# Oracle's Large-Scale Essbase Implementation:

Replacing Oracle Financial Analyzer with Global, Performant Financial Consolidation and Reporting

# Abstract

In 2010, Oracle began a project to consolidate and upgrade its legacy financial analysis and reporting systems, Oracle Financial Analyzer (OFA), to a global financial consolidation and reporting solution. Oracle's rapid growth, much of it from acquisitions, had caused both performance issues and system fragmentation. Financial reporting and analysis was scattered across OFA and other legacy systems, and the declining performance and inflexibility of these aging systems often drove users to spreadsheets.

Oracle chose to consolidate and upgrade to a global financial consolidation and reporting solution based on Oracle Essbase (formerly Hyperion Essbase) and the Oracle Hyperion Planning applications. The corporate financial reporting application (dubbed CORE) was built on Oracle Essbase, while the divisional Line of Business applications were based on Oracle Hyperion Planning. The CORE application is the primary topic of this paper.

While the choice of a market-leading financial consolidation and reporting product was straightforward, the specific architecture of CORE was not. Oracle's initial implementation, using a BSO-only cube architecture, suffered from performance issues in both data loads and reporting. Therefore, the team re-architected the system using a hybrid ASO/BSO cube architecture.

In March 2011, Oracle completed the CORE implementation. After this implementation, performance of data loads and reporting dramatically improved. Data load is up to 790% faster than OFA, and over 97% of report queries are completed in 5 seconds.

This paper describes Oracle's successful Essbase implementation, and compares performance of the legacy OFA solution with the CORE solution that now provides 24/7 access to global financial reporting. Oracle's experience indicates that Essbase in this hybrid architecture provides a highly scalable and performant financial consolidation and reporting solution for large, data-intensive enterprises. Oracle IT recommends that customers with similar large-scale requirements consider adopting the solution patterns described herein.

# Growing Pains

By 2010, Oracle struggled with both system fragmentation and performance issues in its financial analysis and reporting systems – driven by the complexity of Oracle's business and the company's rapid, acquisition-fueled growth.

**System Fragmentation**

Financial analysis and reporting was scattered across a legacy system called Oracle Financial Analyzer (OFA) and a varied collection of custom solutions and spreadsheets, as shown in Figure 1. In addition, the business was handicapped by the lack of tools to perform ad hoc analysis and model business scenarios on the fly. For all of these reasons, a great deal of time was spent on preparing and reconciling reports that could have been better spent analyzing the data in the reports.
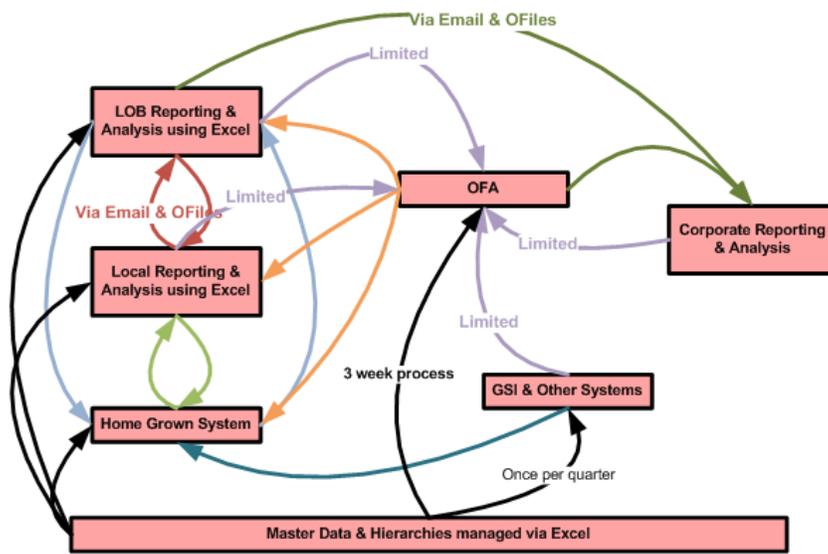


**Figure 1. Fragmented Financial Analysis and Reporting Systems**

**Performance Issues**

Oracle's increasing size and large general ledger created a large volume of data that needed to be summarized and reported on, regularly and frequently. In addition to being very large, Oracle's financial data set was also complex, with multiple ledgers and data sources. One source of complexity was that Oracle's general ledger did not have a single global chart of accounts. An additional source of complexity was that reporting data for product revenue resided in a data warehouse, rather than in the general ledger system. Therefore the new financial consolidation and reporting system would also need to combine data from this data warehouse and from the multiple ledgers in order to produce unified financial reporting.

