft TPC-H Kit Ver. 1.00
//            Copyright Microsoft, 1999
//            All Rights Reserved
//
//
// PURPOSE:   Resource file
// Contact:   Reshma Tharamal (reshmat@microsoft.com)
//
//{{NO_DEPENDENCIES}}
// Microsoft Developer Studio generated include file.
// Used by SMTime.rc
//
#define IDS_PROJNAME            100
#define IDR_SMTIMER             102

// Next default values for new objects
//
#ifdef APSTUDIO_INVOKED
#ifndef APSTUDIO_READONLY_SYMBOLS
#define _APS_NEXT_RESOURCE_VALUE        201
#define _APS_NEXT_COMMAND_VALUE         32768
#define _APS_NEXT_CONTROL_VALUE         201
#define _APS_NEXT_SYMED_VALUE           103
#endif
#endif
```

SMTime.cpp

```
// FILE:      SMTime.cpp
//            Microsoft TPC-H Kit Ver. 1.00
//            Copyright Microsoft, 1999
//            All Rights Reserved
//
//
// PURPOSE:   Implementation of DLL Exports.
// Contact:   Reshma Tharamal (reshmat@microsoft.com)
//
// SMTime.cpp : Implementation of DLL Exports.


// Note: Proxy/Stub Information
//      To build a separate proxy/stub DLL,
//      run nmake -f SMTimeps.mk in the project directory.

#include "stdafx.h"
```

```
#include "resource.h"
#include <initguid.h>
#include "SMTime.h"

#include "SMTime_i.c"
#include "SMTimer.h"


CComModule _Module;

BEGIN_OBJECT_MAP(ObjectMap)
OBJECT_ENTRY(CLSID_SMTimer, CSMTimer)
END_OBJECT_MAP()

/////////////////////////////////////////////////////////////////////////////
// DLL Entry Point

extern "C"
BOOL WINAPI DllMain(HINSTANCE hInstance, DWORD
dwReason, LPVOID /*lpReserved*/)
{
   if (dwReason == DLL_PROCESS_ATTACH)
   {
      _Module.Init(ObjectMap, hInstance, &LIBID_SMTIMELib);
      DisableThreadLibraryCalls(hInstance);
   }
   else if (dwReason == DLL_PROCESS_DETACH)
      _Module.Term();
   return TRUE;    // ok
}

/////////////////////////////////////////////////////////////////////////////
// Used to determine whether the DLL can be unloaded by OLE

STDAPI DllCanUnloadNow(void)
{
   return (_Module.GetLockCount()==0) ? S_OK : S_FALSE;
}

/////////////////////////////////////////////////////////////////////////////
// Returns a class factory to create an object of the requested type

STDAPI DllGetClassObject(REFCLSID rclsid, REFIID riid, LPVOID*
ppv)
{
   return _Module.GetClassObject(rclsid, riid, ppv);
}

/////////////////////////////////////////////////////////////////////////////
// DllRegisterServer - Adds entries to the system registry

STDAPI DllRegisterServer(void)
{
   // registers object, typelib and all interfaces in typelib
   return _Module.RegisterServer(TRUE);
}

/////////////////////////////////////////////////////////////////////////////
// DllUnregisterServer - Removes entries from the system registry

STDAPI DllUnregisterServer(void)
{
   return _Module.UnregisterServer(TRUE);
}
```

SMTime.h

```
/* this ALWAYS GENERATED file contains the definitions for the
interfaces */


/* File created by MIDL compiler version 5.01.0164 */
/* at Thu Sep 19 17:49:55 2002
 */
/* Compiler settings for
C:\charles\Stepmaster\COMMON\SMTime\SMTime.idl:
   Oicf (OptLev=i2), W1, Zp8, env=Win32, ms_ext, c_ext
   error checks: allocation ref bounds_check enum stub_data
*/
//@@MIDL_FILE_HEADING(  )


/* verify that the <rpcndr.h> version is high enough to compile this
file*/
#ifndef __REQUIRED_RPCNDR_H_VERSION__
#define __REQUIRED_RPCNDR_H_VERSION__ 440
#endif

#include "rpc.h"
#include "rpcndr.h"

#ifndef __RPCNDR_H_VERSION__
#error this stub requires an updated version of <rpcndr.h>
#endif // __RPCNDR_H_VERSION__

