



Edison Group, Inc.
Comparative Management Cost
Study of Oracle Database 10g
Release 2 and Microsoft SQL
Server 2005

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Executive Summary

This study compares the effort of managing Oracle Database 10g Release 2 to the effort of accomplishing equivalent tasks in Microsoft SQL Server 2005. Edison Group has previously published a series of manageability studies comparing the major RDBMS products in terms of their ability to manage and administer routine database tasks and resources. These manageability studies are based on our proprietary methodology, Comparative Management Cost Study (CMCS), which identifies the effort and complexity of administration processes. One of these earlier studies¹ compares Oracle Database 10g Release 1 and Microsoft SQL Server 2000. Both of these vendors have released new product versions since that study (Oracle Database 10g Release 2 and Microsoft SQL Server 2005), and this study compares these new releases using the same methodology used for earlier studies.

For the purpose of the study, Edison Group set up a laboratory environment for analyzing a suite of standard RDBMS administrative tasks and measured the respective time taken to complete tasks and complexity based on a proprietary manageability metric. Using the management efficiency results, Edison Group calculated the annual costs that businesses can save due to the enhanced DBA productivity that would result from using the product with superior manageability.

This study result shows that Oracle Database 10g Release 2 holds a substantial advantage in manageability over Microsoft SQL Server 2005. The study reveals that over the course of installing, maintaining, and operating a database:

- Database administrators (DBAs) can perform typical administrative functions in 38% less time when using Oracle Database 10g Release 2 compared to Microsoft SQL Server 2005.
- Oracle Database 10g Release 2 requires 30% fewer steps than Microsoft SQL Server 2005 for the same set of standard RDBMS administrative tasks based on Edison Group's metric for complexity assessment.
- Benefiting from increased DBA productivity, businesses can save up to \$31,664 per DBA per year by using Oracle Database 10g Release 2 rather than Microsoft SQL Server 2005.

There are numerous ways to interpret the significance of these savings, depending upon the size of the organizations involved and the relative importance attached to higher

¹ This study can be obtained from Edison Group, Inc. web site at <http://www.theedison.com>. The document can be found in the document library (Registration required): <http://www.theedison.com/index.php/articles/c51/>

productivity in these organizations. No matter which accounting approach is employed, the observed productivity increase and complex differential are quite significant.

The areas where the manageability of the two products differed the most were performance diagnostics & tuning and backup & recovery management. In the area of performance diagnostics and tuning – an area where DBAs spend a considerable amount of their time – Oracle’s performance diagnostic feature (Automatic Database Diagnostic Monitor) and its SQL tuning solution (SQL Tuning Advisor) were mainly responsible for Oracle’s advantage. Oracle Database 10g Release 2 required 74% less time and was 38% less complex than Microsoft SQL Server 2005 in this area.

In the backup and recovery area, Oracle Database 10g's automatic backup management and human-error recovery features were the primary factors behind its advantage over SQL Server. Oracle took 62% less time and 67% fewer steps than SQL Server in backup & recovery tasks.

The study also highlights the incremental manageability changes in the two products when compared to their prior releases. In our previous study comparing Oracle Database 10g Release 1 and Microsoft SQL Server 2000, Oracle came out ahead as well but by a smaller margin. In that study Oracle Database 10g Release 1 had a 30% time advantage and 20% complexity differential with Microsoft SQL Server 2000, compared to the 38% time and 30% complexity differential that Oracle Database 10g Release 2 now holds over SQL Server 2005. The two key factors responsible for Oracle extending its lead over SQL Server in this latest study were 1) Microsoft SQL Server 2005’s regression in install manageability compared to Microsoft SQL Server 2000, and 2) Oracle Database 10g Release 2’s improvement in managing day-to-day administration tasks through further automation of common tasks and enhanced user interface of its management tool, Oracle Enterprise Manager.

With this study Edison Group has validated the manageability advantage of using Oracle Database 10g over Microsoft SQL Server. With Oracle Database 10g Release 2, DBAs can expect to reduce their daily workload, and businesses can reduce their cost of managing enterprise database systems.

About This Report

This report documents the results of a head-to-head product comparison of the database administration functions of Oracle Database 10g Release 2 and Microsoft SQL Server 2005. The study focuses on the use of human resources. Its objective is to reveal the comparative database administration costs of operating the two products.

Common database management tasks were performed in Oracle Database 10g Release 2 and Microsoft SQL Server 2005 and compared for their ease of use. For both products, their native management tools — Oracle Enterprise Manager 10.2 Database Control for Oracle and Microsoft Management Studio for SQL Server — were used in the study. The purpose is to objectively measure (in quantitative and qualitative terms), the relative manageability of Oracle Database 10g Release 2 and Microsoft SQL Server 2005, and to project over the course of a year the expected savings in management cost due to the administrative efficiency of one product over the other.

Who Should Read this Report?

This report will be useful for corporate decision makers, technical end users (DBAs, database application developers and managers, and system administrators), and independent software vendors (ISVs). It will also be of particular interest to small and medium businesses with critical database requirements but limited IT resources to manage them, and new adoptors of these technologies.

Methodology Overview

This Comparative Management Cost Study (CMCS), conducted by Edison Group, compares the ease of use or manageability of Oracle Database 10g Release 2 and Microsoft SQL Server 2005 and assesses their relative cost of management to a business. It represents a product-specific application of a proprietary, general-purpose methodology developed by Edison Group for making product management cost comparisons. The result is a summary definition of the annual costs that will be incurred by any corporate IT department or ISV running either of these two products.

In the course of this study, Oracle Database 10g Release 2 and Microsoft SQL Server 2005 were compared against a set of methodology metrics in order to determine which of the two products is easier to operate for businesses with real-world database management requirements. The Test Administration Workload Task Areas that we used to perform this study fall into the following four categories:

- Database Setup and Configuration
- Day-to-Day Database Administration
- Backup and Recovery

- Performance Diagnostics and Tuning

Task categories were divided into individual tasks corresponding to significant activities in these areas. To determine the overall manageability of a given task for a given product, each task was broken down into steps to assess the complexity and usability involved.

Next, the task efforts were weighted based on a typical ratio of activities in database administration. These weights were used to determine the relative importance of a given task as measured against all of the tasks required to manage the entire product administration lifecycle. In other words, simple tasks that occur relatively infrequently were given a proportionately lower weighting than complex tasks that occur on a regular basis.

Finally, the results were tallied and the CMCS metrics for each product were substituted into manageability cost formulas to determine the projected human resources cost of operating both products, based on median DBA salary.

Contents of this Report

The following is a brief overview of the sections contained in this document, to provide for quick reference.

- **Rationale Behind this Report** – a discussion of the reasons Edison Group engaged in this research.
- **The Methodology Defined** – this section explains the criteria used in the study, including how we weighted and calculated the results and a description of the workloads evaluated.
- **Test Results** – presents the results of each set of tests, providing summary findings and a discussion of their relevance to business operations.
- **Conclusion** – summarizes our findings.
- **Appendices** – provide details on the test platform, clarification of architectural and terminology issues, the detailed test results, a discussion of our Complexity Calculation Formula, a detailed list of the actual steps performed and their individual timings, and a glossary of task areas.

Rationale behind this Comparison

If you work for or own a small- to mid-size business and run real-world, data-driven back office or Internet/e-commerce applications with commercial production transaction, data storage, and/or reporting requirements, chances are that your day-to-day business operation depends on either an Oracle or a SQL Server database. With the latest release of the Oracle Database 10g product, Oracle is offering a state-of-the-art RDBMS that promises small business customers all of the industrial-strength features and functions found in past Oracle products, with an ease of maintenance that Oracle claims will meet or exceed the point-and-click simplicity of administering a Microsoft SQL Server 2005 database. According to Oracle, Database 10g comes pre-configured and instrumented in a manner that is simpler to install, run, and maintain than Microsoft SQL Server 2005.

The main thrust of this paper is to independently test these claims on a point-by-point basis, in order to arrive at a set of quantitative and qualitative manageability metrics that determine:

- If Oracle Database 10g Release 2 are superior to Microsoft SQL Server 2005.
- Specifically, if Oracle Database 10g Release 2 is less expensive to operate than Microsoft SQL Server 2005 in terms of Comparative Management Costs for businesses with transactional, analytical, and data warehousing workloads that require DBA support.

