

# Oracle to DB2 Database Migration: Lessons Learned

Frank C. Fillmore, Jr.; Principal and Founder, The Fillmore Group

## Executive Summary

Vendor lock-in is a hidden, but tangible cost associated with ongoing deployment of information technology (IT) infrastructure. Expensive annual software maintenance charges and high operational costs of Oracle databases are compelling reasons to overcome this particular vendor lock-in. IBM's enablement of Oracle PL/SQL application programming interfaces (APIs) in their flagship DB2 database has been exploited by over 1,000<sup>1</sup> customers to migrate applications from Oracle to DB2. While the primary motivator is financial, there are a number of ancillary benefits accruing to such a move: server consolidation, operational efficiencies, continuous database availability, fault tolerance, and better performance.

## Overview

In these challenging times, most organizations are looking for a competitive edge. Reducing expenses and increasing agility are two ways enterprises of all types seek to carve out market opportunities and establish reliable, resilient platforms for sustained future growth.

Many IT business units are resigned to tolerating vendor choices made many years ago by colleagues who might be long gone. One key choice has always been: which relational database management system (RDBMS) should they use for online transaction processing (OLTP), online analytical processing (OLAP), data warehousing, data mining, business analytics, and other related processes? Business and technology developments in the RDBMS vendor space raise this vital question today for many Oracle shops.

The purpose of this White Paper is to detail the business and operational advantages of switching RDBMS platforms from Oracle to DB2. Interwoven with a generalized discussion will be specific examples derived from a large-scale conversion project for a worldwide Top-50 financial institution which migrated a mission-critical application from Oracle to DB2 in 2011.

## Benefits of Migrating to DB2

The primary benefit is financial: *DB2 Advanced Enterprise Server Edition (AESE) can be as low as 1/3 the cost of Oracle*<sup>2</sup>.

The next set of benefits are quantitative – DB2 required fewer of everything for this particular client:

- Thirty-six(36) Sun servers reduced to four(4) POWER 770 servers<sup>3</sup> for multiple application databases.
- Fewer servers resulted in fewer instances of DB2 to license.
- Twenty-seven(27) full-time equivalency (FTE) staff positions reduced to twelve(12) FTE for all migrated databases. Surplus staff members were redeployed to other tasks.

Additional benefits are qualitative:

- DB2 High Availability Disaster Recovery (HADR) provides database level failover at data centers 14 miles apart; the customer impact of a database switchover between datacenters under load is 15 seconds, with an automatic cutover of application connections. The client repeatedly had tried without success to implement Oracle Real Application Clusters (RAC) with Data Guard to enable Oracle high availability.
- “The ability to switchover with efficiency is now a valuable triage tool that has significantly improved [our] mean time to recover from application anomalies. It is now customary [for us] to initiate a datacenter database switch to attempt to clear customer impacting locks, slowdowns, and hung threads that previously required a restart during off hours. Database switching in this manner was unanticipated and noteworthy.”<sup>4</sup>
- IBM transaction-level Q Replication provides tertiary failover 500 miles from primary/secondary data centers. In 2010 Oracle block-level replication had transmitted corrupted log records to all failover sites. Database recovery took days resulting in a major, high-visibility customer-facing application outage.
- *DB2 on POWER delivers up to 3 times the performance per core of Oracle database on SPARC*<sup>5</sup>.
- The client anecdotally indicated that IBM DB2 technical support was more responsive and able to address and resolve issues more quickly than did Oracle.

IBM has a series of tools to evaluate and enable a migration from Oracle to DB2:

- Migration Enablement Evaluation Tool (MEET) to make a detailed determination of an existing Oracle database's compatibility with DB2<sup>6</sup>.
- Business Value Assessment (BVA) financial tool to compare current Oracle licensing costs to equivalent DB2 licensing costs.
- IBM Data Movement Tool (IDMT) to extract data and database objects from an Oracle database and load them into DB2<sup>7</sup>.

Contact your IBM representative or IBM Business Partner for additional information regarding these tools and to receive a free review of your Oracle database and workload suitability for migration to DB2.