#ifndef COM_NO_WINDOWS_H
#include "windows.h"
#include "ole2.h"
#endif /*COM_NO_WINDOWS_H*/

#ifndef __SMTime_h__
#define __SMTime_h__

#ifdef __cplusplus
extern "C"{
#endif

/* Forward Declarations */

#ifndef __ISMTimer_FWD_DEFINED__
#define __ISMTimer_FWD_DEFINED__
typedef interface ISMTimer ISMTimer;
#endif      /* __ISMTimer_FWD_DEFINED__ */


#ifndef __SMTimer_FWD_DEFINED__
#define __SMTimer_FWD_DEFINED__

#ifdef __cplusplus
typedef class SMTimer SMTimer;
#else
typedef struct SMTimer SMTimer;
#endif /* __cplusplus */

#endif      /* __SMTimer_FWD_DEFINED__ */


/* header files for imported files */
#include "oaidl.h"
#include "ocidl.h"

void __RPC_FAR * __RPC_USER MIDL_user_allocate(size_t);
void __RPC_USER MIDL_user_free( void __RPC_FAR * );

#ifndef __ISMTimer_INTERFACE_DEFINED__
#define __ISMTimer_INTERFACE_DEFINED__

/* interface ISMTimer */
/* [unique][helpstring][dual][uuid][object] */
```

```
EXTERN_C const IID IID_ISMTimer;

#if defined(__cplusplus) && !defined(CINTERFACE)

   MIDL_INTERFACE("1A6D0AE4-8528-453B-B8E3-
8DAD1F0561B7")
   ISMTimer : public IDispatch
   {
   public:
      virtual /* [helpstring][id] */ HRESULT
STDMETHODCALLTYPE Start( void) = 0;

      virtual /* [helpstring][id] */ HRESULT
STDMETHODCALLTYPE Stop(
         CURRENCY __RPC_FAR *pElapsedTime) = 0;

      virtual /* [helpstring][id][propget] */ HRESULT
STDMETHODCALLTYPE get_Running(
         /* [retval][out] */ BOOL __RPC_FAR *pVal) = 0;

   };

#else        /* C style interface */

   typedef struct ISMTimerVtbl
   {
      BEGIN_INTERFACE

      HRESULT ( STDMETHODCALLTYPE __RPC_FAR
*QueryInterface )(
         ISMTimer __RPC_FAR * This,
         /* [in] */ REFIID riid,
         /* [iid_is][out] */ void __RPC_FAR *__RPC_FAR
*ppvObject);

      ULONG ( STDMETHODCALLTYPE __RPC_FAR *AddRef )(
         ISMTimer __RPC_FAR * This);

      ULONG ( STDMETHODCALLTYPE __RPC_FAR *Release )(
         ISMTimer __RPC_FAR * This);

      HRESULT ( STDMETHODCALLTYPE __RPC_FAR
*GetTypeInfoCount )(
         ISMTimer __RPC_FAR * This,
         /* [out] */ UINT __RPC_FAR *pctinfo);

      HRESULT ( STDMETHODCALLTYPE __RPC_FAR
*GetTypeInfo )(
         ISMTimer __RPC_FAR * This,
         /* [in] */ UINT iTInfo,
         /* [in] */ LCID lcid,
         /* [out] */ ITypeInfo __RPC_FAR *__RPC_FAR *ppTInfo);

      HRESULT ( STDMETHODCALLTYPE __RPC_FAR
*GetIDsOfNames )(
         ISMTimer __RPC_FAR * This,
         /* [in] */ REFIID riid,
         /* [size_is][in] */ LPOLESTR __RPC_FAR *rgszNames,
         /* [in] */ UINT cNames,
         /* [in] */ LCID lcid,
         /* [size_is][out] */ DISPID __RPC_FAR *rgDispId);

      /* [local] */ HRESULT ( STDMETHODCALLTYPE
__RPC_FAR *Invoke )(
         ISMTimer __RPC_FAR * This,
         /* [in] */ DISPID dispIdMember,
         /* [in] */ REFIID riid,
         /* [in] */ LCID lcid,
         /* [in] */ WORD wFlags,
         /* [out][in] */ DISPPARAMS __RPC_FAR *pDispParams,
         /* [out] */ VARIANT __RPC_FAR *pVarResult,
         /* [out] */ EXCEPINFO __RPC_FAR *pExcepInfo,
         /* [out] */ UINT __RPC_FAR *puArgErr);