The Methodology Defined

For purposes of this study, the methodology is defined as a product manageability cost evaluation process whereby the two products in question are compared against a set of task-oriented objective and subjective metrics in order to derive an accurate set of analytical results. The outcome of this study determines the Comparative Management Cost (CMC) incurred by managing and operating either of these products in a production environment. The methodology employed to conduct this comparison consists of the following elements.

- **Workload Weighting:** The workload weighting is a set of constants that define the relative importance of a single task area in the workload, based on frequency of execution and measured against the entire set of task areas that compose this study.
- **The Study:** The study is the baseline checklist of standard database administration tasks routinely performed, which are quantitatively and qualitatively compared in order to objectively determine, on a task-by-task basis, which product is superior. This is measured primarily in terms of ease of administration and secondarily (for certain tasks only) in terms of system speed of execution — the wall clock time it takes for the system in question to complete a job once it has been submitted by a

DBA. The function of this study is to apply a set of quantitative metrics, developed by Edison Group, to a list of tasks typically regarded as qualitative in nature, in order to derive a meaningful set of CMCS statistics that can reveal the real difference in management costs for the two products in question.

- **Tasks:** A task is defined as a complete unit of work, composed of one or more steps, all of which effect a significant alteration on the state of the database. Each task is measured for time and complexity. Time and complexity, as measured in the study, are defined as follows:
 - **Time:** Defined as the amount of time it takes to perform a given task. For certain (asynchronous) tasks, when a job can be run in the background so that the DBA can use the time for accomplishing other tasks, time is measured strictly in terms of the time it takes the DBA to perform the steps to configure, initiate, and submit a given task.

For other (synchronous) tasks in the study that demand the DBA's full attention and prevent the accomplishment of other tasks (as in performing a hot recovery operation on a live database), time is measured to include both the time it takes for a DBA to configure/execute the task in question as well as the time it takes the system to complete the task. All time metrics are measured in wall clock time and are rounded up to the nearest ten seconds.

- **Complexity:** For the purposes of this study, complexity is measured using a proprietary metric devised by Edison Group. It is defined as the number of computed *steps* it takes to complete a given task, where a step is defined as a task component that effects a change of state to the database. Creating a filegroup or tablespace is an example of step.

Because not all steps have the same inherent complexity, each step is further broken down into *increments* to account for the difference. An increment is a decision point that the user must make to complete a step. Increments are technically defined as a part of a step that will have a measurable effect on the state or execution path of that step in the task process, but which in and of itself does not effect a change upon the underlying database state until the step being executed is complete. For example, selecting Basic vs. Advanced Install and clicking the Next button in the Oracle installation wizard screen is an increment which effects an incremental change on the flow of the database installation process but does not change the state of the database.

Complexity is then measured in terms of number of steps but taking into account the following factors:

- The number of increments it takes to complete each step.

- Whether or not instrumentation for a given step is GUI-based or requires the use of a command line/scripting interface.
- Whether or not the task requires a context switch between multiple interfaces in order to be completed. If a context switch exists, then additional steps will be added to the total step count for a given task.

The above factors affect the complexity calculation as follows:

- For every 6th increment taken to complete a step in a task, the step is increased by 1. So if a step has between 0-5 increments, it remains unchanged, if it has between 6-10, it is increased by 1, between 11-15, it is increased by 2, and so on. We decided to do this because while increments are secondary to steps in determining complexity, they do modify the relative complexity of a given step in the course of completing a task. In other words, steps with a low number of increments are simple, and steps with a high number of increments are complex.
- The other modifiers (instrumentation and context switching) occur very infrequently in each of the products under review, but they were significant enough a factor that we needed to account for them in some meaningful way in order to generate a measure of complexity that accurately reflects our experience of using the two products.

Regarding instrumentation, if an operation could be executed entirely within a GUI interface, then the complexity/step value for that task would remain unmodified. If, on the other hand, a step required the use of a command line interface, this would increase the step count. For a simple single-line command operation, the step count was increased by 1, whereas if the operation required the user to write a script, the step value was increased by 2 or more, depending on how much work was required to write the script in question.

Lastly, we come to the matter of context switching. If a context switch was encountered during the course of completing a given task, then 2 or more steps were added to the step count for that task. The possible addition of more than 2 steps was allowed for as a judgment call on the part of the analyst performing the task under consideration. The reason tasks containing context switches were penalized is that we consider that the complexity of understanding the dependencies of relating and performing a single operation in two different environments in order to complete a single task is inherently more complex than performing a similarly complex task in a well-integrated environment, where all the operations can be accomplished in one place.

The workload for this CMCS was reduced to the basic set of atomic maintenance operations that effectively fulfill all fundamental database administration procedures. The reasoning

behind this approach is that enterprise-class database configuration and administration is a non-trivial matter; we therefore set out to develop a (relatively) simple yet comprehensive evaluation process, establishing a CMCS methodology benchmark that we feel is realistic in its technical assessment, yet accessible to the large audience of non-technical decision makers who will read this document.

The evaluation of each task in the study workload was executed by measuring the product's performance in that workload task area against the methodology metrics. This was the process we used in order to test the assertion that Oracle Database 10g Release 2 is less expensive to operate than Microsoft's SQL Server 2005.

This CMCS Methodology has been derived from the following sources:

- The initial baseline workload task list for this paper was based upon research performed by Oracle. This initial baseline was then modified by Edison Group and certain tasks were removed in order to compare both products on equal terms.
- The workload task weighting was based on a survey published by *Database Trends*.
- The baseline workload task list was checked for process consistency by Edison Group analysts against the Oracle Database 10g Administrators Guide.
- The baseline workload weighting and task list was further checked for consistency against Microsoft SQL Server 2005 Books Online documentation, Microsoft release training materials for SQL Server 2005. When the study was conducted, these were the most detailed resources for best practices in SQL Server 2005 management.
- Independent professional Oracle and SQL Server database administrators and engineers were consulted as anonymous third-party verifiers of the methodology and workload tasks employed in the course of conducting this CMCS.

Workload Weighting

To view these results in terms of management costs, we recognized that the tasks in the workload have different levels of importance and complexity, and are performed at differing levels of frequency. For example, tuning a database or creating a new table is performed more frequently than creating a new database. In order to accurately account for this, we have used a weighted average of the workload test areas to measure each set of tasks according to their typical degree of use. Here are the weightings used for this CMCS.

Database Administration Workload Weighting	
Setup and Configuration	5%
Day to Day Administration	34%
Backup & Recovery	14%

Database Administration Workload Weighting	
Performance Tuning	26%
Other	21%
Total	100%

The Database Workload Weighting metrics in the table above came out of an article published in [Database Trends and Applications Online](#) in 2002. The “Other” category represents tasks that were not included in the study, such as software license maintenance and database upgrades. We left this category in the weighting in order to acknowledge in the Comparative Management Costs (CMC) calculations that such activities are a necessary part of day-to-day business. Furthermore, in performing the CMC calculations for this analysis, it was presumed that both products required the same degree of “Other” tasks so as not to favor one product over the other. This approach renders the 21% of the workload weighting that falls into the “Other” category irrelevant to the outcome of this study.

Test Administration Workload

- **Database Setup and Configuration (Workload Task Category)**
 - Install database/software/out-of-box setup
 - Create new database/server instance
 - Set up proactive monitoring
- **Day-to-Day Database Administration (Workload Task Category)**
 - Create user with roles, privileges
 - Create tablespace/filegroup
 - Add space to database
 - Create table
 - Create index
 - Reclaim wasted space from tables with fragmented data
 - Load data from text file
- **Backup and Recovery Tasks (Workload Task Category)**
 - Configure and perform full backup
 - Recover dropped table
 - Recover data file
 - Recover from erroneous transaction

- **Performance Diagnostics and Tuning Tasks (Workload Task Category)**
 - Diagnose performance problem
 - Fix performance problem (tune SQL statement)
 - Tune memory

Test Results²

The table below presents the cumulative test results of the study. In summary, Oracle's claims for their new product held true, with Oracle Database 10g Release 2 outperforming Microsoft SQL Server 2005.

