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VALUE CHAIN PLANNING

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ENGINEERED SYSTEMS

An Oracle White Paper
March 2013

Oracle In-Memory Performance Driven Planning

Overview and Business Value: An Interactive Planning and Analytics Paradigm

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Executive Overview

Planning your complex value chain has always been challenging, and the degree of difficulty keeps increasing. Trends in business and economic conditions as well as emerging technology have added to the complexity. The pressure increases to plan for more complex value chains, more frequently, to a greater level of detail, and to make more informed decisions. Oracle Value Chain Planning is the leading solution for the value chain, with over a thousand customers of all sizes in almost every industry segment successfully running their complex businesses and achieving significant results. Oracle Engineered Systems, which include Exadata and Exalogic, are the preferred platform for deploying Oracle Applications when performance and scalability are important because of the extensive tuning, engineering the hardware and software to work together, and innovations that are only available with the stack. Many Oracle customers have seen significant scalability and performance improvements by deploying the Oracle Value Chain Planning applications on Oracle Engineered Systems, but to reach the next level of performance and scalability the applications themselves need to be engineered to take full advantage of the technology stack. Oracle In-Memory Performance Driven Planning is the newest addition to the Oracle Value Chain Planning solution and enables the next generation of near real time interactive planning, simulation, and analysis. This paper outlines the capabilities and directions of Oracle In-Memory Performance Driven Planning.

Oracle Value Chain Planning Introduction

Oracle Value Chain Planning enables companies to minimize costs, improve on-time delivery, reduce stock-outs, increase forecast accuracy, increase profit, and mitigate supply chain risk via flexible and comprehensive best in class planning business processes. Designed to support the needs of manufacturers, distributors, and retailers, Oracle Value Chain Planning's unique single-platform design creates an information bridge across functional silos, geographic regions, and business units that enables companies to deploy an enterprise-wide planning solution. Combining ease of use with sophisticated and broad planning capabilities, Oracle Value Chain Planning supports customers with basic planning needs as well as those with highly complex planning requirements.

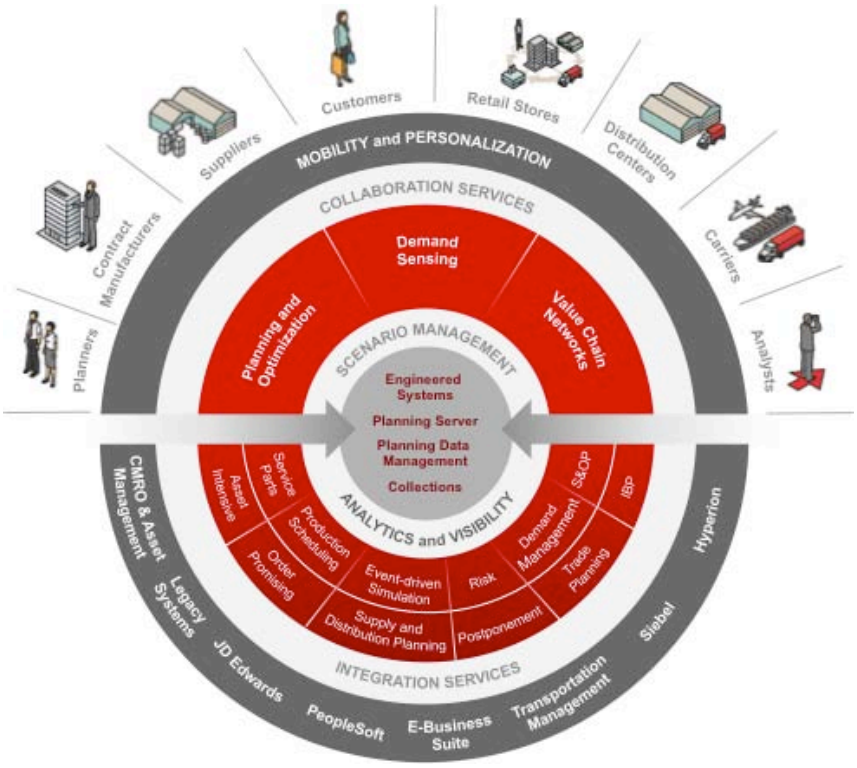

Figure 1 Oracle Value Chain Planning Solution

Global Control, Local Execution, Central Management

Oracle Value Chain Planning enables companies to manage their value chain networks on a global basis in terms of supply chain flows (outbound finished goods, inbound supplies, inter-facility and company shipments, service parts, reverse logistics, and so on), supporting mixed modes of manufacturing (discrete, configure-to-order, project, process, lean), and operating across geographic areas (regional and global). Oracle Value Chain Planning can simultaneously operate against a variety of ERP back-end systems, both Oracle and non-Oracle, and is the single source of truth for all planning

decisions. As a result, companies can support the nuances of their global operations while reaping the efficiencies provided by a single planning solution.