It was no secret within Oracle's finance community that the reporting from legacy accounting systems was difficult at best. Running reports using batch processes that loaded data from the source systems was extremely time-consuming. Oracle IT measured the time consumed by data load, metadata load and queries in OFA. These results are shown in Table 1, Table 2 and Table 3 respectively.

**Table 1. Data Load Performance**

| PROCESS NAME | TIME TO EXTRACT FROM SOURCE SYSTEM TO RELATIONAL STAGING TABLES | TIME FOR PROCESSING AND AGGREGATING DATA ON OFA CUBE | TOTAL END TO END TIME |
|---|---|---|---|
| Consolidated actual (Consol, M&A, Gifts, IS and BS) | 1 hr | Currency conversion + aggregation: 4 hrs 20 min DSO computation: 6 hrs | 10 hrs 20 min |
| Local actuals – EMEA region | 1 hr 40 min | Currency conversion + aggregation: 1.5 hrs | 3hrs 10 min |
| Local actuals – AMER region | 50 min | Currency conversion + aggregation: 1.5 hrs | 2hrs 20 min |
| Local actual – APAC region | 45 min | Currency conversion + aggregation: 1.5 hrs | 2 hrs 15 min |
| Product License Revenue | 5 min | 4.5 hrs | 4hrs 35 min |
| Product Support Revenue | 2.5 hrs | 1hr 15 min | 3hrs 45 min |
| Restatements | 15 min | 20 min | 35 min |
| Forecast Aggregation (every 4 hours) | N/A | 1 - 4 hrs (depending on the changes as well as load on the system) | 1 - 4 hrs |
| Forecast Aggregation (currency conversion to USD aggregation of entire forecast) | N/A | 6 hrs | 6 hrs |

**Table 2. Metadata Load Performance**

| PROCESS NAME | TOTAL END TO END TIME | COMMENTS |
|---|---|---|
| SCOA changes (once a month) | 2 days | |
| Segment changes (twice amonth) | 4 days | This takes longer primarily due to the cost center volume. |

**Table 3. Query Performance**

| SCENARIO | END TO END TIME | COMMENTS |
|---|---|---|
| Time to query a large report in thick client (400k+ intersections) | ~ 45 minutes | Based on a single test for a report with 496,000 cells on 1 page |
| Time to export a large report (400k+ intersections) from thick client to users' local system | ~ 15 minutes | Based on a single test for a report with 496,000 cells on 1 page |

In many cases, Finance simply did not run large reports or complex analyses on OFA, because doing so took too long. In addition, the OFA lacked the flexibility to model different business scenarios. Consequently, most finance users were driven to Excel or homegrown systems to do their analyses and modeling. This proliferation of systems led to data duplication and manual processes, which unsurprisingly produced inconsistencies and errors.

Instead of enabling the business, this complex patchwork actually inhibited the business from focusing on value-add activities. Users wasted time figuring out workarounds. Data consistency and business visibility suffered, and in some cases critical decisions were delayed.

Additionally, there was a lag of up to eight hours between the time Oracle's general ledger team made changes in the Enterprise Resource Planning (ERP) system and the time those changes were available for reporting. Consequently reports were never completely up to date.

Substantial performance improvement was required to meet the needs of the business. Oracle IT and finance jointly developed performance requirements for key functions, as shown in Table 4 below.

