

**Database Manageability and Productivity  
Cost Comparison Study:**

***Oracle Database 11g Release 2  
VS  
IBM DB2 Enterprise 9.7***

**June 2011**

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## Executive Summary

In today's complex and ever changing IT landscape, organizations are finding themselves faced with a growing array of IT management challenges. With such an explosive growth in the number of databases, data volumes, and application requirements, management of database environments is becoming far more complex. All of this is happening while IT resources and budgets are expected to remain flat for the foreseeable future. The purpose of this database manageability and productivity cost comparison study is to provide IT decision makers with factual information to address these challenges.

ORC International compared the database management and productivity costs of two leading enterprise database management systems: Oracle Database 11g Release 2 Enterprise Edition and IBM DB2 Enterprise 9.7.

After interviewing several Oracle and IBM database administrators (DBAs) and IT architects, ORC International set up multiple laboratories and ran multiple tests measuring a typical DBA's daily routine and administrative tasks. Based upon the averages of each task or step's runtime, the normalized result set was determined, in which all levels of administrative tasks were measured. Upon analyzing the results we calculated and compared the productivity savings of the two enterprise databases. In this report we highlighted relative management and productivity cost savings rather than dollar cost savings, since the annual dollar cost of a DBA is a constant for such products.

When planning on the total investment of an enterprise database system, the initial hardware and licensing costs can appear to be the primary source of investment. The actual cost of an enterprise database management system however is in the daily management of these systems by the individuals that are assigned to perform the tasks that have been outlined in this study. The annual salary of a DBA is a constant, therefore the cost savings we outline in this study is realized in increased productivity rather than actual dollars saved.

Based on our weighted averaging of everyday DBA tasks, the study revealed significant time and resource savings when using Oracle Database 11g Release 2 Enterprise Edition over IBM DB2 Enterprise 9.7. The study concluded:

- Oracle Database 11g Release 2 Enterprise Edition resulted in an overall **43 percent time savings** when compared to IBM DB2 Enterprise 9.7.
- Oracle Database 11g Release 2 Enterprise Edition resulted in an overall **45 percent step/complexity savings** when compared to IBM DB2 Enterprise 9.7.
- Based on a **productivity savings of 43 percent**, the time savings amounted to **USD \$51,600.00 per year per DBA** for an Oracle Database 11g Release 2 DBA versus an IBM DB2 Enterprise 9.7 DBA.

The two key areas that combined to account for 55 percent of a DBA's time, based on our weighted variables, included *Backup and Recovery*, and *Performance Tuning Tasks*. These two areas had the greatest manageability differences between the two products. Oracle Database 11g Release 2 Enterprise Edition exceeded IBM DB2 Enterprise 9.7 in these two areas by 44 percent average time saved, and took 39 percent average fewer steps or less complexity.

ORC International also looked at the overall usability of the tools, including the number of tools required to complete the tasks.

Both platforms are Java-based and can be run on virtually any operating system. IBM DB2 Enterprise 9.7 clients are locally-based to each client machine, rather than run from the database itself. This requires a separate installation of manageability functions onto each client machine. Oracle Database 11g Release 2 Database Control (the management console) is browser-based, which means it can be run from any location and any computer with connectivity to Oracle Database 11g Release 2 Enterprise Edition server.

IBM DB2 Enterprise 9.7 also has several tools, which are all accessible from each management tool via the toolbar included in each application. Although navigation is consistent between each tool, the IBM Database introduces a level of complexity that can result in confusion about which tool to use for a given task and can lead to lost productivity.

Both products provide sufficient tools for a DBA to complete frequent and infrequent tasks efficiently. However, this report focuses on the productivity differences between Oracle Database 11g Release 2 Enterprise Edition and IBM DB2 Enterprise 9.7.

## About this Report

This in-depth comparative productivity cost study compares two products, employing pre-defined tasks and steps that DBAs perform daily or regularly. DBAs were interviewed about the amount of time they typically spent in each of the four areas of study to determine the weighted workload value for each subject area, and multiple database disciplines were chosen, including 24x7x365 production DBAs as well as application and development DBAs.

To develop productivity cost comparisons and infer a dollar cost comparison, common DBA tasks were the focus of this study. Some factors were excluded from this study, which could directly affect the overall cost of ownership of either platform. The excluded factors include:

- **Physical Server and Hardware Costs:** The costs associated with servicing the DBMS platforms on the physical hardware were excluded from the cost comparison.
- **Licensing Costs:** The costs associated with servicing the DBMS platforms from a software perspective were excluded from this study. These include operating system costs as well as the DBMS costs, or any other software required to operate these platforms in a production environment.

For this study, the tools provided out of the box with each platform were the only ones used to complete the tasks. No third party tools were used. In a few instances a tool was not available for use and the task was completed using an SQL command, rather than a GUI-based tool. These instances are highlighted in the report.

The tools used for this study were:

### Oracle Database 11g Release 2 Enterprise Edition

- Oracle Enterprise Manager 11g Database Control, including the Diagnostics and Tuning Packs

### IBM DB2 Enterprise 9.7

- Command Center
- Control Center
- Health Monitor

## Report Audience

This report is intended for a variety of DBMS users:

- **Database administrators** who work on the DBMS daily.
- **System architects** who have a stake in the success or failure of the DBMS.
- **Corporate product champions** who are responsible for outlining the features of a corporate application, or system that may rely on DBMS features.
- **Corporate decision makers** who are responsible for making the best decisions for the corporation.

## Testing Methods

Several DBAs in multiple disciplines and environments were interviewed to determine the weighting of the subject areas being tested. The tasks were chosen by a team of database architects and identified as the most common areas of time consumption for the DBA. The categories and tasks were defined as:

- Initial Setup and Installation
  - Out-of-the-box installation
  - Setup of additional database(s)
  - Setup of proactive monitoring
- Daily Administration Tasks
  - Tablespace creation
  - User/schema creation
  - Table creation
  - Index creation
  - Additional user creation
  - Managing database fragmentation
  - Loading data from external sources
  - Configuring and processing workloads
- Backup and Recovery Tasks
  - Configuring and running full backups
  - Recovery of a dropped table
  - Recovery of a dropped data file
  - Recovery of a corrupt data file
  - Recovery of an erroneous transaction

- Performance and Tuning Tasks
  - Problem diagnosis
  - Instance memory tuning
  - SQL statement tuning

Each task was broken into steps, each of which required a user action to continue the workflow. Timing methods were applied to track the time required to complete each task and to track the number of steps required to complete each task. Whenever available, defaults were selected in all test cases, and at the first sign of a “Finish” or “Submit” button, that button was selected .

The tasks were tracked individually for time and step count, so results are available at the detail and aggregate level. A workload weighting constant was applied to each task. The weighting constants were determined during interviews with DBAs of different disciplines.

These results were compared to the total available work hours in a year (40 hours X 52 weeks = 2080 annual work hours), to calculate productivity results.

Dollar cost comparisons were also done to get task cost per occurrence; however the DBA salary per year is a constant in this study (the same for both platforms). Dollar costs can be compared at the individual task level, but the productivity savings value is what will lead to overall dollar savings by an organization.

## Comparison Study

### Workload Weighting

Using workload weighting, constants were applied to the tasks. These constants were based on interviews with DBAs, and take into account the percentage of time a DBA might spend on a specific task area. Reports from various ticketing systems were analyzed for category assignment to also look at the frequency of various requests to help balance the responses from the interviews. The workload weightings are shown in Table 1.

**Table 1 - Workload Weighting**

Task Area	Workload Weighting
A. Initial Setup and Installation	5%
B. Daily Administration Tasks	25%
C. Back and Recovery Tasks	10%
D. Performance and Tuning Tasks	45%
E. Administrative Functions * (Not Measured or Evaluated)	15%

*\*15 percent of time was allotted for administrative/HR functions and not counted towards evaluation of the actual DBA's time and energy. All percentages of time mentioned in the remainder of the document reflect the percentage of time that has been accounted for, 85 percent.*

### Tasks

Each task is a request or action a DBA performs based on a user request. To validate the chosen task list, it was compared to various ticketing system categories in production and application support queues. The categories and issues reported were then looked at for frequency in order to ensure the tasks fit into the most requested categories, and accounted for 85 percent of DBA work, minus administrative functions and meetings.