      /* [helpstring][id] */ HRESULT ( STDMETHODCALLTYPE
__RPC_FAR *Start )(
         ISMTimer __RPC_FAR * This);

      /* [helpstring][id] */ HRESULT ( STDMETHODCALLTYPE
__RPC_FAR *Stop )(
         ISMTimer __RPC_FAR * This,
         CURRENCY __RPC_FAR *pElapsedTime);

      /* [helpstring][id][propget] */ HRESULT (
STDMETHODCALLTYPE __RPC_FAR *get_Running )(
         ISMTimer __RPC_FAR * This,
         /* [retval][out] */ BOOL __RPC_FAR *pVal);

      END_INTERFACE
   } ISMTimerVtbl;

   interface ISMTimer
   {
      CONST_VTBL struct ISMTimerVtbl __RPC_FAR *lpVtbl;
   };


#ifdef COBJMACROS


#define ISMTimer_QueryInterface(This,riid,ppvObject)          \
   (This)->lpVtbl -> QueryInterface(This,riid,ppvObject)

#define ISMTimer_AddRef(This)          \
   (This)->lpVtbl -> AddRef(This)

#define ISMTimer_Release(This)          \
   (This)->lpVtbl -> Release(This)


#define ISMTimer_GetTypeInfoCount(This,pctinfo)     \
   (This)->lpVtbl -> GetTypeInfoCount(This,pctinfo)

#define ISMTimer_GetTypeInfo(This,iTInfo,lcid,ppTInfo)          \
   (This)->lpVtbl -> GetTypeInfo(This,iTInfo,lcid,ppTInfo)

#define
ISMTimer_GetIDsOfNames(This,riid,rgszNames,cNames,lcid,rgDispId
)          \
   (This)->lpVtbl ->
GetIDsOfNames(This,riid,rgszNames,cNames,lcid,rgDispId)

#define
ISMTimer_Invoke(This,dispIdMember,riid,lcid,wFlags,pDispParams,p
VarResult,pExcepInfo,puArgErr)\
   (This)->lpVtbl ->
Invoke(This,dispIdMember,riid,lcid,wFlags,pDispParams,pVarResult,p
ExcepInfo,puArgErr)


#define ISMTimer_Start(This)    \
   (This)->lpVtbl -> Start(This)

#define ISMTimer_Stop(This,pElapsedTime)          \
   (This)->lpVtbl -> Stop(This,pElapsedTime)

#define ISMTimer_get_Running(This,pVal) \
   (This)->lpVtbl -> get_Running(This,pVal)
```

```
#endif /* COBJMACROS */


#endif       /* C style interface */



/* [helpstring][id] */ HRESULT STDMETHODCALLTYPE
ISMTimer_Start_Proxy(
    ISMTimer __RPC_FAR * This);


void __RPC_STUB ISMTimer_Start_Stub(
    IRpcStubBuffer *This,
    IRpcChannelBuffer *_pRpcChannelBuffer,
    PRPC_MESSAGE _pRpcMessage,
    DWORD *_pdwStubPhase);


/* [helpstring][id] */ HRESULT STDMETHODCALLTYPE
ISMTimer_Stop_Proxy(
    ISMTimer __RPC_FAR * This,
    CURRENCY __RPC_FAR *pElapsedTime);


void __RPC_STUB ISMTimer_Stop_Stub(
    IRpcStubBuffer *This,
    IRpcChannelBuffer *_pRpcChannelBuffer,
    PRPC_MESSAGE _pRpcMessage,
    DWORD *_pdwStubPhase);


/* [helpstring][id][propget] */ HRESULT STDMETHODCALLTYPE
ISMTimer_get_Running_Proxy(
    ISMTimer __RPC_FAR * This,
    /* [retval][out] */ BOOL __RPC_FAR *pVal);


void __RPC_STUB ISMTimer_get_Running_Stub(
    IRpcStubBuffer *This,
    IRpcChannelBuffer *_pRpcChannelBuffer,
    PRPC_MESSAGE _pRpcMessage,
    DWORD *_pdwStubPhase);