**Table 4. Business Performance Requirements**

| Business Process Name | Business Requirements (in minutes) |
| --- | --- |
| Local Actuals load – EMEA region | 90 |
| Local Actuals load – AMER region | 90 |
| Local Actuals load – APAC region | 90 |
| Consol + M&A Load (without DSO) | 120 |
| Consol + M&A Load (with DSO) | 120 |
| Product License Load | 120 |
| Product Support Load | 120 |
| Forecast Aggregation | 30 |
| Forecast Aggregation (including currency conversion) | 120 |
| SCOA changes (once a month) | 8 hrs |
| Local Actuals load – AMER region | 8 hrs |
| Time to query a large report in thick client (400k+ intersections) | 1 |
| Time to export a large report (400k+ intersections) from thick client to users' local system | 1 |

Oracle, like many of its enterprise customers, bore the symptoms of a company experiencing rapid, acquisition-driven growth. Oracle's internal Business Intelligence (BI) deployment needed a substantial upgrade to carry the company forward.

## Broad Requirements

**One Solution, Two Audiences**

Oracle wanted a single system to provide summarized financial reporting across all of Finance. The system needed to support the planning requirements of the Corporate Finance team as well as the divisional lines of business, two very specific and different audiences.

The divisional lines of business usually have entirely different planning teams. Corporate finance focuses on summarizing data at a very high level, while the division planners need granular detail around that specific line of business they are supporting.

The unified system needed to support both levels of requirements. Therefore Oracle chose to consolidate and upgrade to a global financial consolidation and reporting solution based on Oracle Essbase (formerly Hyperion Essbase) and the Oracle Hyperion Planning applications. The corporate financial reporting application (dubbed CORE) was built on Oracle Essbase, while the divisional Line

of Business applications were based on Oracle Hyperion Planning. The CORE application is the primary topic of this paper.

**Complex Data Dimensionality and Large Data Volumes**

Oracle's financial data was modeled across nine separate dimensions. Of these, the Organization (Cost Center) dimension – with about 320,000 members – was the largest. To report on the most current data at the beginning of each region's day, the data from local or country ledgers had to be loaded three times every 24 hours. Monthly loads were also performed, at a volume of about 1.1 million records. The data from the consolidated ledgers (all local ledgers combined), was loaded approximately once a day. The volume was approximately 950,000 records per load, but these only needed to provide the big picture of the underlying data. They were not broken out by product. Product-specific revenue data was smaller at around 300,000 records per load. Forecast and budget data was about 200,000 records per month. Forecast data were available for six to eighteen months and budget data for two to four years.

The new system needed to support both complex data dimensions and the vast amounts of data records. A breakdown of the dimensions of the data is shown in Table 5 below.

**Table 5. Data Dimensions for Oracle's Essbase Implementation**

| DIMENSION |
| --- |
| Account |
| Currency Type |
| Version |
| Source |
| Scenario |
| Period |
| Product |
| Company |
| Organization |

## The Goal: From Legacy Systems to a Financial Consolidation and Reporting Solution Based on Oracle Essbase

Oracle's users were global and the output of the financial analysis and reporting system would be far-reaching. In addition to critical internal uses, the system would be the single source of truth for external reporting including SEC reporting.

Based on the above requirements, the company chose to standardize on a financial consolidation and reporting solution based on the Oracle Essbase multi-dimensional online analytical processing (OLAP) server.