### Time

Time was measured from the start of a given task, when the mouse began to move to complete the task. For tasks that could run in the background, time was measured when the job or process was submitted to the DBMS. The job was tracked as a subtask and the run time was recorded independent of the task that required the DBA's attention.

For study consistency, any task that prevented a DBA from completing another task (for example, additional database creation, or initial setup and installation), was measured for the time required to complete the task.

### Complexity

Complexity can be defined in many ways and each task has its own level of complexity. For this study, a formula was defined that weighted the step count to simulate the amount of DBA attention required to complete the task.

A step was defined as requiring a DBA to interact with the application to perform or finish a task, irrespective of clicking Next, Finish, or Submit. A step could include the typing of object names, or configuration of parameters such as passwords or instance names. These intuitive tasks received a step count of one.

Depending on a step's complexity, a step count penalty was applied. This included the inability to perform the task using a GUI-based tool. This penalty was the total number of steps required to perform the task, including clicking of menus, additional commands, and writing of scripts. If a script was required it was viewed as a single step, since most DBAs maintain frequently used scripts in their own toolboxes.

## Comparison Testing

The purpose of doing comparison testing between these database management systems is to determine the long-term productivity and dollar savings or costs between the two systems. At first glance, hardware and licensing costs can appear high. However, the real cost of a database management system is a combination of the daily management of the system and the people costs in time and dollars associated with performing the outlined tasks. The annual dollar cost of a DBA is constant for a given calendar year. Therefore, the cost savings to consider is improved productivity -- allowing the DBA to do more in a calendar year.

To compare dollar cost savings, rather than the dollar costs of each task, a \$120,000.00 US salary was taken from the report of a salary study of database administrators, architects, and developers who mainly focus on database development. The number was chosen from an available online Salary Study, and the number was chosen from the highest salaries reported in the study<sup>1</sup>.

Using the salary from the study and our own weighted productivity savings, we calculated the dollar cost savings of Oracle Database 11g Release 2 Enterprise Edition over IBM DB2 Enterprise 9.7 as:

$$\text{Salary } (\$120,000.00) * \text{DBA Time Savings } (43\%) = \$51,600.00$$

This number represents the cost savings **per DBA, per year**, within a corporate organization. In reality, the cost of the DBA does not change for a corporation; the productivity of the DBA does. The test results below highlight how much more effective a DBA is when operating Oracle Database 11g Release 2 Enterprise Edition compared to IBM DB2 Enterprise 9.7.

This section provides the detailed comparative findings on the two platforms: Oracle Database 11g Release 2 Enterprise Edition and IBM DB2 Enterprise 9.7. For the remainder of the document, Oracle Database 11g Release 2 Enterprise Edition will be referred to as Oracle Database 11g R2 and IBM DB2 Enterprise 9.7 will be referred to as DB2 9.7

## Testing: Administration Workload

The general Administration Workload Testing takes into account tasks performed infrequently by the DBA. In our weighted workload value, these infrequent tasks account for only 5 percent of the DBA's work hours, or 104 work hours per year, based on a 40-hour work week. The tasks included in this part of the test are shown in the table below.

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<sup>1</sup> The salary study is available from:  
[http://salary-surveys.eriari.com/content/Architecture\\_Salary\\_Survey/Database\\_Architect\\_1856/US\\_National.htm](http://salary-surveys.eriari.com/content/Architecture_Salary_Survey/Database_Architect_1856/US_National.htm)

**Table 2 - Testing: Administration Workload Tasks**

A. Initial Setup and Installation		Time (Min:Sec)		Steps		Percent Difference	
		Oracle	DB2	Oracle	DB2	Time	Steps
1	Out of the box installation	16:03	06:25	1	15	-150%	93%
2	Setup of additional database	04:20	01:03	2	8	-313%	75%
3	Setup proactive monitoring	00:19	00:51	4	14	63%	71%
	<b>Total</b>	<b>20:42</b>	<b>8:19</b>	<b>7</b>	<b>37</b>	<b>-149%</b>	<b>81%</b>

### Out-of-the-Box Default Installation

Installation of both systems was straightforward. However, while installing DB2 9.7, an error occurred in the default selection. IBM has documented this error as a bug (Bug ID: JR28800<sup>2</sup>). During this study, steps had to be added to DB2 9.7 installation to overcome the effects of the bug. Overall, Oracle11g R2 took significantly longer to install than DB2 9.7. However, Oracle Database 11g R2 was far less complicated to install and required fewer steps than DB2 9.7. As the results show (Table 6), Oracle Database 11g R2 took only one step to complete, however DB2 9.7 took 15 steps to complete. Because installation accounted for just 5 percent of the DBA's time, the significant time difference during installation would have little impact on the organization.

Additional configuration steps were required for the DB2 9.7 installation before the database instance could be used. These additional steps were not documented in DB2 9.7 installation documentation, and were found by searching various forums<sup>3</sup> for information related to the symptoms of the installation. Various configurations were required of the Windows server installation around the default groups that were created for the instance. Additionally, it was necessary to issue several commands in db2cmd.exe around security groups. These commands were not referenced in the installation documentation, however were found after searching various news and forum groups.

While the entire installation for all required tools and the TOOLSDB initial database were completed from a single interface and installation, there were other steps outside of the installation that were not highlighted as requirements or prerequisite steps, making installation a bit frustrating. Additional steps such as Windows Active Directory configuration, as well as DB2 configurations that had to be performed.

The details of these items are in the step process details located in the Detailed Compilation section of this document. This is something that has been accepted as normal for DB2 9.7 administrators, based on interview feedback and information from other forums<sup>4</sup>. After the first installation it is rather trivial to know the steps required in order to have a successful and usable DB2 9.7 installation.

Oracle Database 11g R2 installation was easy. It required little or no confirmation except for a few text boxes (e.g., passwords, instance names) which required input.

<sup>2</sup> The bug was identified in a previous version of DB2, however was still encountered in the installation of DB2 9.7 Enterprise:  
<https://www-304.ibm.com/support/docview.wss?uid=swg1JR28800>

<sup>3</sup> <https://www-304.ibm.com/support/docview.wss?uid=swg21424932>  
<http://publib.boulder.ibm.com/infocenter/db2luw/v9r7/index.jsp?topic=/com.ibm.db2.luw.admin.sec.doc/doc/c0023391.html>

<sup>4</sup> Additional information, related more specifically to DB2 9.7 Enterprise:  
<http://www.dbforums.com/db2/1648219-toolsdb-fails-install-db2ese9-7-aix-6-1-a.html>

Both systems had few required parameters. Both provided adequate defaults, even if at times they did not make sense. For example, the DB2 9.7 default location for a database and database file is located at the root of the C:\ drive for a Windows 2008 installation. It would have been simple to add a logical location for default files into the installation package, and was likely an oversight by IBM rather than an intentional choice.

It is ORC International's opinion that the complexity of the DB2 9.7 installation outweighs the time spent waiting for installation of Oracle Database 11g R2 in terms of more difficult process for the DBA. Oracle's simpler installation frees the DBA to perform other tasks while waiting for installation to complete.

## **New Database Creation**

New database creation was simple for both systems. Both installed flawlessly without errors or undocumented prerequisites that would be required in order to make the database/instance operational.

As in the previous test, DB2 9.7 won in overall time savings, but required significantly more steps to perform. While DB2 9.7 performed this task in 75 percent of the time it took for instance creation than Oracle Database 11g R2, Oracle Database 11g R2 required 75 percent fewer steps than DB2 9.7. The only steps Oracle Database 11g R2 required for instance creation were the population of the database SID and password. The reason for the additional steps in the DB2 9.7 database setup was a contextual penalty, due to the many screens that had to be processed before the task could be completed.

While most DBAs would not perform an out-of-the-box database installation, accepting all default values, using that approach for this study provided quick proof of concept databases and development databases for both products.

## **Proactive Monitoring Setup & Configuration**

Proactive monitoring setup and configuration were much faster and easier for Oracle Database 11g R2 than DB2 9.7. For both products, four nearly-identical thresholds were modified.