Result Summary	Time (mins)		Complexity (steps)	
	SQL Server	Oracle	SQL Server	Oracle
Overall Total	93.08	46.66	65	25
% difference -- (SS - Oracle)/SS*	47%		49%	
DBA Workday Savings	38.2%		30%	

Oracle Database 10g Release 2 took 47% less time and 49% fewer steps to complete all the tasks in the study. After adjusting the tasks for their prominence in a DBA workday (because not all tasks are performed with equal frequency as discussed in the Workload Weighting section of the report), the study revealed that a typical DBA will need 38.2% less time to perform common administrative functions with Oracle Database 10g Release 2 than with Microsoft SQL Server 2005. Similarly, for product complexity, DBAs will require 30% fewer steps with Oracle Database 10g Release 2 than with Microsoft SQL Server 2005 in the course of their typical workday.

The areas responsible for Oracle Database 10g Release 2's advantage over Microsoft SQL Server 2005 are as follows:

- **Performance Diagnostics & Tuning:** Oracle's unique solutions in proactive performance diagnostics and automatic SQL tuning areas were behind Oracle's advantage. In this area, Oracle Database 10g Release 2 took 74% less time and 38% fewer steps than Microsoft SQL Server 2005.
- **Backup & Recovery:** In this area, Oracle's architectural and functional capabilities like flash-back mechanism that provide ability to recover from human errors are far beyond those offered by Microsoft SQL Server 2005, and they contributed to Oracle's advantage. Oracle Database 10g Release 2 took 62% less time and 67% less steps than Microsoft SQL Server 2005 in this category.
- **Day-to-Day Administration:** In this category, Oracle Database 10g Release 2 demonstrated 27% advantage in time and 25% in steps over Microsoft SQL Server 2005. Oracle's automation of important day-to-day administrative tasks in addition

² The times in all results tables are in minutes. Precision is 1/100th of a minute.

* SS = SQL Server

to enhancements to its Oracle Enterprise Manager graphical interface that make it easier to use, further contributed to Oracle's advantage in this category.

- Installation and Simple "Out-of-the-Box" Setup: Microsoft SQL Server 2005's significant regression in install manageability compared to Microsoft SQL Server 2000 also helped extend Oracle's overall lead. Oracle Database 10g Release 2 took 32% less time and 57% fewer steps when compared to Microsoft SQL Server 2005 when not accounting for prominence of installation and setup in a DBA workday.

***Note on complexity:** The results of this study have demonstrated a real breakthrough in manageability and ease of use for the new Oracle Database 10g product line. The Oracle EM web interface is utilitarian in design, but covers most major DBA requirements effectively. The SQL Server Management Studio is a major step forward from Microsoft's Enterprise Manager, but is missing substantial functionality and is (surprisingly) unintuitive. For a complete rundown of all of the numbers comprised in this report; see Appendix III – "Detailed Test Results," containing the comprehensive numerical analysis derived from this study.*

Comparative Management Cost Savings

The core premise of any Comparative Management Cost Study is that the true cost of owning and operating complex systems like Oracle 10g and SQL Server only start to accrue after the product has been purchased. In most real-world business environments, the management costs will far outweigh the licensing and support costs throughout the life of the product. With this in mind, we estimated the annual costs that businesses can expect to save due to the DBA time savings that result from one product being easier to administer and operate than the other.

In order to compute cost savings, we used DBA salary figures published on Salary.com. For more information on these numbers, go to <http://www.salary.com>.³

From Salary.com: The median total compensation including benefits for a typical Database Administrator in the United States is **\$82,889**. This basic market pricing report was prepared using Certified Compensation Professionals' analysis of survey data collected from thousands of HR departments at employers of all sizes, industries, and geographies.

If we insert the median DBA compensation salary found in the *Salary.com* survey into the formula below, we arrive at the following quantitative management cost (MC) saving calculation:

$$\text{Median DBA Salary} * (\text{DBA time savings}) = \$82,889 * 38.2\% = \$31,664$$

This result can be interpolated to match to your company's DBA salary expenses by applying the above formula.

When multiplied across all of the DBAs in an organization, these management cost savings quickly grow into a figure that dwarfs the one-time licensing fee required to acquire a product of this nature.

³ As of December 2005, according to *Salary.com* the salaries are:

Database Administrator		
25th Percentile	Median	75th Percentile (in the United States)
\$72,213	\$82,889	\$93,971

Workload Category Test Results Synopsis

This section of the report delineates the Results Synopsis for each of the workload categories tested in this study. It will help the reader acquire a deeper understanding of how Oracle Database 10g and Microsoft SQL Server really compare across the board. In the tables below, we refer to "SS" as Microsoft SQL Server 2005 and "Oracle" as Oracle Database 10g Release 2.

Install DB/Software/Out-of-the-Box Setup (Results Synopsis)

This workload category addresses tasks relating to software installation and default out-of-box setup. Three tasks were performed in this area. The quantitative results synopsis for this area is documented in the table below.

Installation and Simple "Out-of-Box" Setup	Time (mins)		Complexity (steps)	
	SQL Server	Oracle	SQL Server	Oracle
Category Sub-Total	39.3	26.7	14	6
% difference -- (SS - Oracle)/SS*	32%		57%	
DBA Workday Savings	2%		3%	

Qualitative Analysis

In this category, Oracle Database 10g Release 2 took 32% less time and 57% fewer steps than Microsoft SQL Server 2005. When adjusted for prominence in a DBA workday, Oracle had a 2% advantage in time and 3% in complexity. This category exhibited the greatest change from previous studies. In the previous study comparing Microsoft SQL Server 2000 against Oracle Database 10g Release 1, SQL Server was marginally better in terms of the amount of time it took to perform these tasks. Now in the current study, SQL Server has regressed in manageability taking more time and steps than its earlier release. This result illustrates significant issues with Microsoft SQL Server 2005 product packaging and installation strategy when compared to its previous releases, while Oracle has maintained its position.

The Microsoft SQL Server 2005 installation started off with an awkward set of steps. The "Upgrade Advisor" in the Microsoft SQL Server 2005 installation process failed to detect the need for two critical components for our up-to-date Windows 2000 Server platform. The "Upgrade Advisor" did not initially detect the absence of the .Net 2.0 Framework, and the Microsoft Data Access Component (MDAC) 2.8 libraries. This "feature" required us to switch contexts to a web browser to retrieve and install those two patches from a Microsoft download site. After clearing that hurdle, the installation routines of Microsoft SQL Server 2005 went smoothly, subjectively speaking. Even so, the number of decisions we had to make in order to install, patch, and configure Microsoft SQL Server 2005 were quantitatively complex when compared to Oracle Database 10g (both Releases 1 and 2).

Since the objective of this comparison is to determine which of the two products currently presents the greatest simplicity to the user, we must conclude from its results that Oracle Database 10g Release 2 is the simpler of the two database products to install.

Day-to-Day Database Administration (Results Synopsis)

The Ongoing Database Administration Workload Task Category relates to the routine database object maintenance operations such as creating users, tables, and indexes, as well as reorganizing data and loading information into the database from external sources. Six tasks were performed in this category. The quantitative results synopsis for this category is documented in the table below.

Day-to-Day Database Administration	Time (mins)		Complexity (steps)	
	SQL Server	Oracle	SQL Server	Oracle
Category Sub-Total	10.3	7.60	12	9
% difference -- (SS - Oracle)/SS	27%		25%	
DBA Workday Savings	8.9%		8.4%	

Qualitative Analysis

There is a sizable manageability gap between the two products in this category. Oracle Database 10g Release 2 took 27% less time and 25% fewer steps than Microsoft SQL Server 2005. After adjusting for the prominence of each task in a DBA workday, Oracle has roughly 9% time and 8% complexity advantage. In the previous study comparing earlier releases of the two products, for this workload category both products were very competitive. In terms of time metric, Oracle Database 10g Release 1 was 10% better than SQL Server 2000, whereas in terms of complexity metric, both products were almost equally efficient (tied). The improvement in Oracle's manageability in this category is mainly due to the fact that in Oracle Database 10g Release 2, key administrative tasks such as determining which objects in the database require space defragmentation based on their usage pattern have been further automated. Moreover, EM GUI has been significantly enhanced to allow administrators to perform common day-to-day tasks more easily, e.g., loading data into the database. While both products are well designed and easy to manage on a day-to-day basis in the previous study, Oracle Database 10g Release 2 is significantly more efficient than Microsoft SQL Server 2005 when it comes to routine day-to-day maintenance tasks.