## Key Players in the Migration Process

Once a choice has been made to consider migrating from Oracle to DB2, who should be involved? And when? The following table lists the various contributors and when they participate in the process.

	Decision	Planning/Design	Implementation	Testing
LOB executives	X			
IT executives	X			
Data/Application Architects	X	X	X	X
Database Administrators		X	X	X
Systems Administrators		X	X	X
Application developers			X	X
End users				X

IT and line-of-business (LOB) executives must collaborate on determining the overall value to the organization of migrating from Oracle, the impact a major infrastructure change will have on new feature/function application development delivery schedules, and – most importantly – the return on investment of choosing to move to DB2. Commitment from both IT and LOB executives is crucial to the success of such an undertaking.

Data and application architects are the only role which spans all phases of a migration project. It is important that architects provide to senior executives validation that a migration is technically feasible, then shepherd the process from a “go” decision to production cutover and beyond.

Some might argue that database administrators (DBAs) should be included in the decision to migrate and application developers in the planning. One practical aspect of this process that must be considered is that Oracle DBAs and developers will be asked to make a major change that some might deem to be detrimental to their careers. Most IT professionals take pride in their skills and develop a loyalty to the products with which they have worked for years. In several instances where clients have contemplated a migration from Oracle to DB2, the in-the-trenches influencers have not unreasonably focused on their perceived career interests rather than the goals and objectives of their employer. Better to make the decision on the financial and technical merits and include other stakeholders as the need arises. An alternative approach is offer financial incentives and retention bonuses to key technical staff members. In this way they can share in the benefits of the migration and mitigate any perceived risk.

## Planning and Designing the Migration<sup>8</sup>

It is prudent to view changing database software within the larger context of an organization's IT infrastructure. While a client could just migrate from Oracle to DB2 and keep all other infrastructure components (e.g. server hardware, operating system, storage, networking, facilities, etc.), the current state of those components such as capacity, projected useful life, and other factors should be considered as well. In the case of the Top-50 financial institution, they changed virtually every aspect of their IT infrastructure. There were two reasons: most of the existing infrastructure was outdated and they wanted to exploit synergies between IBM hardware and middleware. For example: DB2 can exploit an AIX 16 MB page size on IBM POWER systems; for memory-intensive database applications, this can dramatically improve performance. New infrastructure also insulates existing application workloads from the migration process. It is important to note however, that migrating from Oracle to DB2 *does not require* any other changes if existing hardware and operating systems are compliant with DB2 prerequisites.

Design of the new database servers should incorporate existing service-level agreements (SLAs) for OLTP, business analytics, and other database-dependant processes. They should also sustain projected growth in demand and capacity, whether organic or through mergers and acquisitions. IBM's Smart Analytics System (ISAS)<sup>9</sup> is a DB2 database platform which delivers optimized, integrated hardware, software, and storage. ISAS mitigates the risk of incorrectly forecasting future database utilization by providing preconfigured units of additional capacity for all components.

## Application and Data Migration

While up to 98% of a typical client's Oracle PL/SQL workload will run unmodified against a DB2 database<sup>10</sup>, application source code will need to be managed through the migration process to accommodate changes

- for the other 2% of PL/SQL which is not supported by the DB2 APIs
- to improve performance
- to incorporate functional enhancements, comply with legal requirements, and meet other business objectives that arise during the migration.

The migration from one database platform to another doesn't occur in a vacuum and a rapidly changing competitive and regulatory environment won't permit a code "freeze". Application source code, RDBMS Data Definition Language (DDL), batch scripts, and other artifacts should be managed by repository tools that support versioning and multiple user check-in/check-out access.

Data migration is enabled by the IDMT referenced earlier. Through a command line interface or GUI, the no-cost IDMT automates the extraction of Oracle data and DDL and generates DB2 LOAD utility scripts. The Top-50 financial institution used IDMT for all of its migration activity. IDMT, by its nature, is a batch process and must be benchmarked. The elapsed time of extract and load for one of the client's multi-terabyte OLTP databases was measured at approximately five days. Sustaining a five-day outage for this particular application was not feasible, so they used a combination of IDMT and IBM's Q Replication software (to capture Oracle transactions while IDMT was running) to significantly reduce the outage window<sup>11</sup>.