Oracle Database 11g R2 required over 63 percent fewer steps for setup than DB2 9.7. Oracle setup time was also 71 percent less than DB2 9.7. Comparing the two platforms was difficult, as they approach threshold monitoring and configuration quite differently. As the numbers above reflect, using the provided tools for Oracle Database 11g R2 less setup time and steps than using the provided tools with DB2 9.7.

For Oracle Database 11g R2, all monitoring thresholds were configured from a single screen, and all changes enabled in a single submit/commit. When working with DB2 9.7, multiple screens often had to be navigated in order to find the correct threshold. And even then, the threshold itself had to be double-clicked to launch the threshold editor window and to modify the values. This caused additional frustration, more steps and also increased the time it took to complete the task. With DB2 9.7, each threshold had to be committed separately, which increased the number of steps. It was a contextual penalty that led to the increase in steps and complexity for the DB2 9.7 results.

This task is not performed regularly. This typically happens on initial database creation, but sometimes must be changed until the DBA has identified the biggest areas of contention within his or her database. In interviews, DBAs said that of all the administrative tasks, this one must be performed most often. The type of database (e.g., production, implementation, quality assurance, development) plays a role in configuring this task due to monitoring requirements and SLAs being different based on the type of environment the database is in.

One benefit of Oracle Database 11g R2 over DB2 9.7 is the installed Oracle Diagnostics Pack. More specifically, the Automatic Database Diagnostic Monitor (ADDM) is integrated into Oracle Database 11g R2 kernel. This self-diagnostic tool takes much of the guesswork out of performance tuning Oracle

Database 11g R2 instance. Performance tuning often comes from theory, and DBAs are likely to look for performance issues in areas they have encountered in the past, therefore making decisions on performance metrics that may be unfounded or inaccurate. Sometimes these metric configurations yield false positive alerts to the DBA and production support teams, thereby resulting in the alerts being ignored or turned off for lack of response.

With the ADDM performance problems are categorized into trees and root cause is located based on the combined years of performance tuning experience by Oracle's trained architects. Key performance indicators (KPI) are included for each ADDM reported issue, so each issue can be prioritized and addressed according to its impact on the database instance. The ADDM recommendations are based on a repository, called Automatic Workload Repository (AWR) that enables Oracle Database 11g R2 to accurately monitor and diagnose instance problems. The AWR contains statistics on how the instance is used operationally. The purpose of the AWR is to take periodic snapshots of the current database instance load for processing by the ADDM; it forms the foundation for how the ADDM processes and parses the data. The AWR allows the ADDM to identify and present performance issues and enables historical instance analysis to allow the DBA to isolate the instance in question and show performance improvement over time.

The various tools included with DB2 9.7 for diagnostics are not easy to use when compared to the tools available to Oracle Database 11g R2 DBAs. The DBAs on ORC's panel recommended using third-party tools for DB2 9.7 performance analysis and tuning. Purchase of additional tools would then be an unexpected expense that would add to the overall cost of ownership, in addition to added complexity. The DBAs thought database architects who specialize in performance tuning are required for tuning and monitoring a DB2 9.7 instance or database. The DBAs recommended a health monitoring repository for DB2 9.7, the Performance Warehouse, to help manually identify performance bottlenecks and issues.

### Testing: Daily Administrative Tasks

Daily administrative tasks account for 25 percent (520 work hours) of the DBA's workload. These administrative tasks are the day-to-day maintenance and help required of a DBA to aid in production, development and quality assurance. The daily administration tasks identified by our DBA panel are listed in the table below:

**Table 3 - Testing: Daily Administration Tasks**

B. Daily Administration Tasks		Time (Min:Sec)		Steps		Percent Difference	
		Oracle	DB2	Oracle	DB2	Time	Steps
4	Create Tablespace	00:13	00:06	2	1	-117%	-100%
5	Create User/Schema	00:06	00:05	2	1	-20%	-100%
6	Create Table	00:45	00:52	17	17	13%	0%
7	Create Index	00:43	00:57	3	4	25%	25%
8	Create Additional User	00:09	00:06	2	1	-50%	-100%
9	Add Space to Tablespace	00:08	00:15	1	2	47%	50%
10	Reclaim Fragmented Space	00:33	00:00	4	0	NA	NA
11	Load Data from Text File (csv)	01:20	01:01	13	3	-31%	-333%
12	Configure Adaptive Thresholds and Perform Workloads	00:46	02:28	0	18	69%	100%
	<b>Total</b>	<b>4:43</b>	<b>5:50</b>	<b>44</b>	<b>47</b>	<b>19%</b>	<b>6%</b>

## **Object Creation: Tablespace**

Tablespace creation for DB2 9.7 received a 50 percent time savings when compared to Oracle Database 11g R2. The number of steps required for this task using Oracle Database 11g R2 required one more step than DB2 9.7 to perform the test.

As stated earlier, DB2 9.7 has seemingly overlooked default location, at the root of the C:\ drive on Windows 2008. Both platforms performed the task quickly, with a six-second time difference and a one-step difference between the two platforms. While these time differences seem minimal, they can add up to significant annual DBA productivity gains or losses.

Oracle Database 11g R2 provides a logical default location for datafiles, which could increase the step and time count required to create a DB2 9.7 tablespace in order to locate a logical location for data files. To keep the integrity of the test, the location was allowed to be left at the default location for DB2 9.7 files, thereby not increasing the step count; however this resulted in datafiles being created at the root of the C:\ drive on the test machine.

Oracle Database 11g R2 takes into account the installation location of each instance, where it assumes the DBA has planned adequately for I/O needs and restrictions. DB2 9.7 tablespace creation does not account for where the DBA has installed DB2 9.7. Instead it defaults to the root of the C:\ drive for a Windows 2008-based installation.

## **Object Creation: User/Schema**

Creating a new user/schema was easy, quick, and straightforward for both platforms. DB2 9.7 performed this task one second faster than Oracle Database 11g R2, likely due to the additional step required by Oracle to select the default tablespace. The username and password were the same for both platforms.

## **Object Creation: Table**

Table creation was also very similar for both platforms, with identical tables being created. Because the default tablespace was a system based tablespace, an additional step was added in each platform to create the user based objects in a non-system based tablespace. Oracle Database 11g R2 completed the task approximately 13 percent faster than DB2 9.7, using the same number of steps.

## **Object Creation: Index**

Index creation was nearly identical for Oracle Database 11g R2 and DB2 9.7. Default values were selected for both and Oracle Database 11g R2 performed this task 25 percent faster than DB2 9.7, even though it required two more steps than DB2 9.7. The index consisted of a single column.

## **Object Creation: Additional User**

Creation of an additional user was also a very close comparison. Oracle Database 11g R2 and DB2 9.7 each provided an intuitive interface for user/schema creation. Oracle Database 11g R2 took 50 percent more time to complete this task than DB2 9.7, but required one less step. While this is a significant productivity difference, most DBAs use prepared scripts for creating additional or bulk users, which reduces screen navigation time. The user creation task is tricky to analyze fully, since users differ widely and are created for different purposes. In our interviews, we found that standard users are created only once.

Temporary users, on the other hand, are created often, so as to allow architects or developers to diagnose production and quality assurance systems. Temporary users are often created and then dropped, or passwords changed once access is no longer needed.

## Space Management

### Add Space to Tablespace

Oracle Database 11g R2 provides an intuitive user interface to grow the tablespace, rather than add an additional file to the tablespace. For this study, the amount added was 47 percent of the initial space. Oracle Database 11g R2 required one step and eight seconds to add space to a tablespace.

DB2 9.7 lacks an interface for adding space to a data file. A SQL statement is used to add the space, which requires four extra steps for DB2 9.7 to execute the task. The command window had to be opened, written, and run. DB2 9.7 received a single step contextual penalty for not providing tools for this common DBA task.

### Reclaim Fragmented Space

Oracle Database 11g R2 offers the ability to reclaim fragmented space by reorganizing the tablespace. Oracle Database 11g R2 required four steps and 33 seconds to complete this task. There was no way to compare the two platforms, because DB2 9.7 provides automatic fragmentation management during maintenance.