Backup and Recovery (Results Synopsis)

This task category addresses tasks relating to database backup and recovery management. Four tasks were performed in this category. The quantitative results synopsis for this category is documented in the table below.

Backup & Recovery	Time (mins)		Complexity (steps)	
	SQL Server	Oracle	SQL Server	Oracle
Category Sub-Total	21.70	8.3	15	5
% difference -- (SS - Oracle)/SS*	62%		67%	
DBA Workday Savings	8.3%		9%	

Qualitative Analysis

Oracle Database 10g introduced automatic backup management and human-error recovery features were mainly responsible for Oracle’s significant advantage over SQL Server. These are state-of-the-art enhancements in manageability that mark a radical improvement over all past versions of the Oracle Database. Microsoft SQL Server 2005 has a relatively robust transaction logging architecture and is manageable as far as backup and recovery is concerned, but every operation needs to be manually configured post-installation. For time-critical operations of data file and point-in-time recovery, the database recovery configuration needs to be well-architected and regularly maintained in order to avoid costly database failures. In contrast, Oracle Database 10g has the Flashback features that are built upon its multi-version read consistency architecture — which has been steadily evolving ever since Oracle 7. These features enable a level of built-in database fault tolerance that simply does not exist in any competing product. In quantitative terms, the numbers speak for themselves. When you read the numbers prior to applying DBA workday weighting, the results are impressive. In this category Oracle required:

- 62% less time than Microsoft SQL Server 2005, and
- 67% fewer steps.

After applying DBA workday weightings, Oracle results in:

- 8.3% time savings in a typical DBA workday, and
- 9% fewer steps.

Thus, Oracle Database 10g Release 2 proved itself to be substantially less complex than Microsoft SQL Server 2005 by requiring 67% fewer steps. This was largely due to technical advancements in Oracle Database 10g — specifically, the automated online recovery capabilities found in the Flashback features that we used to recover a dropped table and a series of erroneous transactions in this workload area. Additionally, Oracle Database 10g Release 2 has made it much easier to perform complex recovery operations, such as recovering an erroneous transaction or dropped table. Accomplishing some of these tasks in the previous study using Oracle Database 10g Release 1 was relatively more complex than with EM 10.2 interface. As a result, the time differential improvement for Oracle

Database 10g Release 2 with respect to the previous study improved from 50% to 62% and complexity differential from 56% to 67%.

Microsoft SQL Server 2005 supports a feature called “Database Snapshot” that provides ability to generate and use a read-only stable view of the database. This is accomplished by maintaining a separate copy of modified pages for the snapshot and incurs some performance overhead. While the Database Snapshot feature is touted as being able to recover quickly from accidental changes by reverting to the Snapshot image at the table level, it assumes that all the tables have a snapshot created before hand, which is not a realistic scenario. Additionally, even if the snapshot was initiated by a user at a previous point in time, there might be transactions past that point that cannot be recovered (i.e., cannot apply logs to the snapshot). The lost changes have to be manually redone. Hence the Database Snapshot feature was not used in this test. *This aspect is also an important differentiator between Microsoft SQL Server (Releases 2000 and 2005) and Oracle Database 10g (Releases 1 and 2).* As noted in the “Detailed Task Descriptions” section for Backup and Recovery in Appendix V, a fairly conservative approach was used in assessing penalty for Microsoft SQL Server 2005, but taking into account all the intricacies and manual nature of recovery could increase the adjusted complexity significantly.

Oracle Database 10g provides continuous snapshot mechanism within a specified retention period with the Flashback technology guaranteeing that data will never be lost in that period. This feature provides insurance to businesses’ against various kinds of potential errors.

In summary, this section of the study demonstrates a clear advantage of the Oracle-recommended database backup configuration and Flashback recovery features over the Microsoft SQL Server 2005 backup and recovery features.

Performance Tuning (Results Synopsis)

This task category addresses tasks relating to manual and automated systems performance diagnostics and tuning. Three tasks were performed in this area. The quantitative results synopsis for this category is documented in the table below.

Performance Diagnostics and Tuning	Time (mins)		Complexity (steps)	
	SQL Server	Oracle	SQL Server	Oracle
Category Sub-Total	19.25	5.0	8	5
% difference -- (SS - Oracle)/SS	74%		38%	
DBA Workday Savings	19.3%		9.8%	

Qualitative Analysis

Of all the areas of comparison, this was the category where Oracle Database 10g Release 2 revealed its greatest strength. In terms of time and steps metrics, Oracle Database 10g as compared to Microsoft SQL Server 2005 was:

- 74% more efficient in time, and
- 38% more efficient in steps.

Given that DBAs spend more than a quarter of their time conducting performance diagnostic and tuning related functions, Oracle's advantage in this category translates into DBA workday savings of:

- 19.3% in time, and
- 9.8% in steps.

This is the category where the highest-paid DBA specialists and consultants spend most of their time and, incidentally, is the segment of the study where Oracle Database 10g demonstrated a considerable advantage over Microsoft SQL Server.

Oracle's advantage in this category was mainly due to the new self-diagnostic engine (Automatic Database Diagnostic Monitor – ADDM) introduced in Oracle Database 10g Release 1, that proactively identifies and recommends remedies for performance problems encountered by the system, and the SQL Tuning Advisor that fully automates the complex task of application tuning. Whereas Microsoft SQL Server does have features that facilitate SQL tuning such as the Database Tuning Advisor, which is an enhanced version of its Index Tuning Wizard, its solution is not nearly as comprehensive as Oracle's and focuses on just one aspect of application tuning. Moreover, in the area of performance diagnostics, SQL Server does not have anything that compares directly to the self-diagnostic capabilities of ADDM. ADDM and SQL Tuning Advisor together give Oracle a significant edge over SQL Server in the performance diagnostics and tuning category, as aptly reflected in the time and complexity (steps) numbers above.

When it comes to complexity, Oracle has succeeded in automating the involved art of performance diagnostics and tuning in such a way that the adoption of Oracle Database 10g will significantly reduce the management costs for any company. Upon completion of this section of our analysis, it became clear to us that Oracle Database 10g has set a new standard in the high-tech realm of automated database performance management.

Conclusion

After completing our tests and confirming the results with a group of independent third-party database professionals, we have concluded that Oracle Database 10g Release 2 enjoys a sizeable manageability advantage over the Microsoft SQL Server 2005. As a result, we can state with confidence that Oracle Database 10g Release 2 can offer significant management savings when compared to Microsoft SQL Server 2005. In light of the fact that Microsoft SQL Server has historically been regarded as the most SMB-friendly database product on the market, we feel that with Oracle Database 10g Releases 1 and 2, Oracle has raised the bar for RDBMS manageability, setting a new standard for ease of administration against which all competing products will soon be measured.

This study quantifiably demonstrates that Oracle Database 10g Release 2 has a significant manageability superiority over Microsoft SQL Server 2005. Oracle Database 10g Release 2 significantly reduces the DBA management workload as well as the complexity of administrative tasks compared to Microsoft SQL Server 2005. This translates into more productive DBAs, more reliable systems and, most importantly, significant cost savings for businesses.

Appendix I - Test Platform Details

Below are the technical specifications of the lab computers used to conduct this CMCS.

- Hardware Platform: OS/Hardware platform data points.
 - OS: Microsoft Windows Server 2000 5.00.2195 (SP4)⁴
 - Processors: Dual Intel Xeon 2.8 GHz CPUs w/512 K Cache, 533 MHz FSB
 - Memory: 1 GB DDR, 2x512 MB 266 MHz DIMMS
 - Storage: Three 36 GB, 10 K RPM, 1in (Ultra 320) SCSI Hot Plug Hard Drives
 - HD Configuration: On-board RAID 5, three drives connected via on-board RAID
- Software Platforms: Relational database management software platform data points.
 - Oracle
 - Oracle Database 10g Enterprise Edition 10.2.0.1
 - Oracle Enterprise Manager 10g Release 2 Database Control (Bundled)
 - Database Configuration Assistant (Bundled)
 - Microsoft
 - SQL Server 2005 Enterprise Edition
 - SQL Server Management Studio (Bundled)
 - Database Tuning Advisor (Bundled)
 - SQL Server Profiler (Bundled)

Note: All comparisons were performed using the database management tools bundled with the products under consideration. Since this study was a comparison of the stock manageability features bundled with these two products, no third-party or add-on software was taken into consideration in the course of conducting this study.