#endif       /* __ISMTimer_INTERFACE_DEFINED__ */



#ifndef __SMTIMELib_LIBRARY_DEFINED__
#define __SMTIMELib_LIBRARY_DEFINED__

/* library SMTIMELib */
/* [helpstring][version][uuid] */


EXTERN_C const IID LIBID_SMTIMELib;


#ifndef __StepMasterTimeFunctions_MODULE_DEFINED__
#define __StepMasterTimeFunctions_MODULE_DEFINED__


/* module StepMasterTimeFunctions */
/* [dllname][version][helpstring] */

/* [entry][helpstring] */ CURRENCY __stdcall Get64BitTime(
    /* [in] */ LPSYSTEMTIME lpInitTime);

/* [entry][helpstring] */ void __stdcall JulianToTime(
    /* [in] */ CURRENCY julianTS,
    /* [out][in] */ int __RPC_FAR *yr,
    /* [out][in] */ int __RPC_FAR *mm,
    /* [out][in] */ int __RPC_FAR *dd,
    /* [out][in] */ int __RPC_FAR *hh,
    /* [out][in] */ int __RPC_FAR *mi,
    /* [out][in] */ int __RPC_FAR *ss,
    /* [out][in] */ int __RPC_FAR *ms);

#endif /* __StepMasterTimeFunctions_MODULE_DEFINED__ */

EXTERN_C const CLSID CLSID_SMTimer;

#ifdef __cplusplus

class DECLSPEC_UUID("27BAB71B-89E1-4A78-8854-
FDFFBDC8037E")
SMTimer;
#endif
#endif /* __SMTIMELib_LIBRARY_DEFINED__ */

/* Additional Prototypes for ALL interfaces */

/* end of Additional Prototypes */

#ifdef __cplusplus
}
#endif

#endif
```

SMTimer.cpp

```
//  FILE:      SMTimer.cpp
//             Microsoft TPC-H Kit Ver. 1.00
//             Copyright Microsoft, 1999
//             All Rights Reserved
//
//
//  PURPOSE:    Implementation of CSMTimer
//  Contact:    Reshma Tharamal (reshmat@microsoft.com)
//
// SMTimer.cpp : Implementation of CSMTimer
#include "stdafx.h"
#include "SMTime.h"
#include "SMTimer.h"

/////////////////////////////////////////////////////////////////////////////
// CSMTimer

/////////////////////////////////////////////////////////////////////////////
// Construction/Destruction
/////////////////////////////////////////////////////////////////////////////

CSMTimer::~CSMTimer()
{

}

STDMETHODIMP CSMTimer::Start()
{
            // Starts the timer
            assert(!m_bInProcess);
            m_bInProcess = TRUE;

            m_lStartTime = MyTickCount();

            return S_OK;
```

```
}

STDMETHODIMP CSMTimer::Stop(CURRENCY *pElapsedTime)
{
	TC_TIME		lEndTime = MyTickCount();

	// Stops the timer and returns the elapsed time
	assert(m_bInProcess);
	m_bInProcess = FALSE;

	pElapsedTime->int64 = lEndTime - m_lStartTime;

	return S_OK;
}

TC_TIME CSMTimer::MyTickCount(void)
{
	TC_TIME currentTC;
	LARGE_INTEGER	l;
	__int64 count;

	//The purpose of this function is to prevent the 49 day
wrapping effect of the
	//system API GetTickCount(). This function essentially
provides a monotonically
	//increasing timer value which is milliseconds from class
instantiation.

	if ( m_bCountUnavailable )
	{
		count = (__int64)GetTickCount();
		currentTC = (TC_TIME)(count-m_baseTC);
	}
	else
	{
		QueryPerformanceCounter(&l);
		count = (__int64)l.HighPart << 32 |
(__int64)l.LowPart;
		currentTC = (TC_TIME)(((count-m_baseTC) *
1000) / m_Timerfreq);
	}

	return currentTC;
}

STDMETHODIMP CSMTimer::get_Running(BOOL *pVal)
{
	*pVal = m_bInProcess;