### Load Data

For this task, ORC International's testing representatives chose a small country-to-IP mapping table and identified a 169,000-record dataset for loading. This table is commonly truncated, loaded and unloaded into production systems. For this exercise, the technicians chose to create the table upon the first load, adding considerable steps to Oracle Database 11g R2's loading of the file.

Oracle Database 11g R2 required 30 percent more time than IBM DB2 9.7. DB2 9.7 saved time and steps by automatically assuming table format and creation during the import process. Oracle Database 11g R2 required the user to fill out the structure of the table prior to importing it. Oracle did auto-generate control files for the import process.

While the overall process of importing data took significantly longer for Oracle Database 11g R2, importing data into the respective platforms took 71 percent longer for DB2 9.7 than Oracle Database 11g R2.

## Configure Adaptive Thresholds and Perform Workloads

This is an important task for any database administrator. In order to analyze and know what is happening inside of the database instance on a day to day basis, it is very critical to properly analyze how the database responds to various application loads. It also enables the database administrators to communicate properly to various departments how the users behave in the system, and how they use a given database. The need to quickly access this data and consume this data is critical to the everyday interface for the database administrator.

Oracle Database 11g R2 was far superior in this category and testing scenario. Oracle Database 11g R2 accomplished configuration, consumption and processing of the workload in 46 seconds, 70 percent less time than the comparable test run on DB2 9.7. Oracle Database 11g R2 also accomplished this task with zero steps, only increments. Nothing was required of the database administrator as far as input.

DB2 9.7 however required a 100 percent manual process. The only available tool in order to accomplish this task was the Command Editor. SQL Scripts were required in order to create, enable and start the workload monitors, and additional scripts were required in order to gather the data from the system.

Once the test was complete the workload processors had to be stopped manually as well using more SQL scripts. This made the process of configuring, consuming and processing the workload data in DB2 a very tedious and arduous task.

## Testing: Backup & Recovery Tasks

Backup and recovery are vitally important to a DBMS platform and not surprisingly, both systems performed these tasks. Oracle Database 11g R2 showed significant productivity gains over DB2 9.7. The following table outlines the tasks performed:

**Table 4 - Testing: Backup & Recovery Tasks**

C. Backup and Recovery Tasks		Time (Min:Sec)		Steps		Percent Difference	
		Oracle	DB2	Oracle	DB2	Time	Steps
13	Configure and Run Full Backup	00:08	00:09	0	1	11%	100%
14	Recover Dropped Table	00:28	03:06	3	12	85%	75%
15	Recover Dropped Datafile	01:32	01:03	5	6	-46%	17%
16	Recover Corrupt Datafile	01:48	01:02	5	6	-74%	17%
17	Recover from erroneous transaction using Flashback	01:18	09:46	8	18	87%	56%
	<b>Total</b>	<b>5:14</b>	<b>15:06</b>	<b>21</b>	<b>43</b>	<b>65%</b>	<b>51%</b>

### Configure & Run Full Backup(s)

Configuring and running full backups were very similar for both Oracle Database 11g R2 and DB2 9.7. Both have intuitive interfaces for accomplishing this task outside standard maintenance. This task was included in the a backup and is often required in the middle of the day or a production time, when a release occurs, a problem needs diagnosis, or QA requires a refresh of the most current data.

Oracle Database 11g R2 performed the backup process 11 percent faster than DB2 9.7, and required no steps on the technician's part other than selecting next/submit. For DB2 9.7 backup, the technician had to select the path for the backup, which accounted for one step in the entire process.

### Recover Dropped Table

Recovery of a dropped table in Oracle Database 11g R2 was very simple. In fact Oracle Database 11g R2 outperformed DB2 9.7 with an 85 percent time and 75 percent step/complexity savings. Oracle Database 11g R2 provided out of the box options for the recovery of a table. The steps are clearly defined and easy to follow, and in less than 30 seconds, our testing had recovered a table with over 160,000 rows in it.

DB2 9.7 required the testers to restore the database to a new location, extract the data from the newly restored database, truncate the destination table, then import the freshly exported data. It was found that there were multiple points at which this could cause problems. For a database of significant size in a production environment, where the database is > 100 GB this additional restore could add hours to the overall restore process of a single table when using DB2 9.7, not to mention the requirement for additional space in a production environment.

Had this been an actual production instance, of significant size, Oracle Database 11g R2 would have still performed within seconds, since the option to flashback a single table is present and available. The exact

amount of time to restore a database of significant size on DB2 9.7 is not known since each production environment, including the computer and disk subsystem architecture can vary from company to company.

### **Recover Dropped and/or Corrupt Data File**

We were able to restore a DB2 9.7 tablespace by using the Restore Data Wizard within the Control Center. With Oracle Database 11g R2 we were also able to restore a tablespace using Oracle Advised Recovery. When dealing with a dropped data file, DB2 9.7 outperformed Oracle Database 11g R2 by 54 percent in time savings. Oracle Database 11g R2 however outperformed DB2 9.7 by 17 percent in step/complexity savings.

When looking at fixing a corrupt tablespace Oracle Database 11g R2 outperformed DB2 9.7 by 26 percent and 17 percent in a time/step savings. In this scenario Oracle Database 11g R2 flashback technology again proves its usefulness in an everyday scenario. Of course the tool does not guard against human errors, which are a major reason for system outages, corrupt data, and mistakenly run SQL, however it does provide a level of protection that other competing products do not. Flashback has again proven that within a fraction of the time it takes other products to recover, Oracle Database 11g R2 database can be up and running again with minimal effort on the part of the DBA.

### **Correct Erroneous Transaction**

This scenario was very complex for the DB2 9.7 testers to complete. In this test not only did ORC have to repeat certain steps, to restore the database to a new location, export the table, import it back into the destination table after a truncation, but ORC also had to repeat certain transactions, since we only had our most recent backup to work with. By using the Flashback technology again, Oracle Database 11g R2 outperformed DB2 9.7 by 87 percent in time savings and 56 percent in step/complexity savings.

It must be noted again that in the case of a large production database, this can result in many hours invested by the DB2 9.7 DBA in order to perform this recovery operation. Even with a DBA being 100 percent focused on the recovery, the amount of manual steps in the DB2 9.7 recovery operation can lead to further human errors that can potentially increase the amount of time it takes to recover from an erroneous transaction.

### **Testing: Performance & Tuning Tasks**

Performance and tuning tasks are vital to the scalability and survivability of applications, so productivity in this area is important. The DBA needs to be able to quickly diagnose and solve a performance and tuning problems. ORC International's panel of database professionals revealed that in true 24x7 environments, this task accounted for nearly half of the DBAs' time.

Oracle Database 11g R2 out-performed DB2 9.7 by a factor of 6.3, with a productivity savings of 84 percent. The below table highlights the tasks tested:

**Table 5 - Testing: Performance & Tuning Tasks**

D. Performance and Tuning Tasks		Time (Min:Sec)		Steps		Percent Difference	
		Oracle	DB2	Oracle	DB2	Time	Steps
18	Problem Diagnosis	00:08	00:11	2	4	27%	50%
19	Tune Instance Memory	00:00	00:00	0	0	0%	0%
20	Tune SQL Statements	00:00	00:40	0	4	100%	100%
	<b>Total</b>	<b>00:08</b>	<b>00:51</b>	<b>2</b>	<b>8</b>	<b>84%</b>	<b>75%</b>

## Problem Diagnosis

Oracle Database 11g R2 showed significant gains over DB2 9.7 in problem diagnosis, with 27 percent time savings and 50 percent step savings. No steps are required to determine if there are issues with installation of Oracle Database 11g R2. Also, the initial Oracle Enterprise Manager 11g's intuitive dashboard, with its KPIs and visualizations of database performance, makes problems easy to diagnose and locate.

With DB2 9.7 an additional tool must be employed in order to see potential issues. Within the Control Center, the Activity Monitor is launched and the user is presented with queries to run against the instance to locate issues. To match Oracle Database 11g R2's level of problem diagnosis using DB2 9.7, the DBA must run each query provided with the DB2 9.7 installation. After that, manual diagnosis must be done on the data gathered from the instance. Oracle Database 11g R2 AWR and ADDM automatically provides a view of KPIs and details on potential issues, without user interaction.