⁴ The choice of hardware and OS (Windows Server 2003 or Windows Server2000) does not bear significance on the study. This is because the study focuses on manageability and complexity of the vendor products rather than on performance. Additionally, both database vendor products have the same core functionality for the hardware chosen for the study.

Appendix II – Clarification of Architectural and Terminology Discrepancies

Both Oracle Database 10g and Microsoft SQL Server are mainstream relational database management systems. Yet, relative to how these products have been designed to execute their respective database management functions, a few key architectural and terminological discrepancies should be clarified so that both Oracle and SQL Server users reading this report will have a clear understanding of the synonymous terms and tasks comprised within this comparison. (See Appendix VI for a Glossary of Terms)

In terms of disk resources, the physical definitions of what defines a database are essentially the same for both Oracle and SQL Server. From this perspective, a database is a repository of information contained in one or more data files logically organized into one or more tablespaces (in Oracle) or file groups (in SQL Server). Yet a deeper look into the logical structures that define the term “database” reveals a few interesting differences.

First of all, a distinct difference exists in how database users are defined in Oracle and in SQL Server. In Oracle, a user is an atomic entity. In SQL Server, a user has two elements: a global login and a local database user. This difference arises from the fact that Oracle is an open platform product designed to run on many operating systems, and as such cannot rely on the underlying operating system to behave in a certain way. In order to operate in a consistent manner across all supported platforms, it must implement and encapsulate all critical objects (such as users) and functions (such as authentication) that are required by the DBMS. By contrast, SQL Server has both the luxury and the liability of being totally dependent on Microsoft Windows. Given this tight coupling between SQL Server and Windows, SQL Server leverages many Windows features running in the background as operating system services (e.g., Active Directory) to accomplish various operations. Identity management of database users is the main area of significant differences between these products, which brings up the key difference in how these products logically define a database.

In Oracle, databases are equivalent to server instances (except in the case of RAC clusters). Oracle has a schema feature to match ANSI SQL standards, but practically database users can own objects, and the objects owned by a user are considered a schema. While SQL Server has a concept of database login and connection login, Oracle has a single authorization process. Oracle objects are stored, as segments, in tablespaces which are composed of files. These tablespaces are operational management facilities, and are the nearest Oracle equivalent to the SQL Server database and/or the underlying SQL Server file groups

The preceding section has highlighted the main architectural and terminology discrepancies between the Oracle 10g Database and Microsoft SQL Server. The overarching

differences in the articulation of core product terminology, and the way the vendors advise companies to manage large-scale database installations using their products, is important in understanding the Comparative Management Costs that these products will exact for an IT organization. This is especially true in light of the self-maintaining database features that are now available in Oracle 10g Releases 1 and 2.

Appendix III - Detailed Test Results

Task	Description	Time (mins)		Complexity (steps)	
		SQL Server	Oracle	SQL Server	Oracle
Installation and Simple "Out-of-Box" Setup Tasks					
1	Install db/software/out-of-box setup	31	19.3	9	2
2	Create 2nd database server/instance	6.42	6.83	3	3
3	Setup proactive monitoring	1.83	.5	2	1
	Category Sub-Total	39.3	26.66	14	6
	% difference -- (SS - Oracle)/SS*	32%		57%	
	DBA Workday Savings	1.6%		2.9%	
Day-to-Day Database Administration Tasks					
4	Create user with roles, privileges	.7	.7	1	1
5	Create tablespace/filegroup	.58	.7	2	1
6	Add space to database	.33	.5	1	1
7	Create table	.33	.5	1	1
8	Create index	.83	.8	1	1
9	Reclaim space due to fragmented data	3.7	.9	3	1
10	Load data from text file	3.9	3.5	3	3
	Category Sub-Total	10.3	7.6	12	9
	% difference -- (SS - Oracle)/SS*	27%		25%	
	DBA Workday Savings	8.9%		8.4%	
Backup and Recover Tasks					
11	Configure and perform full backup	1.75	0	4	0
12	Recover dropped table	7.17	.33	5	2
13	Recover data file	5.58	5.33	1	1
14	Recover from erroneous transaction	7.17	2.67	5	2
	Category Sub-Total	21.67	8.33	15	5
	% difference -- (SS - Oracle)/SS*	62%		67%	
	DBA Workday Savings	8.3%		9%	
Performance Diagnostics and Tuning Tasks					
15	Diagnose performance problem	9.25	2.0	3	1
16	Tune resource-intensive SQL	10.0	1.5	5	2
17	Tune memory	0	1.5	0	2
	Category Sub-Total	19.25	5.0	8	5
	% difference -- (SS - Oracle)/SS*	74%		38%	
	DBA Workday Savings	19.3%		9.8%	
Overall Total		93.08	46.66	65	25
	% difference -- (SS - Oracle)/SS*	47%		49%	
	Total DBA Workday Savings	38.2%		30%	

Appendix IV – Complexity Calculation Formula

Complexity is defined as the number of computed steps it takes to complete a given task. The formula used to compute complexity for each of the tasks in this study is as follows.

1. For every five increments contained in a step we increase the step value by 1. For example:
 - If a step has 0-5 increments, step value = step + 0,
 - If a step has 6-10 increments, step value = step + 1
 - If a steps has 11-15 increments, step value = step + 2
 - ... and so on.
2. The type of instrumentation offered to perform a given task modifies the tasks complexity.
 - If a task can be performed completely with a GUI, then step count = step count + 0.
 - If a task requires the use of a command line interface, then step count is modified as follows:
 - If the command line operation consists of a single line command, then step count = step count + 1.
 - If the command line operation requires writing a script, then step count = step count + 2 or more steps, depending on a subjective assessment of the complexity of the script.
3. If a task requires a context switch between different environments, then step count = step count + 2 or more steps, depending on a subjective assessment of the complexity of the context switch.

In the case of point-in-time recovery operations (task 12 and task 14), we exercised the right to assess step penalties that we consider exceptions to these rules, due to the open-ended subjective and analytical nature of the operations required to successfully complete those tasks.

Appendix V - Detailed Task Descriptions⁵

Installation and Simple "Out-of-Box" Setup

Task 1: Install database and management software, and create starter database

Task	Oracle		SQL Server	
	Step	Time	Step	Time
Install DB Server & Management Software, Set up Networking configuration	1. Launch the Oracle Installer * Specify File Locations * Select Installation Type (Enterprise Edition) * Select Database Configuration (Create Starter Database, General Purpose) * Specify Database Configuration Options(DB Naming, DB Char Set, DB Examples) and keep defaults. * Select DB Management Option and keep defaults * Select DB File Storage Options and keep defaults * Select Backup and Recovery Options, Set Enable Automated Backups and keep defaults * Check archivelog mode leaving defaults * Set Backup Job Credentials with the username and password of a user with at least backup operator privileges.	19 min 20 sec	1. Launch the installer * Run Upgrade Advisor * Note Missing Components 2. Microsoft Download Site / .Net Framework 2.0 *Select Download * Accept License Agreement * Install 3. MDAC Download Site * Select MDAC 2.8 SP1 * Select Open * Accept License Finish 4. Restart Setup Wizard *Select Components to Install *Accept License *Install Prerequisites *Verify System Configuration *Server Setup Accept Registration Info * Verify Components to Install *Select Instance Name (Default) * Select Service Account * Select Services to start at end of setup	31 ⁶ min

⁵ In the Task Description tables, "*" in the Step column, represents *increment* for the step. For more information on this metric refer to the section, The Methodology Defined.

⁶ Time for Install does not include time to download the appropriate patches that are mandatory but not on the installation disks.