	return S_OK;
}

CURRENCY __stdcall Get64BitTime(LPSYSTEMTIME lpInitTime)
{
	__int64	ms_day, ms_hour, ms_minute, ms_seconds,
ms_milliseconds, ms_total;
	int		day;
	SYSTEMTIME	tim;
	CURRENCY	tmReturn;

	if ( lpInitTime )
		memcpy(&tim, lpInitTime,
sizeof(SYSTEMTIME));
	else
		GetLocalTime(&tim);
	day = JulianDay((int)tim.wYear, (int)tim.wMonth,
(int)tim.wDay);

	ms_day		= (__int64)day *
(__int64)(24 * 1000 * 60 * 60);
	ms_hour		= (__int64)tim.wHour*
(__int64)(1000 * 3600);
	ms_minute	= (__int64)tim.wMinute * (1000 *
60);
	ms_seconds	= (__int64)(tim.wSecond *
1000);
	ms_milliseconds	= (__int64)tim.wMilliseconds;

	ms_total = ms_day + ms_hour + ms_minute + ms_seconds +
ms_milliseconds;
	tmReturn.int64 = ms_total;

	return tmReturn;
}

// JulianDay computes the number of days since Jan 1, 1900.
// This function is valid for dates from 1-Jan-1900 to 1-Jan-2100.
// 1-Jan-1900 = 0
int JulianDay( int yr, int mm, int dd )
{
	// MonthArray contains cumulative days for months in a non
leap-year
	int MonthArray[12] = { 0, 31, 59, 90, 120, 151, 181, 212,
243, 273, 304, 334};
	int j1, j2;

	// compute day of year (j1)
	j1 = MonthArray[mm-1] + dd - 1;
	// adjust day of year if this is a leap year and it is after
February
	if ((yr % 4)==0 && (yr != 1900) && (mm > 2))
		j1++;
	// compute number of days from 1/1/1900 to beginning of
present year
	j2 = (yr-1900)*365 + (yr-1901)/4;
	return j1+j2;

}

// Breaks up the Julian Time into it's sub-components
void __stdcall SMTime_JulianToTime( CURRENCY CurJulian, int*
yr, int* mm, int* dd, int *hh, int *mi, int *ss, int *ms )
{
	int julianDay, msLeft;
	JULIAN_TIME		julianTS = CurJulian.int64;

	*ms = julianTS % 1000;

	julianTS /= 1000;

	julianDay = (int)(julianTS / ( 60 * 60 * 24 ));

	JulianToCalendar(julianDay, yr, mm, dd );

	msLeft = (int)(julianTS - (julianDay * (__int64)( 60 * 60 *
24 )));

	*hh = msLeft / (60 * 60);
	msLeft = msLeft - *hh * 3600;
	*mi = msLeft / (60);
	*ss = msLeft % 60;
}

// JulianToCalendar converts a day index (from the JulianDay function)
to
// its corresponding calendar value (mm/dd/yr).  The valid range for
days
// is { 0 .. 73049 } for dates from 1-Jan-1900 to 1-Jan-2100.
void JulianToCalendar( int day, int* yr, int* mm, int* dd )
{
```

```
	int y, m, d;
	// month array contains days of months for months in a non
leap-year
	int month[12] = { 31, 28, 31, 30, 31, 30, 31, 31, 30, 31, 30,
31 };

	// compute year from days
	if (day < 365)
		y = 1900;
	else
		y = 1901 + ((day-365)/1461)*4 + (4*((day-
365)%1461)+3)/1461;

	// adjust February if this year is a leap year
	if ((y % 4)==0 && (y != 1900))
		month[1] = 29;
	else
		month[1] = 28;

	d = day - JulianDay( y, 1, 1 ) + 1;
	m = 1;

	while (d > month[m-1])
	{
		d = d - month[m-1];
		m++;
	}

	*yr = y;
	*mm = m;
	*dd = d;
}
```

SMTimer.h

```
//  FILE:	SMTimer.h
//		Microsoft TPC-H Kit Ver. 1.00
//		Copyright Microsoft, 1999
//		All Rights Reserved
//
//
//  PURPOSE:	Declaration of the CSMTimer
//  Contact:	Reshma Tharamal (reshmat@microsoft.com)
//
// SMTimer.h : Declaration of the CSMTimer