In our opinion, DB2 9.7 cannot be compared on any level of problem diagnosis with Oracle Database 11g R2, without the installation and configuration of third-party or custom built tools. Oracle Database 11g R2's additional productivity is gained by employing the ADDM and AWR.

## Instance Memory Tuning

Both Oracle Database 11g R2 and DB2 9.7 offer out-of-the-box instance memory tuning. Therefore, this test will be removed from subsequent studies of this kind, since nothing was available for us to test.

## SQL Statement Tuning

SQL statement tuning is an often-overlooked aspect of DBA work, but one that takes a good portion of their time. Sometimes DBAs are hired by organizations that have poorly-designed databases, or databases that require constant tuning. Other times, they find themselves part of a development team, or supporting a development team where the developers outnumber the DBAs 10 or 15 to one. In these cases, DBAs tune and review a lot of SQL. Oracle Database 11g R2 showed a total domination in productivity and time savings when compared to DB2 9.7. Oracle Database 11g R2 used no steps or time in order to complete this task.

Oracle Database 11g R2 provides out-of-the-box tuning of SQL statements and reporting of problematic SQL. The DBA needs not wait for alerts on blocked objects or reports from operations that web pages are non-responsive. The DBA can easily navigate within Oracle Enterprise Manager 11g using the SQL Response Time chart on the performance dashboard to quickly dive into KPIs and look at the collection details to identify poorly written SQL if they choose to not rely solely upon the Automatic Tuning features of Oracle Database 11g R2. For the purposes of this test, we made the assumption that SQL would be automatically tuned, that none of our production SQL contained recursive statements, or that queries would not go parallel<sup>5</sup>.

<sup>5</sup> Oracle Automatic SQL Tuning Features and Usage:  
[http://download.oracle.com/docs/cd/E11882\\_01/server.112/e16638/sql\\_tune.htm#CHDHICFI](http://download.oracle.com/docs/cd/E11882_01/server.112/e16638/sql_tune.htm#CHDHICFI)

DB2 9.7 required the DBA to move back into the Activity Monitor, and to know which metric report to view and process based on reported user behavior. There is no KPI or automatic metric for the DBA to be able to see and proactively resolve before the issue becomes apparent to the users without manual research into the instance. The DBAs will be able to proactively maintain Oracle Database 11g R2 instance without causing or waiting for service interruption that could affect customers or internal staff.

## Summary Compilation

### Comparison Summary Results

Table 6 Summary of Testing Results

Task	Description	Time (Min:Sec)		Steps	
		Oracle	DB2	Oracle	DB2
<b>A. Initial Setup &amp; Installation</b>		<b>20:42</b>	<b>8:19</b>	<b>7</b>	<b>37</b>
1	Out of the box installation	16:03	6:25	1	15
2	Setup of additional database	4:20	1:03	2	8
3	Setup proactive monitoring	0:19	0:51	4	14
<b>B. Daily Administration Tasks</b>		<b>4:43</b>	<b>5:50</b>	<b>44</b>	<b>47</b>
4	Create Tablespace	0:13	0:06	2	1
5	Create User/Schema	0:06	0:05	2	1
6	Create Table	0:45	0:52	17	17
7	Create Index	0:43	0:57	3	4
8	Create Additional User	0:09	0:06	2	1
9	Add Space to Tablespace	0:08	0:15	1	2
10	Reclaim Fragmented Space	0:33	0:00	4	0
11	Load Data from Text File (csv)	1:20	1:01	13	3
12	Configure Adaptive Thresholds and Perform Workloads	0:46	2:28	0	18
<b>C. Backup and Recovery Tasks</b>		<b>5:14</b>	<b>15:06</b>	<b>21</b>	<b>43</b>
13	Configure and Run Full Backup	0:08	0:09	0	1
14	Recover Dropped Table	0:28	3:06	3	12
15	Recover Dropped Datafile	1:32	1:03	5	6
16	Recover Corrupt Datafile	1:48	1:02	5	6
17	Recover from erroneous transaction using Flashback	1:18	9:46	8	18
<b>D. Performance and Tuning Tasks</b>		<b>0:08</b>	<b>0:51</b>	<b>2</b>	<b>8</b>
18	Problem Diagnosis	0:08	0:11	2	4
19	Tune Instance Memory(Appendix E)	0:00	0:00	0	0
20	Tune SQL Statements	0:00	0:40	0	4

## Final Results

Table 7 Summary of Weighted DBA Time and Step Savings

Tasks Area		Workload Weighting	% Difference		Workday Savings	
			Time	Steps	Time	Steps
A.	Initial Setup & Installation	5%	-149%	81%	-7%	4%
B.	Daily Administration Tasks	25%	19%	6%	5%	2%
C.	Backup and Recovery Tasks	10%	65%	51%	7%	5%
D.	Performance and Tuning Tasks	45%	84%	75%	38%	34%
Total		85%*			43%	45%

\*15 percent of time was allotted for administrative/HR functions and not counted towards evaluation of the actual DBA's time and energy.

## Detail Compilation

### Initial Setup & Installation

#### Task 1: Default Installation

Oracle				IBM DB2			
Process Flow	Penalty	Time	Steps	Process Flow	Penalty	Time	Steps
<b>Task: Default Installation</b>							
In Explorer Navigate to DVD and start setup by double clicking setup.exe		00:00	0	In Explorer Navigate to DVD and start setup by double clicking setup.exe		00:00	0
Waiting for Installer to Load		00:04	0	Splash Screen / Navigate to Install a Product/ Select new after scrolling to DB2 Enterprise Edition 9.7/ Wait for secondary splash screen to finish		0:11	1

Email Configuration: Defaults selected/Warnings ignored		0:02	0	Accept License Agreement		0:03	1
Install Options: Default selected		0:02	0	Typical install options selected for installation type		0:02	0
System Class / Defaults selected		0:02	0	Multiple secondary options screens navigated through		0:15	0
Password Screen / Set password to 123456		0:05	1	Password Screen / Set password to 123456		0:05	1
Installation Review / Finish Selected		0:08	0	Multiple screens, defaults selected, but Prepare the DB2 tools catalog selected (with defaults used) Set up Notifications - Option unselected, since no SMTP server was installed to support the installations.		0:18	2
Actual Installation / Binary Copy, etc.		8:31	0	Installation Review		0:05	0
Oracle Database Configuration Assistant ran based on previous inputs.		7:09	0	Actual Installation / Binary copy, etc.		4:12	0

	The Oracle installed without any issues or errors			Error occurred during creation of TOOLSDB (Documented bug JR28800)	Context penalty of 4 due to known bug		4
				Post installation configuration / modification of AD groups on Windows. The issue was not properly documented by installation documentation.	Context penalty of 2 for lack of docs / Counted as 6 steps in order for Windows Administration functions	1:14	6
<b>Oracle Total</b>		<b>16:03</b>	<b>1</b>	<b>DB2 Total</b>		<b>6:25</b>	<b>15</b>

**Task 2: Create additional database server/instance**

Oracle				IBM DB2			
Process Flow	Penalty	Time	Steps	Process Flow	Penalty	Time	Steps
<b>Task: Setup of additional database</b>							
Launch the database configuration assistant		00:00	0	Start Menu/DB2/First Steps		00:00	0
Splash screen		0:02	0	Database Creation/Create Your Own Database	Context penalty of 4 added to actual step count of 1, for 8 option screens.	0:06	5
Create Database Screen		0:02	0	Specify Name - Accept Defaults / Select Next		0:06	1

Database Template screen / General Purpose/OLTP selected		0:02	0	Specify Storage - Accept Defaults / select Next		0:02	2
Database Identification / Database SID set to comptst		0:04	1	Accept various defaults and select Next		0:06	0
Management Options / Default selected, nothing changed. (On subsequent run, the daily disk backup option was selected, where an OS username and password was entered in addition to default values selected)		0:04	0	Review and select Finish		0:43	0
Password Screen: Select "Use the same password for all accounts" in order to speed process.		0:04	1				
Database File Locations: Defaults selected – Finish button found and selected		0:02	0				
Summary Screen/ OK selected		0:03	0				
Database Creation Screen (Cosmetic, nothing to do)		3:56	0				