Task	Oracle		SQL Server	
	Step	Time	Step	Time
	* Specify Database Schema Passwords and use same password for all accounts. Install		*Select Authentication Mode (Mixed) * Enter password for sa * Select collation settings * Select Error and Usage Report Settings * Start installation * View/Save Summary Log Finish	
Management framework setup	Part of the install	N/A	Part of the install	N/A

Metrics	Oracle	SQL Server
Time	19 min 20 sec	31 min
Steps	1	4
Increment Penalty	1	2
Context Switch Penalty	0	3
Adjusted Steps (Complexity)	2	9

Task 2: Create additional database server/instance

Task	Oracle		SQL Server	
	Step	Time	Step	Time
Create a new database instance	1. Launch DBCA from the Start Menu * Create new database * Select General Purpose Database Template (this is selected by default) * Enter New Database Name and SID * Select Management Options and keep defaults (Use DB Control for DB Mgmt) * Enable Daily Backup by setting Start time, OS User Name and Password. * Set DB	6 min 50 sec	1. Launch the installer * Select Install Server Components * Accept Licensing Terms * Monitor Pre-Install Check * Installation Wizard Pre-Req Test * Accept Registration Personalization * Select Database Component Installation *Named Instance: Enter Name *Set Service Account Settings * Select Authentication Mode * Choose Collation Settings * Set Usage and Error Reporting Settings * Initiate Install	6 min 25 Sec

Task	Oracle		SQL Server	
	Step	Time	Step	Time
	Credentials and Use Same password for all accounts. * Set storage options and keep defaults. * Select DB file locations and keep defaults. * Set recovery configuration and keep defaults * Check archive log mode * Specify Database Content and keep defaults * Configure Initialization Parameters and keep defaults * Set Creation Options Finish		Finish	

Metrics	Oracle	SQL Server
Time	6 min 50 sec	6 min 25 sec
Steps	1	1
Increment Penalty	2	2
Adjusted Steps (Complexity)	3	3

Task 3: Set up pro-active monitoring for performance and space utilization

Task	Oracle		SQL Server	
	Step	Time	Step	Time
Create task to monitor for performance problems and space issues	N/A		1. In Management Studio: * Select Server/ Service Agent / New /Alert * Enter Alert Name /Alert Type/ Object to Monitor / Object Property to Monitor/ DB Instance Condition/<OK>	1min 10 sec
Set thresholds for each event, save event, and start monitoring database	1. Go to the "Manage Metrics" page (EM home page, * Click on the "Manage Metrics" link). * Click the "Edit Threshold" button. This takes you to the "Edit Thresholds" page. * Set threshold for <i>Buffer Cache Hit (%)</i> . OK	30 sec	2. In Management Studio: * Select Server/ Service Agent / New /Alert * Enter Alert Name /Alert Type/ Object to Monitor / Object Property to Monitor/ DB Instance Condition/<OK>	40 sec

Metrics	Oracle	SQL Server
Time	30 sec	1 min 50 sec
Steps	1	2
Increment Penalty	0	0
Adjusted Steps (Complexity)	1	2

Installation and Simple "out-of-box" Setup Tasks Results Summary

Metrics	Oracle	SQL Server
Time	26 min 40 sec	39 min 15 sec
Adjusted Steps (Complexity)	6	14

Day-to-Day Database Administration

Task 4: Create user, assign roles/privileges

Task	Oracle		SQL Server	
	Step	Time	Step	Time
Create User and Assign Role(s)/Privs	1. Navigate in EM to the <i>Administration</i> tab and... * Select Security→Users link. * Select the Create button and enter the username, password. * Select the default tablespace information for the new user. (The CONNECT role is granted by default) OK.	40 secs	1. In Management Studio * Select: Database / Security / New / Login * New Login Screen: Enter Existing User / Accept Defaults * Select Default DB for Login and Select Server Role * Assign Database Roles * Accept remaining defaults and approve	40 secs

Metrics	Oracle	SQL Server
Time	40 sec	40 sec
Steps	1	1
Increment Penalty	0	0
Adjusted Steps (Complexity)	1	1

Task 5: Create tablespace/filegroup

Task	Oracle		SQL Server	
	<i>Step</i>	<i>Time</i>	<i>Step</i>	<i>Time</i>
Create table-space	1. Go to the EM <i>Administration</i> tab and... * Select the <i>Tablespaces</i> link. Click the Create button and enter tablespace name * Click the Add Button in the Datafile section * Enter datafile path/name, and size. Continue Click <i>OK</i>	30 sec	1. Create Filegroup * From Mgmt Studio Select: Server / Database / Properties * In Database/Properties Select: Filegroups / Add * Enter Filegroup Name / <OK> * Enter Description / <OK> 2. Create TableSpace on Filegroup * In Database/Properties Select: File/ Add * Enter Logical Name / Select New Filegroup from Dropdown /Set Initial Size / <OK>	35 sec

Metrics	Oracle	SQL Server
Time	42 sec	35 sec
Steps	1	2
Increment Penalty	0	0
Adjusted Steps (Complexity)	1	2

Task 6: Add more space to the database

Task	Oracle		SQL Server	
	Step	Time	Step	Time
Add more space to the DB	1. Go to the EM Administration TAB->Tablespaces link. * Choose the Add Datafile option and click GO. * Enter new file name and size. Click OK.	30 sec	1. From Mgmt Studio * Select: Server / Database / Properties / Files * Select Logical Name / Initial Size * Increase Size / <OK>	20 sec

Metrics	Oracle	SQL Server
Time	30 sec	20 sec
Steps	1	1
Increment Penalty	0	0
Adjusted Steps (Complexity)	1	1

Task 7: Create table

Task	Oracle		SQL Server	
	Step	Time	Step	Time
Create table	1. Go to the EM Administration Tab->Tables link. * Click the Create button. (This launches the table creation wizard.) * Enter table name, 3 columns with data types (number, varchar2 and date) Click OK.	30 sec	1. From Mgmt Studio * Select: Server / Database / Tables / New Table * Enter 3 Column Names and Data Types * Select Save * Enter Table Name / <OK>	20 sec

Metrics	Oracle	SQL Server
Time	30 sec	20 sec
Steps	1	1
Increment Penalty	0	0
Adjusted Steps (Complexity)	1	1

Task 8: Create index

Task	Oracle		SQL Server	
	Step	Time	Step	Time
Create Index	1. Go to the EM <i>Administration</i> Tab -> <i>Indexes</i> link. * Click <i>Create</i> button. (This launches index creation page.) Enter index name, table name, and columns. Click <i>OK</i> .	30 sec	1. From Mgmt Studio * Select: Server / Database / Tables / TableName * Select Table / Indexes /New Index * In New Index Form: Enter Index Name / <ADD> * Select Column(s) from Selected Table <OK>	50 sec

Metrics	Oracle	SQL Server
Time	48 sec	50 sec
Steps	1	1
Increment Penalty	0	0
Adjusted Steps (Complexity)	1	1

Task 9: Reclaim Lost Space due to Fragmented Data

Task	Oracle		SQL Server	
	Step	Time	Step	Time
Determine if any tables in the application tablespace need to be reorganized.	1. EM → Advisor Central → Segment Advisor → Review Recommendations → Accept Advice	0 sec	1. Launch Mgmt Studio: * For Each Database Select: New Query / Options / Results / Text / De-Select Include Headers <OK> * Load DBCC ShowContig Script * Run Script * Select Database / New Query * Paste Results from DBCC ShowContig script into query window * Execute Query and Save Results	1 min 20 sec
Execute shrink command	N/A	54sec	2. In Mgmt Studio * For Each Database needing re-organization (identified in Step 1): Select Tasks / Shrink / Files [Multiple Files for Database are possible] *Accept Defaults / <OK>	2 min 20 sec

Metrics	Oracle	SQL Server
Time	54 sec	3 min 40 sec
Steps	1	2
Increment Penalty	0	1
Adjusted Steps (Complexity)	1	3

Task 10: Load data from a text file

Task	Oracle		SQL Server	
	Step	Time	Step	Time
Data Loading	1. From Oracle Enterprise Manager *Select/ Schema / EM Load Data wizard *Select columns *Select delimiter *Select file, * Select table * Accept Datatype Defaults 2. Run Job	3 min 30 sec	1. Process using Import Wizard * Select Database / Tasks / Import Data * Import Wizard: Choose DataSource/Flat File * Select Browse / Filename / SelectFile / <OK> * Choose DataSource / General / Accept Defaults, Choose Datasource / Advanced / Suggest Types * Suggest Column Types / Accept Defaults / <OK> * Choose Datasource / Advanced / <NEXT> * Verify Column Data Type Mappings / <NEXT> Import Export Wizard / Select Destination * Verify / Correct Mappings / <OK> * Select Execute Immediately / <NEXT> Review Execution Plan / <Finish> 2. Run Job	3min 54 sec