## Testing and Validation

An organization undertaking an Oracle to DB2 migration would be wise to set up multiple environments for testing.

1. a Development (DEV) environment for unit testing
2. a Quality Assurance (QA) environment for functional validation and integration testing
3. a Performance (PERF) environment for volume testing
4. a Production (PROD) environment as the target for final production cutover.

For smaller migrations or to reduce expenses, DEV/QA and/or PERF/PROD can be combined. Only the PERF and PROD environments need to have sufficient processing and storage capacity to accommodate a production workload.

Application developers and end users should be enlisted to define test plans and test cases. These should include both daily transaction processing as well as important business cycles (i.e. month-end, period closing, and so forth). Testing batch jobs is as important as OLTP, but many batch processes that invoke Oracle commands and utilities will undergo significant changes. It will be important to analyze these internal IT processes in light of DB2 feature/functionality to determine if these batch jobs continue to meet a business objective. In some cases DB2 database maintenance might produce significant savings in terms of runtime and administrative effort. The client noted an exceptional reduction of time and effort when using DB2 backup utilities compared to the steps necessary to backup an Oracle database.

QA testing should be used to verify exception and error handling and validate key numerical values such as row counts and total amounts (e.g. account balances).

PERF testing is vitally important because, although DB2 supports PL/SQL syntax, it might not perform the same way as it natively does in Oracle<sup>12</sup> – at least without tuning. There are a variety of ways to mitigate variations in performance through:

- DDL changes (e.g. indexes)
- exploitation of DB2 features such as range partitioning, materialized query tables (MQTs), multi-dimensional clustering (MDC)
- as a last resort, rewriting the SQL itself.

PERF test cases should include expected spikes in processing related to time-of-day and seasonal and business cycles. As discussed earlier, the migration process itself should be benchmarked to determine if it will successfully complete within an acceptable application outage window.

## Skills Enablement

Many of an organization's technical staff members will be new to DB2. While Oracle and DB2 SQL APIs will work the same (98% of the time) there are significant differences in commands, utilities, terminology, and underlying structure. Providing formal training in DB2 for DBAs and application developers early in the migration process will pay enormous dividends. It will also demonstrate to staff members management's commitment to enhancing their technical capabilities. There are a variety of self-study and classroom courses specifically designed to help the Oracle specialist become familiar and comfortable with DB2. An example is IBM course code CL720 "Oracle to DB2 Enablement Workshop"<sup>13</sup>. There are also a number of other courses, books, conferences, and seminars on specialized topics such as DB2 design, tuning, backup/recovery, tools and utilities, high availability, etc. IBM also offers free how-to manuals known as Redbooks<sup>14</sup>. These are typically written by IBM specialists and Business Partners covering a particular technical topic at great depth - usually in the form of a case study detailing the implementation of a technology to solve a specific business requirement.

## The Big Day

After a few months of meticulous planning and hard work – the Top-50 financial institution completed their first database cutover from Oracle to DB2, from "go" decision to live customer-facing production, in less than 3 months – the big day arrives for your organization. The client had a dedicated project manager who maintained a detailed timeline of all of the activities of the various groups involved: systems administrators, DBAs, developers, operations, security, and the like. They arranged to have key personnel and IBM subject matter experts (SMEs) available onsite and on-call in case an unexpected problem cropped up. The timeline included periodic checkpoints and fallback plans. In addition, they had implemented automated monitoring for

both business-as-usual (BAU) and migration processing. Of the four major Oracle to DB2 migrations undertaken by this client in 2011, all completed successfully without customer impact.