Password Management Screen / Exit found and clicked.		0:01	0				
<b>Oracle Total</b>		<b>4:20</b>	<b>2</b>	<b>DB2 Total</b>		<b>1:03</b>	<b>8</b>

**Task 3: Set up proactive monitoring for performance and space utilization**

Oracle				IBM DB2			
Process Flow	Penalty	Time	Steps	Process Flow	Penalty	Time	Steps
<b>Task: Setup Proactive Monitoring</b>							
Enterprise Manager homepage / Select Metric and Policy Settings at the bottom of the page.		0:01	0	Control Center / Select the Health Center toolbar button		0:01	1
Metric and Policy Settings / Edit four various thresholds and select OK		0:18	4	Health Center / Right click the instance, select Configure – Health Indicator Settings		0:04	0
				Health Indicator Config / Select instance Settings	Contextual penalty, should have known instance based on previous behavior	0:12	1
				Health Indicator Config / Double click Memory Heap Utilization		0:03	1

				Configure Health Indicator / Alter Warning and Alarm thresholds		0:04	2
				Health Indicator Config / Select Global Settings	Contextual Penalty	0:12	1
				Global Health Indicator Config / Edit three various elements	Contextual Penalty	0:00	3
				Configure Health Indicator / Cache Hit Ratio		0:04	1
				Configure Health Indicator / Package Cache Hit Ratio		0:04	1
				Configure Health Indicator / Shared Workspace Hit Ratio		0:04	1
				Finalize / Close various modal screens that prevent using the application	Usability Penalty	0:03	2
<b>Oracle Total</b>		<b>00:19</b>	<b>4</b>	<b>DB2 Total</b>		<b>00:51</b>	<b>14</b>

## Daily Administration Tasks

### Task 4: Create Tablespace

Oracle				IBM DB2			
Process Flow	Penalty	Time	Steps	Process Flow	Penalty	Time	Steps
<b>Task: Create Tablespace</b>							
Server Screen / Tablespaces Selected		0:01	0	Server Screen / Control Center – Right click database select Add Storage		0:02	0
Tablespace Creation / Under Datafiles select Add (new tablespace named PRODDATA		0:05	1	Add Storage Screen / Select Add...		0:00	0
New Datafile Creation Location default selected. New file named proddata.tbs / OK selected		0:06	1	Create Tablespace Wizard / specify tablespace name PROD_DATA, leave defaults, select Finish		0:04	1
Tablespace Creation Review / Summary screen viewed to ensure new space was created.		0:01	0	DB2 Message Modal Screen / select Close		0:00	0
<b>Oracle Total</b>		<b>00:13</b>	<b>2</b>	<b>DB2 Total</b>		<b>00:06</b>	<b>1</b>

**Task 5: Create User/Schema**

Oracle				IBM DB2			
Process Flow	Penalty	Time	Steps	Process Flow	Penalty	Time	Steps
<b>Task: Create User/Schema</b>							
Enterprise Manager Homepage / select Security		0:01	0	Control Center / In Database Context/Right click Schemas / select Create Schema		0:02	0
Security Page / Click Create		0:01	0	PROD_APP set for Schema name in Create Schema screen. All other defaults left as is / Selected OK		0:03	1
Enter username "PROD_APP" password 123456 and all other fields left default / Select OK		0:04	2				
<b>Oracle Total</b>		<b>00:06</b>	<b>2</b>	<b>DB2 Total</b>		<b>00:05</b>	<b>1</b>

**Task 6: Create Table**

Oracle				IBM DB2			
Process Flow	Penalty	Time	Steps	Process Flow	Penalty	Time	Steps
<b>Task: Create Table</b>							
Enterprise Manager Home, go to Schema / tables		0:01	0	Control Center / In Database Context / Right click Tables / select Create		0:02	0

Tables change default schema from System to PROD_APP / Click Create		0:02	1	Create Table / Select Schema PROD_APP from drop down / Enter Tablename / select Next		0:03	1
Enter Table Name / 5 columns change various default values / data types/ nullability / Click OK		0:42	16	Select Add for new column definitions for this table		0:00	0
				Enter column name / select data type to match predefined table structure to use apply default if needed based on structure and apply nullability based on structure / click OK		00:00	0
				Repeat above two steps 4 more times for each column in our predefined table model. (Timing in this slot is meant to represent total time for repeated steps listed above)		0:46	16
<b>Oracle Total</b>		<b>00:45</b>	<b>17</b>	<b>DB2 Total</b>		<b>00:52</b>	<b>17</b>

**Task 7: Create Index**

Oracle				IBM DB2			
Process Flow	Penalty	Time	Steps	Process Flow	Penalty	Time	Steps
<b>Task: Create Index</b>							
Enterprise Manager Home / go to Schema / tables		0:01	0	Control Center / In Database Context / Right click Indexes		0:02	0
Select Indexes / Create		0:02	0	Create Index Wizard / Specify table schema and table name / click next		0:06	2
Input index name, enter table name and select Populate Columns		0:06	2	Give a name to the index / click next		0:04	1
Select single column to include in the index. / Select OK		0:34	1	Add a single column to the index, leave defaults / select Finish		0:45	1
<b>Oracle Total</b>		<b>00:43</b>	<b>3</b>	<b>DB2 Total</b>		<b>00:57</b>	<b>4</b>

**Task 8: Create Additional User**

Oracle				IBM DB2			
Process Flow	Penalty	Time	Steps	Process Flow	Penalty	Time	Steps
<b>Task: Create Additional User</b>							
Enterprise Manager Homepage / select Security		0:01	0	Control Center / In Database Context/Right click Schemas / select Create Schema		0:02	0
Security Page / Click Create		0:02	0	PROD_MAILER set for Schema name in Create Schema screen. All other defaults left as is / Selected OK		0:04	1
Enter username "PROD_MAILER" password 123456 and all other fields left default / Select OK		0:06	2				
<b>Oracle Total</b>		<b>00:09</b>	<b>2</b>	<b>DB2 Total</b>		<b>00:06</b>	<b>1</b>

**Task 9: Add Space to Tablespace**

Oracle				IBM DB2			
Process Flow	Penalty	Time	Steps	Process Flow	Penalty	Time	Steps
<b>Task: Add Space to Tablespace</b>							
Enterprise Manager Homepage / Datafiles		0:01	0	Command Editor / SQL Issued in order to add space to the tablespace	Contextual Penalty to do it in the command editor + 1 for total step count of 2	0:15	2
Pick an existing datafile / Additional space specified, OK selected		0:07	1				
<b>Oracle Total</b>		<b>00:08</b>	<b>1</b>	<b>DB2 Total</b>		<b>00:15</b>	<b>2</b>

**Task 10: Reclaim Fragmented Space**

Oracle				IBM DB2			
Process Flow	Penalty	Time	Steps	Process Flow	Penalty	Time	Steps
<b>Task: Reclaim Fragmented Space</b>							
Enterprise Manager Homepage		0:00	0	Included as part of the maintenance process and already completed automatically.		0:00	0
Schema Tab / Reorganize Objects / Tablespace / Various wizard screens to complete.		0:33	4				
<b>Oracle Total</b>		<b>00:33</b>	<b>4</b>	<b>DB2 Total</b>		<b>00:00</b>	<b>0</b>

**Task 11: Load Data from Text File (CSV)**

Oracle				IBM DB2			
Process Flow	Penalty	Time	Steps	Process Flow	Penalty	Time	Steps
<b>Task: Load Data from Text File (CSV)</b>							
Enterprise Manager Homepage / Data Movement		0:00	0	Control Center / In Database Context / Select Tables / Pick Table/ right click / Select import		0:01	0
Data Movement / Automatically generate control file, host credentials entered.		0:02	0	Select files and locations, select OK and remaining defaults.		0:23	3
Data Movement / Select Datafile / Create table, have to manually specify tables, even though source file has already been specified.		0:51	13	Actual Load		0:37	0
Data Movement / Conventional Path / Various screens related to job submission, accept defaults.		0:09	0				
Job review		0:07	0				
Actual Load		0:11	0				
<b>Oracle Total</b>		<b>1:20</b>	<b>13</b>	<b>DB2 Total</b>		<b>1:01</b>	<b>3</b>