Metrics	Oracle	SQL Server
Time	3 min 30 sec	3 min 54sec
Steps	2	2
Increment Penalty	1	1
Adjusted Steps (Complexity)	3	3

Day-to-Day Database Administration Tasks Results Summary

Metrics	Oracle	SQL Server
Time	7min 36 sec	10 min 18 sec
Adjusted Steps (Complexity)	9	12

Backup & Recovery

Task 11: Configure and Perform Full Database Online Backup

Task	Oracle		SQL Server	
	Step	Time	Step	Time
Configuring for online backup	N/A (Oracle 10g R2 recommended backups are configured and scheduled automatically upon database creation.)	0 min	1. SQL Management Studio * Select Management / Maintenance Plans / Maintenance Plan Wizard * Server Maintenance Plan Wizard / Next * Target Server Window / Enter Task Name /Accept Server and Authentication Defaults * Maintenance Task Wizard / Select Maintenance Task / Select Back Up Database - Full * Maintenance Task Wizard / Select Maintenance Task Order - Confirm Single Step * Define Back Up Database (Full) Task - Configure / SELECT "Backup Database Across One or More Files" * Select Backup Destination Dialog: Select Filename <...> *Find File In Directory Tree * Select Backup Destination Dialog: <OK> * Maint Plan Wizard: Report Options /Accept Defaults * Complete The Wizard <Finish> * Maint Plan Wizard / monitor processing until success * <Close>	1 min 30 sec
Perform backup		0 min	2. Management Studio: * Mgmt./Maintenance Plan <select plan to execute> * Popup Menu/Execute * Verify Success / <CLOSE>	15 sec

Metrics	Oracle	SQL Server
Time	0	1 min 45 sec
Steps	0	2
Increment Penalty	0	2
Adjusted Steps (Complexity)	0	4

Task 12: Recover Dropped Table

Task	Oracle		SQL Server	
	Step	Time	Step	Time
Recover dropped table.	1. Recover table using "FLASHBACK TABLE <table name> TO BEFORE DROP" command.	20 sec	1. Server Management Studio / Restore Database * Restore Database / General / Select Restore Target / * Restore Database / General / Specify Backup Media and Location /<ADD> * Locate Backup File / Select File / <OK> * Point In Time / Specify Date and Time / <OK> * Restore Database / Select Backup Sets From Selected Device (File)/To Point In Time * Set point in time to restore from * Restore Options / Select Defaults / <OK> 2. Wait for Successful Completion Message / <OK> 3. Manually re-do lost transactions	7 min 10sec

Metrics	Oracle	SQL Server
Time	20 sec	7min 10 sec
Steps	1	3
Increment Penalty	0	2*+
Command line usage penalty	1	0
Adjusted Steps (Complexity)	2	5+

Note: Oracle Database 10g Release 2 offers both command line and GUI interface to perform this operation. After deliberation, we determined that the simplicity of executing a single command on the SQL*Plus command line was the simplest way to perform this operation. Furthermore, after calculating complexity as defined above, it was determined that in purely technical terms, the command line and the GUI methods for executing this operation were of equal weight, though subjectively we felt that the command line operation was the simpler of the two means. For SQL Server this was a non-trivial operation with essentially the same process as was required in the recover from erroneous transaction as described in task 14. *The fact that we were required to manually redo all lost transactions after the point in time when the table was dropped was a serious disadvantage. Because of*

this, we were forced to assess () two manual operation penalty steps against SQL Server in this area. These two steps were assessed because in a real world environment chances are reasonable that there will be multiple transactions executed on the database between the time of the error and the time of the recovery that will have to be manually recovered. In Oracle, we were able to flash back the dropped table while the database was running and continue as if nothing had happened. This was one of two areas in the study where we actually assessed step penalties based on subjective criterion outside the scope of the methodology complexity definition specified at the outset of this paper.*

**, +: Taking into account all the intricacies associated with recovery could increase the adjusted complexity for the task. The penalty assessed for Microsoft SQL Server 2005 is fairly conservative in these two areas: a) Amount of work that needs to be done to manually redo all lost transactions in Step3, and b) Incremental penalty assessed in Step1 (Server Management Studio/Restore database)*

Task 13: Recover Data File

Task	Oracle		SQL Server	
	Step	Time	Step	Time
Data file recovery: application data file of size 1.2 Gigs is lost.	1. Go to the EM <i>Maintenance</i> tab and Click on <i>Perform Recovery</i> link. This launches the Recovery Wizard. * Specify the datafile(s) you want to recover. * Specify the Recovery Location * Review Recovery Parameters & Submit.	5 min 20 sec	Management Studio / Tasks / Restore / Database * Restore Database: / Specific Database / General [{OPTION}: From Device ...] * Restore Database: Specific Backup /Default Media [File] Add * Locate Backup File / Select File / <OK> * Select Backup Set to Restore / <OK> * Monitor Successful Completion	5 min 35 sec

Metrics	Oracle	SQL Server
Time	5 min 20 sec	5 min 35 sec
Steps	1	1
Increment Penalty	0	0
Adjusted Steps (Complexity)	1	1

Note: The time to actually perform a datafile recovery in a real-world scenario varies greatly based on file size and the speed of the system performing the operation.

Task 14: Recover from erroneous transaction

Task	Oracle		SQL Server	
	Step	Time	Step	Time
Recovery scenario: Due to a human error, a transaction was submitted by mistake	1. Go to the tables page in EM (<i>Administration</i> → <i>Schema</i> → <i>Tables</i>), * Select the INVENTORIES table and * Select <i>Action</i> “Flashback by timestamp” → go → Identify the time to recover from 2. Execute the undo SQL	2 min 40 sec	1. Server Management Studio / Restore Database * Restore Database / General / Select Restore Target / * Restore Database / General / Specify Backup Media and Location /<ADD> * Locate Backup File / Select File / <OK> * Point In Time / Specify Date and Time / <OK> * Restore Database / Select Backup Sets From Selected Device (File)/To Point In Time * Set point in time to restore from * Restore Options / Select Defaults / <OK> 2. Wait for Successful Completion Message / <OK> Manually re-do lost transactions	7 min 10 sec

Metrics	Oracle	SQL Server
Time	2 min 40 sec	7 min 10 sec
Steps	2	3 +
Increment Penalty	0	2* +
Context switch penalty	0	0
Adjusted Steps (Complexity)	2	5 +

Note: Oracle Database 10g Release 2 provides very fine-grained mechanisms to recover from erroneous transactions. The task definition seems to allow for the most basic version. At the same time, SQL Server 2005 recovery from a single bad statement is almost impossible; it would involve recovery to another database and attempting to extract the good data.

This feature allowed us to undo an erroneous transaction, using native software features, against a live database, in a finite period of time and activity in a relatively straightforward manner, without having to shut the system down. In the SQL Server case we were required to manually redo all lost transactions after the point in time up to which we recovered the database - a serious disadvantage. Because of this, we were forced to assess 2+ manual operation penalty steps against Microsoft SQL Server 2005 in this area. These steps were assessed because in a real-world environment chances are

reasonable that there will be multiple transactions executed between the time of the error and the time of the recovery that will have to be manually recovered. For a relative operation in Oracle, an administrator simply has to undoing using a simple and intuitive GUI without needing to restore and manually applying the transactions. This was one of two areas in the study where we actually assessed step penalties based on subjective criterion outside the scope of the methodology complexity definition specified at the outset of this paper.

**, +: Taking into account all the intricacies associated with recovery could increase the adjusted complexity for the task. The penalty assessed for Microsoft SQL Server 2005 is fairly conservative in these two areas: a) Amount of work that needs to be done to manually redo all lost transactions in Step3, and b) Incremental penalty assessed in Step1 (Server Management Studio/Restore database)*

Backup & Recovery Task Summary

Metrics	Oracle	SQL Server
Time	8 min 20 sec	21 min 40 sec
Adjusted Steps (Complexity)	5	15

Performance Diagnostics & Tuning Tasks

Task 15: Diagnose performance problem

Task	Oracle		SQL Server	
	Step	Time	Step	Time
Configure system to identify top resource consuming SQL	N/A	0	1. SQL Profiler New Trace * Login to Database * Set Trace Name /Select Trace Type Template 2. SQL Management Studio * Select problem Stored Procedure /Execute *Stop Trace * SQL Profiler - Save Trace Results	1 min 15 sec
Identify resource intensive SQL	1. Go to the EM home page and review the last ADDM report.	2 min	3. From SQL Profiler *Re-load Trace Results and Review	8 min

Metrics	Oracle	SQL Server
Time	2 min	9 min 15 sec
Steps	1	3
Increment Penalty	0	0
Context Switch Penalty	0	0
Adjusted Steps (Complexity)	1	3

Note: Oracle Database 10g Release 1 introduced a new feature, the Automatic Workload Repository (AWR) that proactively captures performance statistics and SQL workloads. This obviates the need for manual configuration like that needed for Microsoft SQL Server 2005 for performance diagnostics.