#ifndef __SMTIMER_H_
#define __SMTIMER_H_

#include "resource.h"	// main symbols

#include "assert.h"

#define	MAX_JULIAN_TIME
	0x7FFFFFFFFFFFFFFF
#define JULIAN_TIME		__int64
#define	TC_TIME		DWORD

#ifdef SMTIMER
#define DLL_LINK	__declspec( dllexport )
#else
#define DLL_LINK	__declspec( dllimport )
#endif

#ifdef __cplusplus
extern "C"
{
#endif
//DLL_LINK		CURRENCY		__stdcall
SMTime_Get64BitTime(LPSYSTEMTIME lpInitTime);
int		JulianDay( int yr, int mm, int dd );
void		JulianToCalendar( int day, int* yr, int* mm, int*
dd );
#ifdef __cplusplus
}
#endif


/////////////////////////////////////////////////////////////////////////////
// CSMTimer
class ATL_NO_VTABLE CSMTimer :
	public CComObjectRootEx<CComSingleThreadModel>,
	public CComCoClass<CSMTimer, &CLSID_SMTimer>,
	public IDispatchImpl<ISMTimer, &IID_ISMTimer,
&LIBID_SMTIMELib>
{
public:
	CSMTimer()
	{
		LARGE_INTEGER	l;

		if ( !QueryPerformanceFrequency(&l) )
		{
			m_baseTC =
(__int64)GetTickCount();
			m_bCountUnavailable = TRUE;
		}
		else
		{
			m_bCountUnavailable = FALSE;

			m_Timerfreq = (__int64)l.HighPart
<< 32 | (__int64)l.LowPart;
			QueryPerformanceCounter(&l);
			m_baseTC = (__int64)l.HighPart <<
32 | (__int64)l.LowPart;
		}
		m_bInProcess = FALSE;
	}

DECLARE_REGISTRY_RESOURCEID(IDR_SMTIMER)

DECLARE_PROTECT_FINAL_CONSTRUCT()

BEGIN_COM_MAP(CSMTimer)
	COM_INTERFACE_ENTRY(ISMTimer)
	COM_INTERFACE_ENTRY(IDispatch)
//	COM_INTERFACE_ENTRY2(IDispatch, ISMTimer)
END_COM_MAP()

// ISMTimer
public:
	STDMETHOD(get_Running)(/*[out, retval]*/ BOOL
*pVal);
	STDMETHOD(Stop)(CURRENCY *pElapsedTime);
	STDMETHOD(Start)();
	virtual ~CSMTimer();

private:
	__int64		m_baseTC;
	__int64		m_Timerfreq;
	BOOL		m_bCountUnavailable;
	TC_TIME		m_lStartTime;
	BOOL		m_bInProcess;

	TC_TIME		MyTickCount(void);
};

#endif //__SMTIMER_H_
```

StdAfx.cpp

```
// stdafx.cpp : source file that includes just the standard includes
//  stdafx.pch will be the pre-compiled header
//  stdafx.obj will contain the pre-compiled type information

#include "stdafx.h"

#ifdef _ATL_STATIC_REGISTRY
#include <statreg.h>
#include <statreg.cpp>
#endif

#include <atlimpl.cpp>
```

StdAfx.h

```
//  FILE:       stdafx.h
//              Microsoft TPC-H Kit Ver. 1.00
//              Copyright Microsoft, 1999
//              All Rights Reserved
//
//
//  PURPOSE:    include file for standard system include files,
//      or project specific include files that are used frequently,
//      but are changed infrequently
//  Contact:    Reshma Tharamal (reshmat@microsoft.com)
//

#if
!defined(AFX_STDAFX_H__4CDF88F4_EE9C_4F29_8212_61557F2
51BDD__INCLUDED_)
#define
AFX_STDAFX_H__4CDF88F4_EE9C_4F29_8212_61557F251BDD_
_INCLUDED_

#if _MSC_VER > 1000
#pragma once
#endif // _MSC_VER > 1000

#define STRICT
#ifndef _WIN32_WINNT
#define _WIN32_WINNT 0x0400
#endif
#define _ATL_APARTMENT_THREADED

#include <atlbase.h>
//You may derive a class from CComModule and use it if you want to
override
//something, but do not change the name of _Module
extern CComModule _Module;
#include <atlcom.h>

//{{AFX_INSERT_LOCATION}}
// Microsoft Visual C++ will insert additional declarations immediately
before the previous line.