## Defining the Strategy

Having defined the key business requirements and selected Essbase as the basis of the solution, the next step was to define a high-level strategy for how the components of the financial consolidation and reporting solution would interact, as shown in Figure 2.
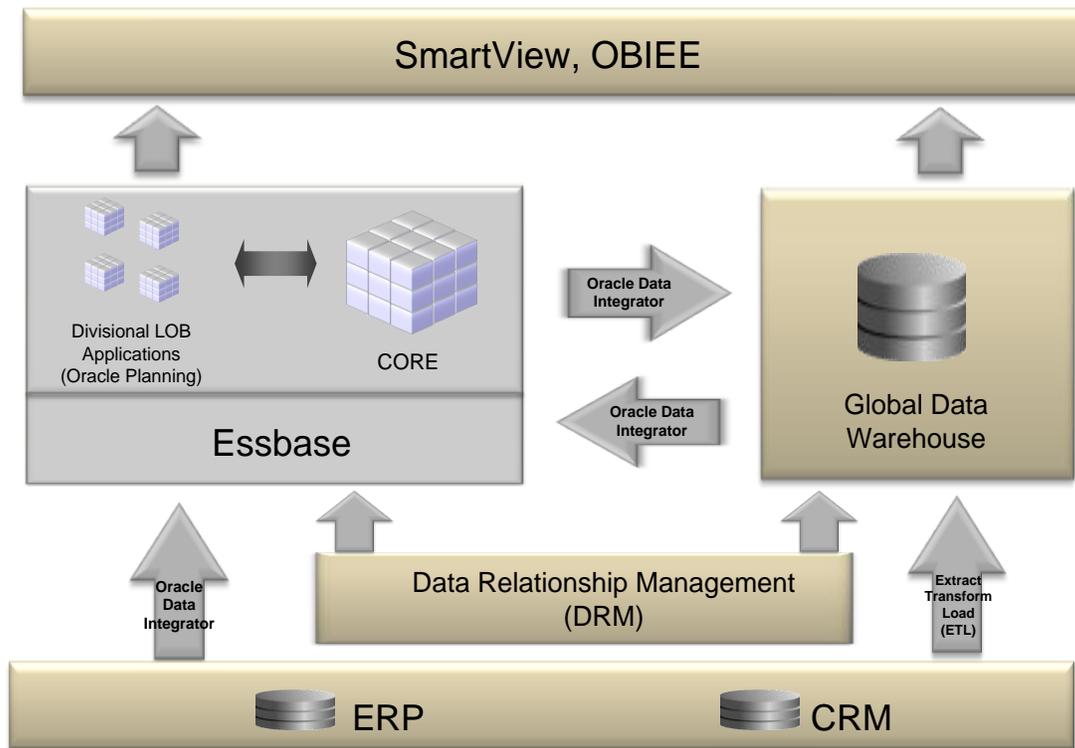


**Figure 2. Oracle's Financial Consolidation and Reporting Strategy**

The primary corporate financial reporting application, dubbed CORE, would be developed based on Essbase. CORE was designed to provide summarized financial management and external reporting. Divisional LOB applications would be developed using Oracle Hyperion Planning, which uses Essbase as the underlying database. Collectively these applications would provide both summarized financial reporting and meet the planning needs of Corporate Finance and the Lines of Business (LOBs).

To meet the need for these very different levels of detail, Oracle's approach would be to have its global data warehouse complement Essbase. Essbase would store only the summarized informational data, not the transactional level details. The global data warehouse would enable reporting at the transactional level. Data would flow between Essbase applications and the data warehouse via Oracle Data Integrator.

Oracle Data Relationship Management (DRM) would master the hierarchies and metadata about dimensional relationships, aggregation paths, and formulas used for this reporting in a single place – while still allowing the information to be published to the various downstream systems. Essbase and the global data warehouse would access DRM for metadata.

SmartView and Oracle Business Intelligence Suite Enterprise Edition Plus (OBIEE) would be the primary reporting tools to surface the information in Essbase applications and the data warehouse.

## Defining the Correct Cube Architecture for a Large, Data-Intensive Global Deployment

With the high level strategy defined, Oracle IT began architecture and implementation. A key decision in this process was the choice of cube type. As the team discovered, this choice becomes more critical in large global deployments.

Block Storage Option (BSO) has been the traditional way for Essbase to store data. BSO cubes provide the most flexibility in the ways that data can be calculated, but can experience performance issues as the number of dimensions and members become very large.

Aggregate Storage Option (ASO) cubes were added to Essbase starting with version 7 to address situations where performance considerations outweigh the need for calculation flexibility. ASO cubes can comfortably have significantly more dimensions and members than BSO cubes. However, they are more limited in the ways that data can be calculated. Table 6 compares the key strengths and weaknesses of the BSO and ASO cube types.