Foundation for Value Chain Planning Best Practices

Oracle Value Chain Planning provides support for the following planning business functions:

- **Demand sensing**
- **Forecasting and consensus demand management**
- **Promotion planning and optimization**
- **Integrated business planning**
- **Network design**
- **Risk management and Postponement**
- **Tactical supply and distribution planning**
- **Event-driven simulation**
- **Trading partner collaboration**
- **Business performance analysis**
- **Execute to plan – Promise and schedule**
- **Store level forecasting and replenishment**
- **Service parts and asset intensive planning**

All of the Oracle Value Chain Planning products are modular and designed to enable you to start with your most pressing business issue first, yet integrated to enable synergies when you expand to more comprehensive processes. Oracle Value Chain Planning is also open, and can be deployed against any ERP or transaction system back end. And Oracle continues with a high degree of investment and innovation in the planning area to continually enable the next generation of best in class business processes.

For more information on Oracle Value Chain Planning

Oracle Value Chain Planning

Oracle Engineered Systems Introduction

Oracle Exalogic

Oracle Exalogic is an Engineered System on which enterprises deploy Oracle business applications, Oracle Fusion Middleware or third-party software products. Exalogic comes pre-built with compute nodes, memory, flash storage and centralized storage, all connected using InfiniBand in a high redundancy architecture delivering five-nines availability, with fault tolerance and zero-down-time maintenance.

Exalogic dramatically improves the performance of Oracle Applications, Fusion Middleware and third party applications without requiring code changes and reduces costs across the application lifecycle, from initial set-up to on-going maintenance, as compared to conventional hardware platforms. Oracle has made unique optimizations and enhancements in Exalogic firmware, Exalogic software, and in Oracle Fusion Middleware and Oracle Applications. These include on-chip network virtualization based on near zero latency Infiniband fabric, high-performance Remote Direct Memory Access, workload management in Oracle Weblogic server and optimizations in Oracle Coherence and Oracle Traffic Director. Exalogic includes support for a highly optimized version of the Oracle VM, which significantly outperforms comparable virtualization solutions and is an ideal consolidation platform for Oracle Applications. There are templates available to simplify install, deployment and configuration of Applications on Exalogic.

Oracle Exadata Database Machine

Oracle's Exadata Database Machine is Oracle's database platform delivering extreme performance for database applications including Online Transaction Processing, Data Warehousing, Reporting, Batch Processing, or Consolidation of mixed database workloads. Exadata is a pre-configured, pre-tuned, and pre-tested integrated system of servers, networking and storage all optimized around the Oracle database. Because Exadata is an integrated system, it offers superior price-performance, availability and supportability. Exadata frees users from the need to build, test and maintain systems and enables them to focus on higher value business problems.

Exadata uses a scale out architecture for database servers and storage. This architecture maintains an optimal storage hierarchy from memory to flash to disk. Smart Scan query offload has been added to the storage cells to offload database processing. Exadata implements Smart Flash Cache as part of the storage hierarchy. Exadata software determines how and when to use the Flash storage for reads and write as well as how best to incorporate Flash into the database as part of a coordinated data caching strategy. A high-bandwidth low-latency InfiniBand network running specialized database networking protocols connects all the components inside an Exadata Database Machine. In addition to a high

performance architecture and design, Exadata offers the industry's best data compression to provide a dramatic reduction in storage needs.

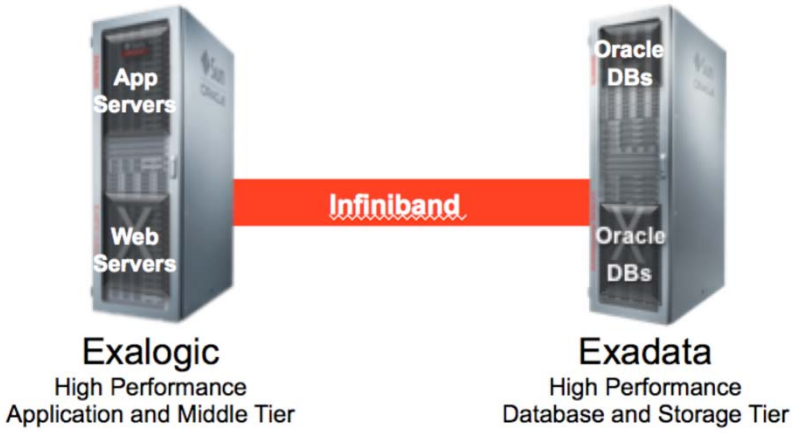

Figure 2 Engineered Systems: Exalogic, Exadata; Applications, and Database. The fastest, easiest path to unbeatable application performance