**Task 12: Configure Adaptive Thresholds and Perform Workloads**

Oracle				IBM DB2			
Process Flow	Penalty	Time	Steps	Process Flow	Penalty	Time	Steps
<b>Task: Configure Adaptive Thresholds and Compare Workloads</b>							
Enterprise Manager Homepage / Select Baseline Metrics		0:04	0	Control Center / Start the Command Editor	Contextual Penalty for required use of command editor + 2	0:04	2
Threshold Configuration / Quick Configuration Selected		0:06	0	Command Editor -Connect to TOOLSDB		0:06	1
Profile Selected		0:05	0	Command Editor - Enable event monitors for activities and statistics [CREATE EVENT MONITOR DB2ACT FOR ACTIVITIES WRITE TO <T>]	Nearly duplicate command for statistics (accounts for two steps, because two separate commands required)	0:14	2
Review Profile / Finish Selected		0:04	0	Command Editor - Start the event monitors [SET EVENT MONITOR DB2ACT STATE 1]	Nearly duplicate command for statistics (accounts for two steps, because two separate commands required)	0:09	2

Wait Time for Consuming		0:27	0	Command Editor - Collect individual activities with details [ALTER WORKLOAD <W> COLLECT ACTIVITY DATA ON COORDINATOR WITH DETAILS]	Used with details so that we got all information relevant to the workload, including the actual SQL and the compilation environment.	0:06	1
				Command Editor - Collect activity stats [ALTER SERVICE CLASS <SC> UNDER <UC> COLLECT AGGREGATE ACTIVITY BASE DATA]		0:08	1
				Wait time for workload to generate so we can view data	Same workload consumption time used as Oracle Database 11g R2	0:27	0
				Command Editor - Send in memory stats to the monitor [CALL SYSPROC.WLM_COLLECT_STATS()]		0:12	1

				Command Editor - Manually gather statistics information from the event monitor - SQL Query from SCSTATS_DB2 STATISTICS	Contextual Penalty for manual system table query + 1 for a total step count of 2.	0:21	2
				Command Editor - Manually gather activity information	Contextual Penalty for manual system table query + 1 for a total step count of 2.	0:18	2
				Command Editor - Set activity gather to off - [ALTER WORKLOAD <W> COLLECT ACTIVITY DATA NONE		0:08	1
				Command Editor - Set aggregate collector to off - [ALTER SERVICE CLASS <SC> UNDER <UC> COLLECT AGGREGATE ACTIVITY DATA NONE]		0:09	1

				Command Editor - Turn off activity and statistics event monitors [SET EVENT MONITOR DB2ACT STATE 0]	Nearly duplicate command for statistics (accounts for two steps, because two separate commands required)	0:06	2
<b>Oracle Total</b>		<b>0:46</b>	<b>0</b>	<b>DB2 Total</b>		<b>2:28</b>	<b>18</b>

## Backup & Recovery

### Task 13: Configure and Run Full Backup

Oracle				IBM DB2			
Process Flow	Penalty	Time	Steps	Process Flow	Penalty	Time	Steps
<b>Task: Configuring and Run Full Backup</b>							
Backup Configuration / Schedule a Full Backup		0:01	0	Control Center / In Database Context / Right click database select Backup		0:01	0
Schedule Oracle Suggested Backup		0:01	0	Initial Splash Screen / Select Next		0:01	0
Disks left as default		0:02	0	Add Path for the backup		0:03	1
Default time of 2:00 AM selected		0:04	0	Click Finish and get a modal Wait screen.		0:04	0
Job submitted		0:00	0				
<b>Oracle Total</b>		<b>00:08</b>	<b>0</b>	<b>DB2 Total</b>		<b>00:09</b>	<b>1</b>

### Task 14: Recover Dropped Table

Oracle				IBM DB2			
Process Flow	Penalty	Time	Steps	Process Flow	Penalty	Time	Steps
<b>Task: Recover dropped table</b>							
Enterprise Manger Homepage / Availability		0:02	0	Without prior configuration, required restore of database, not configured properly out of the box, so steps were followed that assuming database had been setup in out of the box default installation	Contextual penalty, as database should be configured correctly in the out of the box setup. - Time penalty of 1 minute, however time was actually longer, and step penalty of 2.	1:00	2
Availability / Perform Recovery		0:00	0	New database Created via restore		0:00	0
Perform Recovery / Change the scope to tables / Operation Type to Flashback Dropped Tables / Click Recovery		0:03	3	Restore / Provide new database name / select backup set / add to selected backup images / click finish.		0:37	3
Defaults selected / Object Recovered.		0:23	0	Control Center / In Database Context of newly restored database / Select tables / Find table requiring restore and right click / select Export / Select Output File location, Select Message File location,		0:19	2

				Select OK			
				Start Command Editor under context of production database to be restored to. Truncate destination table to be restored.	Command Editor penalty.	0:17	2
				Control Center / In Context of Database to be restored to / Select Tables / Find Table / Right click table / select Import		0:21	3
				Select File location / select OK and allow import to complete.		0:32	0
<b>Oracle Total</b>		<b>00:28</b>	<b>3</b>	<b>DB2 Total</b>		<b>3:06</b>	<b>12</b>

### Task 15: Recover Dropped Datafile

Oracle				IBM DB2			
Process Flow	Penalty	Time	Steps	Process Flow	Penalty	Time	Steps
<b>Task: Recover Dropped Datafile</b>							
Cannot connect to the Database Instance / Select Perform Recovery		00:00	0	Control Center / Pick the database to restore as the context / Right click / Select Restore		00:00	0
Perform Recovery / Provide username / password combination		00:06	2	Restore Wizard in Database Context as before / Select Next		00:04	0
Perform Recovery / Oracle Suggested Recovery		00:02	1	Restore Wizard / Tablespace / Select Tablespace / Select Next		00:04	1
Manage Failures / Review / Datafile Missing / Select Advise		00:04	2	Restore Wizard / Pick the backup file location / Select Next		00:07	1
Restore File / Recover		1:20	0	Restore Wizard / Change the container for a tablespace		00:13	1
				Restore Wizard / Restore by rolling forward to the end of the current logs		00:33	1
				Splash screen / Select Next	Context Penalty 1	00:02	2
<b>Oracle Total</b>		<b>1:32</b>	<b>5</b>	<b>DB2 Total</b>		<b>1:03</b>	<b>6</b>

**Task 16: Recover Corrupt Datafile**

Oracle				IBM DB2			
Process Flow	Penalty	Time	Steps	Process Flow	Penalty	Time	Steps
<b>Task: Recover Dropped Datafile</b>							
Cannot connect to the Database Instance / Select Perform Recovery		00:00	0	Control Center / Pick the database to restore as the context / Right click / Select Restore		00:00	0
Perform Recovery / Provide username / password combination		00:09	2	Restore Wizard in Database Context as before / Select Next		00:04	0
Perform Recovery / Oracle Suggested Recovery		00:02	1	Restore Wizard / Tablespace / Select Tablespace / Select Next		00:04	1
Manage Failures / Review / Datafile Missing / Select Advise		00:08	2	Restore Wizard / Pick the backup file location / Select Next		00:06	1
Restore File / Recover		1:29	0	Restore Wizard / Change the container for a tablespace		00:13	1
				Restore Wizard / Restore by rolling forward to the end of the current logs		00:33	1
				Splash screen / Select Next	Context Penalty 1	00:02	2
<b>Oracle Total</b>		<b>1:48</b>	<b>5</b>	<b>DB2 Total</b>		<b>1:02</b>	<b>6</b>