### **We Did It! Now what?**

After a suitable celebration – scheduled after a few important business cycles are processed without incident – what’s next? Join together with other DB2 shops to share experiences and engage in an ongoing dialogue to fully exploit your new investment. Venues to do this include

- Regional DB2 Users Groups<sup>15</sup>
- International DB2 Users Group (IDUG)<sup>16</sup>
- IBM Information on Demand Conference (IOD)<sup>17</sup>

Users groups and conferences provide attendees with substantive learning opportunities on specific topics that are important to your organization. Most users groups meet quarterly and the IDUG and IOD conferences are held annually in different geographies around the world.



## Endnotes

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<sup>1</sup> Since 2009 ([ibm.com/facts](http://ibm.com/facts)).

<sup>2</sup> Cost based on publicly avail U.S. pricing info as of 4/3/2012 for IBM DB2 Advanced Enterprise Server Edition + Oracle Database Enterprise Edition software w/added priced products/features to provide comparable functionality. IBM prices exclude applicable taxes, and are subject to change by IBM without notice. IBM: assumes 100 Processor Value Units. Oracle: assumes 1.0 processor core factor. Both including Y1 maintenance/support.

<sup>3</sup> Includes DB2 HADR secondary.

<sup>4</sup> Senior client architect who guided the migration.

<sup>5</sup> [www.tpc.org](http://www.tpc.org) (<http://www.tpc.org>) as of 4/3/2012 [IBM Power 780 (3 x 64 C)(24 Ch/192 C/768 Th); 10,366,254 tpmC; \$1.38/tpmC; avail 10/13/10 v. Oracle SPARC SuperCluster w/T3-4 Servers (27 x 64 C)(108 Ch/1728 C/13824 Th); 30,249,688 tpmC; \$1.01/tpmC; avail 6/1/11]. TPC-C is a trademark of Transaction Performance Processing Council. [www.sap.com/solutions/benchmark/](http://www.sap.com/solutions/benchmark/) (<http://www.sap.com/solutions/benchmark/>) as of 4/3/2012 [IBM Power 795 (32 P/256 C/1024 Th); 126063 users/2-tier SAP ERP 6.0 pack4/AIX 7.1 + DB2 9.7; cert 2010046 v. Oracle SPARC Enterprise Server M9000 (64 P/256 C/512 Th); 39100 users/2-tier SAP ERP 6.0/Solaris 10, Oracle 10g; cert 2008042]. SAP is registered trademark of SAP AG in Germany and in several other countries. Any price comparisons made by IBM are not based on the specific benchmarks listed here.

<sup>6</sup> <http://www.redbooks.ibm.com/redbooks/SG247736/wwhelp/wwhimpl/java/html/wwhelp.htm?href=3-3.htm>

<sup>7</sup> <http://www.ibm.com/developerworks/data/library/techarticle/dm-0906datamovement>

<sup>8</sup> Much of this and some succeeding sections were derived from "Successfully Migrating From A Sun/Solaris/Oracle Stack To IBM p770/AIX/DB2 9.7" Session Number 1495 at the IBM Information on Demand Conference held in Las Vegas, NV October 2012 presented by Jeff Richardson of IBM. Jeff was the lead IBM architect of the specific migration discussed in this White Paper.

<sup>9</sup> <http://www-01.ibm.com/software/data/infosphere/smart-analytics-system/>

<sup>10</sup> Based on internal IBM tests and MEET analysis of customer PL/SQL workloads.

<sup>11</sup> Details on this approach for the specific migration discussed in this White Paper can be found in "Zero Outage Oracle to DB2 Migrations" presented at the International DB2 Users Group ([www.idug.org](http://www.idug.org)) held in Denver, CO May 2012 presented by the author.

<sup>12</sup> Remember, Oracle and DB2 use vastly different SQL optimizer technologies.

<sup>13</sup> Details can be found at [www.ibm.com/training](http://www.ibm.com/training).

<sup>14</sup> <http://www.redbooks.ibm.com>

<sup>15</sup> <http://www.idug.org/p/cm/ld/fid=84>

<sup>16</sup> <http://www.idug.org>

<sup>17</sup> <http://www-01.ibm.com/software/data/2012-conference/>