SPARC SuperCluster

Oracle's SPARC SuperCluster is the world's most efficient multi-purpose engineered system, delivering extreme efficiency, cost savings, and performance for consolidating mission critical applications and rapidly deploying cloud services. Oracle's SPARC SuperCluster represents a complete, pre-engineered, and pre-tested high-performance enterprise infrastructure solution that is faster and easier to deploy than a collection of individual database and application servers. The system combines innovative Oracle technology—the computing power of Oracle's SPARC servers, the performance and scalability of Oracle Solaris, the Sun ZFS Storage Appliance, the optimized database performance of Oracle Database accelerated by Oracle Exadata Storage Servers, and a high-bandwidth, low-latency InfiniBand network fabric—into a scalable, engineered system that is optimized and tuned for consolidating mission-critical enterprise applications

Oracle's SPARC SuperCluster provides both the capacity for growth, as well as the fine-grained server virtualization needed to isolate individual application components. With multiple layers of enterprise application infrastructure consolidated onto a high-performance, highly available SPARC SuperCluster system, deployment speed, application performance, and availability can all be optimized. Designed as a pre-configured, pre-tested, and ready-to-deploy SPARC SuperCluster engineered system, the solution provides a complete and optimized infrastructure solution for applications, built around robust compute, networking, storage, virtualization, and management resources. The result is a system that is orders of magnitude easier to manage, and up to five times faster to deploy than alternatives, all while occupying considerably less real estate requiring less power. Furthermore, the SPARC SuperCluster system provides full built-in redundancy resulting in a highly reliable infrastructure without single point

of failure. An issue with one component will not impact other components of the system offering true isolation. Customers can consolidate multiple environments with minimum disruption, without fear of performance degradation, and the ability to achieve required service levels.

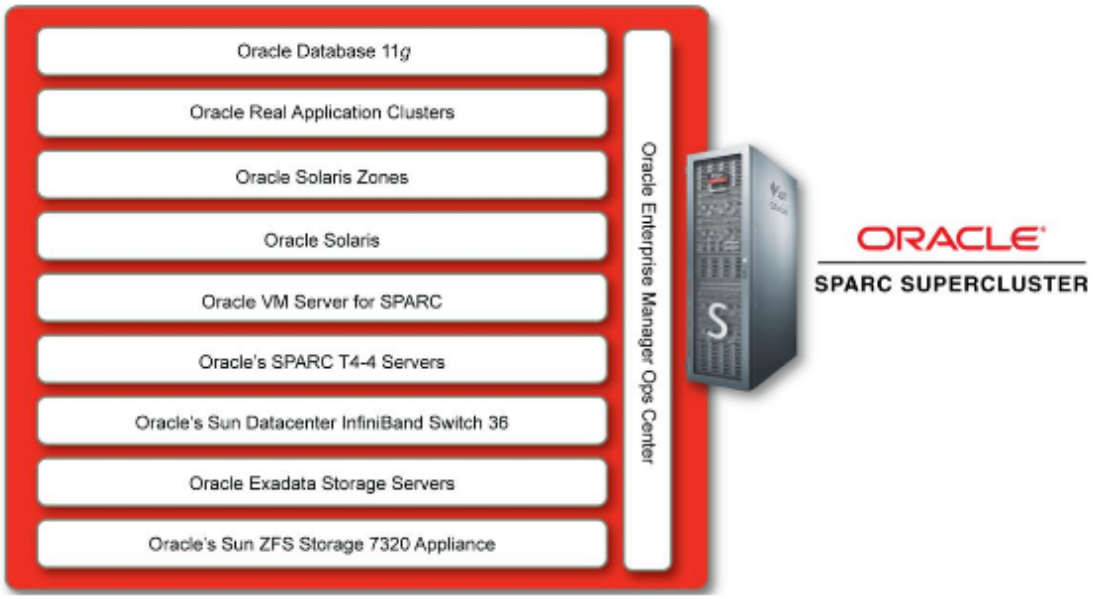

Figure 3 Oracle Sparc SuperCluster Architecture

Additional reference materials:

Oracle Exadata Database Machine Brochures and Data Sheets

Oracle Tech Network Oracle Exadata Database Machine

Oracle Exalogic Elastic Cloud Overview

Oracle In-Memory Performance Driven Planning Introduction

Oracle In-Memory Performance Driven Planning has been engineered to take full advantage of the capabilities uniquely provided by Exadata. For example, Oracle In-Memory Performance Driven Planning enables Real Application Cluster support for Value Chain Planning to take advantage of increased parallelism and scalability enabling much faster performance for database intensive planning processes like data collection, plan snapshot, and plan flush. This enables much shorter end to end planning times for the Value Chain Planning products like Oracle Rapid Planning, Oracle Advanced Supply Chain Planning, Oracle Inventory Optimization, and Oracle Service Parts Planning. Another example is re-engineering Oracle Advanced Planning Command Center to take full advantage of Exadata's Smart Flash Cache.

One key function of Oracle Advanced Planning Command Center is to provide the embedded analytics as well as the analysis layer for all of the Oracle Value Chain Planning products. There is a critical process step between runs of the various planning processes and the analysis, where the plan output is archived and transformed into pre-aggregated business metrics for the dashboards, reports, and ad-hoc queries. Oracle In-Memory Performance Driven Planning reduces run times of some key batch processes by 5x or more, but also totally eliminates many batch processes altogether by taking advantage of the Exadata platform to enable a real time interactive simulation and analysis process.

The unique features provided by Oracle In-Memory Performance Drive Planning and how they translate to business benefit for Oracle Value Chain Planning Customers will be described in the following sections.

Benefit #1: Reduced Planning Cycle Time and Data Latency

Planning processes are all very data and performance intensive. Historically, in designing planning business processes, tradeoffs have been made in the frequency of the planning cycle based on the time required to complete the entire cycle. By deploying Oracle Value Chain Planning on Oracle Engineered Systems, customers have seen improvement across all aspects of their planning processes, including data collection, plan snapshot times, plan run times, plan flush times, and archival of plan data for analysis. Existing benchmarks show up to 40% reduction in data collection and plan run times. Oracle In-Memory Performance Driven Planning takes this even farther by engineering the applications to take full advantage of unique capabilities provided by Oracle Exadata.

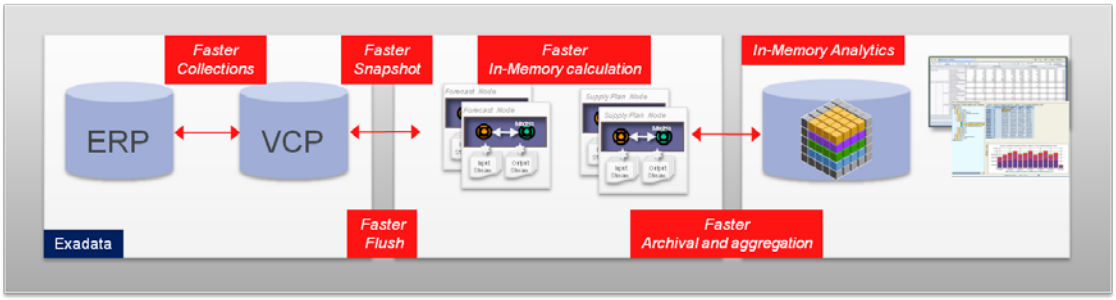

Figure 4 Planning Process Steps

Oracle In-Memory Performance Driven Planning reduces run times of all key batch processes illustrated in figure 3 above by 5x or more and increases the parallelism of these processes to add further scalability. It also totally eliminates many batch processes altogether by taking advantage of the Exadata platform to keep more of the processing directly in memory. Exadata Smart Flash Cache uses Flash memory to dramatically reduce the time to read and write database and log records. The intelligence in Smart Flash Cache transparently moves active database blocks from disk to flash in real time, thus ensuring that "hot" data is in Flash memory when the next access occurs. Blocks that should not be in Flash are similarly recognized, maximizing the amount of space in Flash for active data. Exadata Smart Scan speeds up data-intensive queries by leveraging the processing power of Exadata Storage Servers to scan and filter out results. By moving queries to storage instead of moving the data to the database servers, long-running reports and queries often complete 10x faster than on conventional systems. This improved performance and scalability can translate into tangible business benefits in several ways including moving to more frequent planning cycles, reducing IT batch windows to increase plan availability, expanding the scope of planning processes to incorporate more detail, and enabling new business processes.