#endif //
!defined(AFX_STDAFX_H__4CDF88F4_EE9C_4F29_8212_61557F2
51BDD__INCLUDED)
```

APPENDIX F: THIRD PARTY QUOTES

Microsoft Corporation
One Microsoft Way
Redmond, WA 98052-6399

Tel 425 882 8080
Fax 425 936 7329
http://www.microsoft.com/

Microsoft

January 24, 2006

Bull
Francy Jourdan
Ave. Jean Jaures - BP 68
Les Clayes-sous-Bois, 78340

Mr. Jourdan:

Here is the information you requested regarding pricing for several Microsoft products to be used in conjunction with your TPC-H benchmark testing.

All pricing shown is in US Dollars ($).

Part Number	Description	Unit Price	Quantity	Price
810-04793	**SQL Server 2005 Enterprise Itanium Edition** *Server License with 25 CALs* *Discount Schedule: Open Program - No Level* *Unit Price reflects a 39% discount from the retail unit price of $13,969.*	$8,487	1	$8,487
359-01911	**SQL Server 2005 Client License** *Discount Schedule: Open Program - No Level* *Unit Price reflects a 4% discount from the retail unit price of $163.*	$156	45	$7,020
P72-00284	**Windows Server 2003 Enterprise Edition for Itanium-based Systems** *Server License Only - No CALs* *Discount Schedule: Open Program - No Level* *Unit Price reflects a 41% discount from the retail unit price of $3,999.*	$2,334	1	$2,334
254-00170	**Microsoft Visual C++ Standard Edition** *No Discount Applied*	$109	1	$109
046-00856	**Microsoft Visual Basic .Net Professional** *No Discount Applied*	$109	1	$109
N/A	**Microsoft Problem Resolution Services** *Professional Support* *(1 Incident)*	$245	1	$245

All products are currently orderable through Microsoft's normal distribution channels. A list of Microsoft's authorized resellers can be found at: http://www.microsoft.com/products/info/render.aspx?view=22&type=mnp&content=22/licensing.

Defect support is included in the purchase price. Additional support is available from Microsoft PSS on an incident by incident basis at $245 per call.

This quote is valid for the next 90 days.

If we can be of any further assistance, please contact Jamie Reding at (425) 703-0510 or jamiere@microsoft.com.

Reference ID: PHfrjo0124107067.
Please include this Reference ID in any correspondence regarding this price quote.

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LSI Logic SAS3442E-R SATA II RAID PCI-E Controller Card 5-Pack at Heightsperformance.com - Windows Internet Explorer

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LSI Logic SAS3442E-R SATA II RAID PCI-E Controller Card 5-Pack

$1,140.00

MGF# LSI00111
HPS# A153046B

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Description | Details

Product Details

- Data Transfer Rate: 3Gbps per port
- Warranty: 3 years
- RAID Levels: RAID 0, 1, 1E, 10E
- Bus Type: PCI-E
- External Connectors: 8-port
- Operating Temperature: 0°to 60°C
- x4 internal SFF-8484 /x4 external SFF-8470 connectors
- MD-2 small form factor design
- Connects to both SAS and SATA HDDs and tape drives
- Allows more than 122 total end-point devices
- Fusion-MPT architecture provides more than 140,000 I/Os per second
- Supports all major operating systems
- Integrated RAID avoids additional host CPU overhead
- Flexible SAS/SATA array architecture optimizes cost
- SAS/SATA interconnect proven through robust LSI serial technology
- Speed: 3 Gb/s per port combines to 4.8 Gb/s full duplex speed
- Complete solution: kit includes all necessary cables and brackets
- Market leader: LSI SAS powers 80% of SAS worldwide

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LSI Logic SAS3442E-R SATA II RAID PCI-E Controller Card Retail

MGF# LSI00110
HPS# A153096R

$328.00

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Description | Details

Product Details

- Data Transfer Rate: 3Gbps per port
- Warranty: 3 years
- RAID Levels: RAID 0, 1, 1E, 10E
- Bus Type: PCI-E
- External Connectors: 8-port
- Operating Temperature: 0°to 60°C
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