**Task 17: Recover from erroneous transaction**

Oracle				IBM DB2			
Process Flow	Penalty	Time	Steps	Process Flow	Penalty	Time	Steps
<b>Task: Recovery from erroneous transaction</b>							
Enterprise Manager Homepage / Select Schema / Select Tables		00:04	1	Without prior configuration, required restore of database, not configured properly out of the box, so steps were followed that assuming database had been setup in out of the box default installation		00:00	0
Table Search – Enter Owner/Schema / Select Go / Select the table to flashback		00:09	2	New database Created via restore		00:00	0
View Table: Select Flashback Table in Actions Go / Pick a point in time to flashback to input it into Flashback to a timestamp		00:12	2	Restore / Provide new database name / select backup set / add to selected backup images / click finish.		06:51	3

Perform OLR / Flashback Tables / Defaults Selected / Select Next		00:04	2	Control Center / In Database Context of newly restored database / Select tables / Find table requiring restore and right click / select Export		00:14	3
Confirmation / Select Next / Review / Select Submit		00:49	1	Select Output file location, select Message File Location, select OK		00:18	3
				Start Command Editor under context of production database to be restored to. Truncate destination table to be restored.	Context Penalty for using the command editor - 5	00:39	5
				Control Center / In Context of Database to be restored to / Select Tables / Find Table / Right click table / select Import		00:12	2
				Select File location / select OK and allow import to complete.		01:32	2
<b>Oracle Total</b>		<b>1:18</b>	<b>8</b>	<b>DB2 Total</b>		<b>9:46</b>	<b>18</b>

## Performance and Tuning Tasks

### Task 18: Problem Diagnosis

Oracle				IBM DB2			
Process Flow	Penalty	Time	Steps	Process Flow	Penalty	Time	Steps
<b>Task: Configure System to Identify Top Resource-Consuming SQL</b>							
Enterprise Manager Homepage / Review latest ADDM findings and ORA errors in the alert log		0:02	0	Control Center / In Database Context / Right click / Select Activity Monitor		0:01	0
Drill into each KIP to find root cause		0:06	2	Activity Monitor / Select report to see		0:03	1
				Filter through report (Manual exercise) to diagnose issues, sorting by any of the columns, report was sorted by Execution Times of SQL, Total CPU Time as well as Worst preparation Time		0:07	3
<b>Oracle Total</b>		<b>00:08</b>	<b>2</b>	<b>DB2 Total</b>		<b>00:11</b>	<b>4</b>

### Task 19: Tune Instance Memory

Oracle				IBM DB2			
Process Flow	Penalty	Time	Steps	Process Flow	Penalty	Time	Steps
<b>Task: Tune Instance Memory</b>							
Automatic Memory Tuning is enabled as part of the installation		0:00	0	Self-Tuning Memory is Automatically Enabled (for non-partitioned databases) when a New Database is Created		0:00	0
<b>Oracle Total</b>		<b>00:00</b>	<b>0</b>	<b>DB2 Total</b>		<b>00:00</b>	<b>0</b>

### Task 20: Tune SQL Statements

Oracle				IBM DB2			
Process Flow	Penalty	Time	Steps	Process Flow	Penalty	Time	Steps
<b>Task: Tune SQL Statements</b>							
Automatic SQL Tuning used for this Task / No penalty / Nothing to do		0:00	0	Control Center / In Database Context / Right click and select Activity Monitor		0:02	0
				Select a report, for this exercise the report "Dynamic SQL Statements in the cache with the largest number of rows read" was chosen.		0:04	1

				Review the report by sorting on various columns, and reviewing the Statement Text column to identify the poorly running SQL.		0:34	3
<b>Oracle Total</b>		<b>00:00</b>	<b>0</b>	<b>DB2 Total</b>		<b>00:40</b>	<b>4</b>

## Appendix A: Test Platform Details

### Hardware

- Processors: Dual Xeon 5520
- Memory: 12 GB DDR, 6x2 GB
- Storage
  - Primary system drives
    - 2 146 GB SAS 15k RPM RAID 1
  - Data drives
    - 3 146 GB SAS 15k RPM RAID 5

### Operating System

- Microsoft Windows Server 2008 R2 Enterprise

### Oracle

- Oracle Database 11g Release 2 Enterprise Edition (64 bit)
- Oracle Enterprise Manager 11g Diagnostics and Tuning Packs
- Oracle Database Configuration Assistant

### IBM DB2

- IBM DB2 Enterprise 9.7
- DB2 Control Center
- DB2 Command Line Processor
- DB2 Health Monitor
- DB2 Activity Monitor

## Appendix B: New Features

### Oracle Database 11g

The list of new features contained in the Oracle Database 11g R2 Enterprise Edition can be found at: [http://download.oracle.com/docs/cd/E11882\\_01/server.112/e17128.pdf](http://download.oracle.com/docs/cd/E11882_01/server.112/e17128.pdf)

### IBM DB2 9.7

The list of new features contained in IBM DB2 9.7 Enterprise can be found at: <http://publib.boulder.ibm.com/infocenter/db2luw/v9r7/index.jsp?topic=/com.ibm.db2.luw.wn.doc/doc/c0052035.html>

## Appendix C: Detailed Task Descriptions

### Testing: Administration Workload

#### Out-of-the-Box Installation

A standard installation of both DBMS platforms, accepting all defaults and only providing input when required in order to complete the steps. These installation steps do not account for any customization for the server platform for use in a production environment.

#### New Database Creation

Using provided tools and wizards, only defaults were selected and input was provided only when required in order to complete the steps. This step focused on the creation of a new database/instance for the DBMS.

#### Proactive Monitoring Setup & Configuration

Using the provided tools, monitoring was configured for both DBMS platforms. Defaults were selected.

#### Daily Administrative Tasks

These tasks were identified as daily administrative tasks that DBAs typically perform.

#### Object Creation: Tablespace

This task tested the creation of additional space for the database, in a separate file.

#### Object Creation: User/Schema

This task tested the creation of an additional user for the database. This could be viewed as either a temporary user account for access to the database, or a new application user of a more permanent nature.

#### Object Creation: Table

This task tested the creation of a new table.

#### Object Creation: Index

This task tested the creation of a new index on a given table.

#### Space Management

These tasks tested the ability and ease to add and remove space from existing data files.

#### Add Space to Tablespace

This task tested the ease of adding space to an existing tablespace that had grown to capacity.

#### Reclaim Fragmented Space

This task tested the ability to remove unused space from a data file.

## **Testing: Backup & Recovery Tasks**

This set of tasks tested various backup and recovery options available in both DBMS platforms.

### **Configure & Run Full Backup(s)**

In this test we checked the ability to run a single backup, at user request, which was not scheduled.

### **Recover Dropped Table**

In this test we compared the DBMS platform's ability to recover a single table that had been lost either through user error, or through corruption.

### **Recover Dropped Datafile**

In this test we compared the DBMS platform's ability to recover a single data file that had been lost either through user error, or through corruption.

### **Recover from Erroneous Transaction**

In this test we recovered from a transaction that was run in error to either mass update a table or group of tables.

## **Testing: Performance & Tuning Tasks**

In this group of tests we compared the DBMS platform's ability to quickly diagnose and resolve performance problems related to the everyday usage of the database platform in question.

### **Problem Diagnosis**

For this test we looked at the ease in which problems could be located, and how quickly user response could be determined.

### **Instance Memory Tuning**

This test was not run, since both platforms provide the out of the box instance memory management. This test will be removed from future iterations of this study.

### **SQL Statement Tuning**

In this test we determined the ability for each DBMS platform to quickly isolate and resolve problematic SQL statements.

## Appendix D: Formula Analysis

### Weighted Averages

A weighted average is any number that has one or many multiplying factors in order to arrive at a comparable result, when looking at an entire dataset. Moving averages are typically thought of in terms of time, in this case the working year of an individual.

Weighted averaging is the product of statistical analysis of the times and steps recorded in this study. The focus of this study relies mostly on descriptive statistics, whereby we are aiming to summarize the data in this study into quantitative results that are easy for the general population to understand and digest. The ultimate goal in this report is to provide simple summaries about the measures we have taken during our analysis.

The following is a representation of the formula used in calculating the productivity savings in this study, utilizing the various statistical methods that we used as an approach to this study:

#### Equation 1

$$R1 = (Wp^1 * Ra^1) + \dots (Wp^{(x)} * Ra^{(x)}) \dots$$

Where R1 is the final result, W=Weighted, p=Percent, R=Result, a=Average