The self-diagnostic engine introduced in Oracle Database 10g Release 1, Automatic Database Diagnostic Monitor (ADDM), proactively analyzes AWR to identify performance related issues and recommends appropriate remedies for them. In our test scenario, the cause of the performance problem was a bad SQL statement that was consuming too many resources. Given that SQL statements are often the predominant cause of the performance problems; this was considered to be a realistic scenario. ADDM automatically and proactively identifies SQL statements that are overloading the system. This is why in Oracle a user needs to only look at the ADDM report to track performance issues. On the other hand, Microsoft SQL Server (Releases 2000 and 2005) have employed a more traditional model that requires visual analysis of trace files using its SQL Profiler tool. As a result, problem diagnostic in Microsoft SQL Server 2005 took significantly longer than Oracle. It should, however, be noted that ADDM is a general solution that identifies all types of performance problems and not just SQL problems, whereas the method employed for Microsoft SQL Server 2005 is specific to problem SQL identification.

Task 16: Fix Performance Problem (Tune SQL Statement)

Task	Oracle		SQL Server	
	Step	Time	Step	Time
Tuning SQL	1. From the ADDM report page, click on Run SQL Tuning Advisor button to tune resource-intensive SQL identified in the previous task. 2. Navigate to EM Advisor Central page * Click on the SQL Tuning Advisor task result * Accept SQL Tuning Advisor Recommendations.	1 min 30 sec	1. SQL Studio * Save Problem SQL Query to File as Workload 2. Database Tuning Advisor * Connect to Database * Enter Tuning Task Session Name / [Workload File Option]: Select Workload File /Select Database for Analysis * Start Analysis / Monitor Analysis Processing * Save Results / View Report / * Save Recommended Schema Change Script 3. Notepad * Open Recommended Schema Change Script * Copy Script 4. SQL Studio * Paste Copied Script * Execute / Monitor Execution of Schema Change to Completion 5. If the performance problem persists... * Rewrite poor performing SQL manually * Infer and apply optimizations based on output provided by the SQL Server Profiler's execution plan tool	10+ minutes

Metrics	Oracle	SQL Server
Time	1:30 min	10+ min
Steps	2	5+
Increment Penalty	0	
Context switch penalty	0	0
Adjusted Steps (Complexity)	2	5+

Note: For Microsoft SQL Server 2005, the process of tuning a poorly performing complex SQL

Statement is mostly manual (index tuning being the only exception); therefore, given the fact that this task will almost always take a significant and variable period of time, we feel that 10+ minutes is a fair, conservative estimate of how long it would take an expert performance engineer to perform this task on Microsoft SQL Server 2005 against a wide range of tunable queries encountered in a real world environment. On the other hand, Oracle Database 10g's SQL Tuning Advisor tunes SQL statements more comprehensively by looking at all aspects of SQL tuning as they apply to the Oracle database, e.g., index creation, query restructuring, statistics analysis, and SQL profiling. Hence, no manual tuning was required in Oracle's case. The only interaction with the user is in launching the advisor and accepting its recommendations, once they are generated. Since the actual tuning is carried out by the advisor in the background while a DBA is free to perform other activities, the time taken by the advisor to generate the recommendations was not included in the timing of this task.

Task 17: Tune Memory

Task	Oracle		SQL Server	
	Step	Time	Step	Time
Tune memory	1. Check the latest ADDM report. 2. Change SGA_TARGET and/or PGA_Target based on ADDM advice.	1 min 30 sec	N/A (SS performs automated memory tuning)	0 min

Metrics	Oracle	SQL Server
Time	1 min 30	0
Steps	2	0
Increment Penalty	0	0
Adjusted Steps (Complexity)	2	0

Performance Tuning Task Summary

Metrics	Oracle	SQL Server
Time	5 minutes	19 min 15 sec
Adjusted Steps (Complexity)	5	8

Appendix VI – Glossary of Task Areas/Tasks

Database Setup and Configuration (Workload Task Area): Database setup and configuration is a workload task area that encompasses all of the operations that a DBA would need to perform in order to accurately install and configure either product prior to using it in a real world application.

Install db/software/out-of-box setup: Install db/software/out-of-box setup is the workload task that identifies the process of installing and configuring either of these products for the first time.

Create new database server/instance: Create new database instance is the workload task that allows a DBA to create a second Database Server/Instance on a computer already running one or more instances of the RDBMS.

Set up proactive monitoring: Proactive monitoring is a tool that allows a DBA to identify problems with the RDBMS before they become performance or operational issues. Setting up monitoring is crucial in providing a highly reliable system.

Day-to-Day Database Administration (Workload Task Area): Day-to-Day Database Administration is the workload task area where all of the routine DBA operations of creating database users and objects (such as tables, indexes, triggers, procedures) as well as granting and revoking roles/privileges plus database table/tablespace/datafile sizing occur.

Create user with roles, privileges: Create user with roles, privileges setup is the workload task that allows DBAs to manage user security in the database.

Create tablespace/filegroup: Create tablespace setup is the workload task that allows DBAs to a new tablespace for use by a particular database instance or schema.

Add space to database: Add space to database is the workload task that allows a DBA to add data files to a filegroup/tablespace thus increasing the amount of space available to all of the objects contained in that database.

Create table: Create table is the workload task that allows DBAs to create a table object to store information inside a schema in the database.

Create index: Create index is the workload task that allows DBAs to create an index on a set of columns in a table that are heavily queried in order to speed the execution of queries run against that table.

Reclaim wasted space from tables with fragmented data: Reclaim wasted space from tables with fragmented data is the workload task that allows DBAs to pack/shrink the database after prolonged use in order to consolidate space and optimize performance.

Load data from text file: Load data from text file is the workload task that allows a DBA to load information from an external source such as a flat file or spreadsheet into one or more tables in the database.

Backup and Recovery Tasks (Workload Task Area): Backup and Recovery Tasks is the workload task area where all tasks pertaining to database backup and recovery are performed.

Configure and perform full backup: Configure and perform full backup is the workload task that allows DBAs to schedule and execute regular system backups as part and parcel of standard system fault tolerance operations.

Recover dropped table: Recover dropped table is the workload task that allows a DBA to recover a table that has been inadvertently dropped from the database by a DBA, developer or Power User in the course of working with the database.

Data file recovery: Data file recovery is the workload task that allows the DBA to recover a datafile from a backup copy in the event of a media failure.

Recover erroneous transaction: Recover erroneous transaction is the workload task that allows an DBA to undo a mistakenly executed transaction (insert, update, delete, select into..., sp_bad_proc(p_fubar);) in order to restore the object(s) ill effected by this transaction to the state it (they) was (were) in before the transaction was executed.

Performance Diagnostics and Tuning Tasks (Workload Task Area): Performance Diagnostics and Tuning Tasks is the workload task area where all performance related diagnostic, tuning and optimization tasks are performed.

Diagnose performance problem: Diagnose performance problem is the workload task that allows a DBA to analyze a poorly performing system in order to assess the performance problem as a prerequisite to performing the systems optimization functions (such as creating additional indexes, tuning a query/procedure, defragmenting tablespaces or adjusting the servers memory configuration) required to bring the level of system performance to an optimal state.

Fix performance problem (tune SQL statement): Fix performance problem (tune SQL statement) is the workload task that allows DBAs to optimize a poorly running query/procedure so that it executes in an efficient manner.

Tune Memory: Tune memory is the workload task that allows DBAs to adjust server/instance system memory configuration parameters in order to efficiently support the load placed on the system by all of the applications that access that particular instance/server.