**Table 6. Comparison of BSO and ASO Cube Types**

|  | BSO | ASO |
|---|---|---|
| **STRENGTHS** | Data entry / Planning | Fast aggregation |
|  | Complex calculations / allocations | Large, sparse data sets |
|  | Replicated partitions | Large outlines |
| **WEAKNESSES** | Lengthy data aggregation | Limited ability to perform complex calculations |

Initially, Oracle's need for a highly flexible reporting system led the team to choose a BSO-only architecture for the CORE financial reporting application. A single large BSO cube was developed, into which users would submit all corporate forecast and budgets. All of the actuals data from the general ledger and from the data warehouse would be loaded into the same cube, then aggregated and summarized. Various transformations were performed within the cube, including currency conversions, computation of Constant Dollar (CD) plugs and other minor transformations – transformations well suited to BSO.

However key characteristics of Oracle's data proved far less well suited to this BSO-only cube architecture. From a data storage perspective, the majority of Oracle's financial data set was very sparse. The dimensions for reporting were large and the data was not available at all the intersections.

BSO alone therefore did not scale to meet Oracle's needs. Aggregation of the entire BSO cube took many hours – due to the volume, sparsity of data, and the size of the outline. It took two and a half hours to extract data from source systems and perform all the transformations on them using Calculation scripts. At Oracle's data volumes, this could have meant that finance reports that had to be

run at the beginning and end of the day would never be up to date. Changes to the cube's dense dimensions also took hours to complete, and this operation completely restructured the cube. Therefore the system would have been unavailable to users whenever such changes were made – pushing such changes to the weekend. In addition, changes tended to fragment the database, making the performance of a number of calculation scripts unpredictable and inconsistent.

Attempts to optimize the BSO-only architecture produced some performance improvement; however none produced a breakthrough. Oracle IT had discovered empirically the limits of a BSO-only approach for a large global enterprise Essbase deployment. While perfectly acceptable and even preferable for smaller deployments, BSO-only was not performant for a global financial consolidation and reporting solution in a business as large, complex and data-intensive as Oracle.

At this point, the team went "back to the whiteboard" to rearchitect the solution. The team reevaluated the diverse requirements Oracle needed the financial consolidation and reporting solution to fulfill – requirements that neither a pure BSO nor ASO cube type appeared able to completely meet. Could a solution architecture that used each cube type to cover its areas of strength be the answer?

Such a hybrid architecture was not common in the Essbase installed base. However it could potentially allow Oracle to handle a large and sparse data set at Oracle with substantially greater performance and still perform all required calculations. The CORE application was redesigned using two cubes – one ASO and one BSO – structured to leverage the strengths of both. Figure 3 below shows the topology of the combined ASO/BSO architecture.
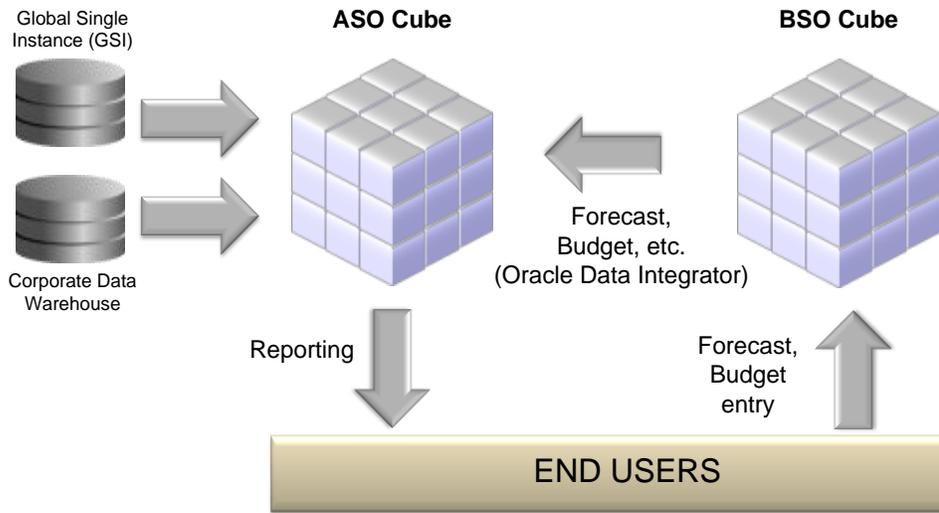


**Figure 3. ASO/BSO Hybrid Architecture**

The power of an ASO cube lies in fast aggregation and ability to handle sparse data sets. Therefore, the ASO cube was the one all users would access for reporting. No specialized calculations would be performed in the ASO cube.

The more flexible but less performant BSO cube would be leveraged for its strengths in data entry and planning. The BSO cube would be used by a smaller set of users for submitting forecasts and budgets. A process was set up so that approximately every four hours, the budget/forecast data would be extracted from the BSO cube, loaded into the ASO cube and aggregated via Oracle Data Integrator.

The overall increase in performance of the hybrid architecture proved dramatic. Primary data loading time did not change because the data load had already been optimized during the initial implementation of the BSO-only architecture.  However, because data aggregation can now be done in minutes rather than hours, it is possible to incorporate changes as they occur and create reports on that fresh data on the same day that the data is incorporated.

One key source of performance gains in the hybrid architecture is in the area of fragmentation. Because the initial BSO-only cube could tolerate no more than 10% fragmentation, it had to be defragmented every weekend. In the hybrid ASO/BSO architecture, the cubes can withstand a 30 to 40% fragmentation and can go for 1 to 2 months without a defragmentation. The chart of accounts maintenance processes are designed to be executed monthly, so dense dimension changes are performed once a month. These dimension changes now take about five minutes and defragmentation occurs during this the COA maintenance process. Therefore it is not necessary to explicitly defragment the cubes.

The decision to use a hybrid ASO/BSO architecture was only part of the architecture process. Having previously chosen the nine dimensions required by the business, Oracle IT evaluated these dimensions to configure them for optimal performance in the hybrid architecture.

In the BSO cube, defining each dimension correctly as dense or sparse directly affects cube performance. In the ASO cube, correctly defining each dimension as stored or dynamic has substantial performance impact. Table 7 shows how Oracle IT configured ASO and BSO dimensions.  Therefore, Oracle IT recommends that customers considering similar deployments carefully plan the configuration as well as selection of dimensions.

**Table 7. Configuration of Dimensions in Oracle's ASO and BSO Cubes**

|  | BSO | ASO |
|---|---|---|
| Account | Dense | Dynamic |
| Currency Type | Dense | Dynamic |
| Version | Sparse | Stored |
| Source | Sparse | Stored |
| Scenario | Sparse | Dynamic |
| Period | Sparse | Stored |
| Product | Sparse | Stored |
| Company | Sparse | Stored |
| Organization | Sparse | Stored |

## Dramatic Improvements

The CORE financial consolidation and reporting solution was deployed to internal Oracle users, with phase 1 completed in November 2010 and phase 2 in March 2011. CORE currently serves as the single source of truth for more than 1000 users across the globe 24x7. It is used by the financial planning and analysis team for analysis, by country controllers during close processing, and for Oracle's corporate

forecasting and budget submissions, which occur nearly every week of the quarter. Most importantly, CORE is also used for Oracle's critical external reporting, including reporting to the SEC.

In meeting all of the above demands, CORE's hybrid ASO/BSO architecture has dramatically improved performance. Table 8 below shows the performance comparison of CORE, OFA and what business expected.

As shown in Table 8, it only takes one to two minutes for end users to see reports. In this one to two minutes, most queries on the Essbase server only takes 25 seconds or less. At Oracle, it is not uncommon for users to run reports that retrieve close to half a million intersections. Even running these very large reports, performance data for the first three months in 2012 shows that over 89% queries on the

> *"At Oracle, our corporate reporting Essbase application is used for internal management and external reporting, budgeting and forecasts, and daily accounting close. These diverse needs require the application to be both fast and flexible, while retaining necessary controls to ensure accuracy.*
>
> *Essbase is meeting these needs with much greater speed and flexibility than the systems it replaced. Data aggregation is running 2X to 11X faster than in OFA. Report queries are 20X faster, and we are able to retain fine-grained control over when budgets and forecasts are updated to ensure that the proper user input data is presented."*
>
> *Jim English*
> *Vice President, Finance*

Essbase server completed in one second or less, over 97% in 5 seconds or less, over 97% in 10 seconds or less, and over 99% in 25 seconds or less (Figure 4). In addition, the average query execution time remained less than 1.6 seconds even as the number of queries increased (Figure 5).

**Table 8. CORE vs. OFA Performance Comparison**

| BUSINESS PROCESS NAME | OFA TIMINGS | BUSINESS EXPECTATIONS (IN MINUTES) | CORE TIMINGS (IN MINUTES) | % IMPROVEMENT IN CORE VS. OFA |
|---|---|---|---|---|
| Local Actuals load – EMEA region | 3hrs 10 min | 90 | 45 | 320% |
| Local Actuals load – AMER region | 2hrs 20 min | 90 | 45 | 210% |
| Local Actuals load – APAC region | 2hrs 15 min | 90 | 45 | 200% |
| Consol + M&A Load (without DSO) | 4hrs 20 min | 120 | 54 | 380% |
| Consol + M&A Load (with DSO) | 10 hrs 20 min | 120 | 70 | 790% |
| Product License Load | 4hrs 35 min | 120 | 42 | 550% |
| Product Support Load | 3hrs 45 min | 120 | 62 | 260% |
| Forecast Aggregation | 1 to 4 hrs | 30 | 30 | 400% |
| Forecast Aggregation (including currency conversion) | 6hrs | 120 | 30 | 1100% |
| SCOA changes (once a month) | 2 days | 8 hrs | < 8hrs | 500% |
| Local Actuals load – AMER region | 4 days | 8 hrs | < 8hrs | 1100% |
| Time to query a large report in thick client (400k+ intersections) | ~ 45 min | 1 | 1 to 2 min | 2150% |
| Time to export a large report (400k+ intersections) from thick client to users' local system | 15 min | 1 | 1 to 2 min | 650% |
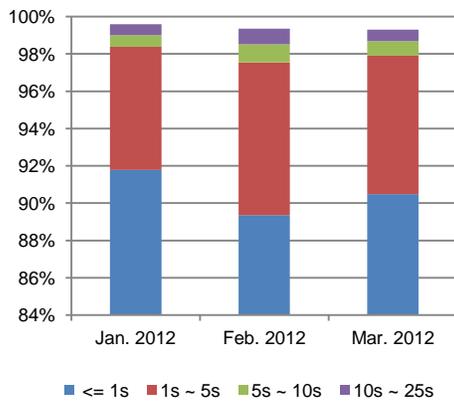


Figure 4.  Query Execution Time Breakdown (Seconds)
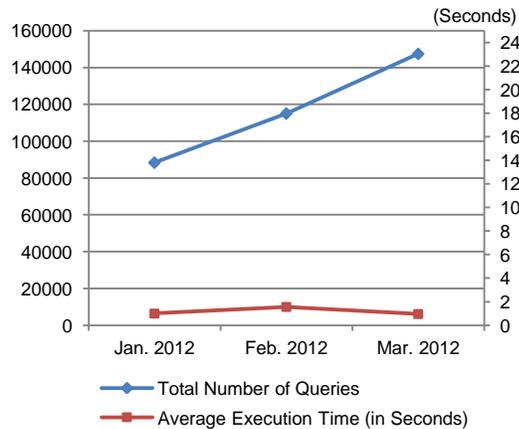


Figure 5. Total Number of Queries and Execution Time

Finance reports high satisfaction that data load processes now run in minutes, not hours. The forecast/budget data that is submitted in the BSO cube is extracted, transformed, loaded and aggregated into the ASO cube in less than 30 minutes.

## Conclusion

As a large, complex and data-intensive enterprise, Oracle represents one of the most difficult customers for a global financial reporting system. The legacy financial analysis and reporting systems, OFA, failed to fulfill Oracle's financial reporting requirements due to system fragmentation and performance issues. The Essbase implementation entirely solved these issues by dramatically improving performance while meeting the company's broad requirements.

Correctly architected, Essbase provides a strong base for Oracle's present and future financial business intelligence needs. Oracle's experience indicates that a hybrid ASO/BSO cube architecture is likely to provide the optimal combination of calculation flexibility and performance for global deployments in large, data-intensive enterprises. Oracle IT therefore recommends that enterprises planning global financial consolidation and reporting solutions consider this architecture.

# ORACLE®

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