More Frequent Planning Cycles

One constant pressure on existing planning processes is to reduce the size of planning cycles and increase the frequency of planning. Examples include moving from a monthly to a weekly or daily forecasting cycle, moving from a daily supply planning cycle to every shift or multiple times a day. Oracle In-Memory Performance Driven Planning enables customers to further reduce their planning cycle times and increase the frequency of planning. Increasing the frequency of planning processes means they are based on more timely and relevant information and not based on dated or no longer relevant assumptions, enabling more effective business decisions. In addition to increasing the frequency of existing processes, this can also translate into additional what if scenarios to be performed and analyzed for any given decision, enabling a more comprehensive analysis.

Reducing Batch IT Windows to Increase Plan Availability

Another constant pressure is the ability to complete all planning processes within narrow IT batch processing windows. This is particularly acute for global companies where there are no time windows where planners are not actively working on plan results. The unprecedented performance and scalability provided by Oracle In-Memory Performance Driven Planning enables all of the planning processes to be completed in a timely manner, and more importantly, means planning information is available to all planners around the world when needed for decision making.

Expanding the Scope of Planning Processes

Improved performance can also enable increasing the scope of planning processes. For example, expanding forecasting and replenishment to daily store level information, or increasing the time horizon and detail of supply chain planning. Other business requirements can drive the value of being able to scale, for example:

- For companies in high growth industries (i.e. mobile or e-commerce) or rapid market expansion (i.e. emerging markets) growth in the volume of transactions associated with growth in a company's business can mean the need to plan for larger planning footprints
- Growth in the volume of transactions can also result from a specific business event such as an acquisition or restructuring or merger of company divisions

Enabling New Business Processes

The increase in scalability also enables new business processes that were not previously feasible. One example that is increasing in adoption and importance is enterprise level integrated business planning. Typically, companies have implemented sales and operations planning or integrated business planning processes at the business unit level. The new trend is for large enterprises to implement a broader scale process to coordinate activities and resource loads across business units and optimize performance at the enterprise wide level. This creates a need to consolidate a huge amount of planning data from multiple planning systems and aggregate the information to an enterprise level.

Oracle In-Memory Performance Driven Planning enables consolidating planning data from multiple planning systems or instances to perform cross-instance analytics to support processes like enterprise level integrated business planning.

Benefit #2: Increased Application Availability

As companies grow either via organic growth or acquisitions, the planning processes need to scale up to incorporate the increased scale. On the Exadata platform Oracle Value Chain Planning customers have experienced up to 2.75x faster plan runs for large plans. This significantly compresses planning cycles and increases system availability for planners enabling them to scale their planning processes. All of the in-memory plan run times of the Oracle Value Chain Planning products like Oracle Rapid Planning, Oracle Advanced Supply Chain Planning, Oracle Inventory Optimization, and Oracle Service Parts Planning can also benefit by deploying Oracle Exalogic to dramatically improve plan run times. Applications using WebLogic benefit from a number of optimizations for thread efficiency, faster inter-process communication and higher message throughput. An optimized work scheduler for Exalogic balances the number of threads per core available on Exalogic systems, providing better application processing efficiency. WebLogic Server has changed to use shared byte buffers instead of array copies when passing data, improving application inter-process communication performance and a 66% reduction in number of objects created. This reduces heap usage and results in fewer expensive garbage collections for Applications. WebLogic also optimizes socket calls to reduce lock contention on Exalogic, allowing fewer threads to process a larger number of message requests. Applications running on Exalogic utilize Exabus, the underlying Infiniband fabric, which provides low latency and high throughput eliminating I/O bottlenecks in every application layer. Applications components are typically deployed in more than one server and Exabus provides low latency for I/O across nodes on same Exalogic rack. Access to ZFS storage device over Exabus greatly reduces latency for log file writes and other file access operations. For applications running on Exalogic and accessing database

tier on Exadata, Exabus delivers faster I/O, reduces CPU usage on both the mid-tier and DB-tier and provides higher connection pooling efficiency.

With In-Memory Performance Driven Planning, customers get full support for Oracle Real Application Clusters (RAC) when running any of the Value Chain Planning applications. Customers will now get the full benefit of horizontal scalability and high reliability of Oracle RAC. All Value Chain Planning processes like collections, snapshot, and so on, will now utilize the full processing power of all the nodes in the cluster (instead of being pinned to one node) and thus will perform that much faster. With this dramatic improvement in performance, customers can schedule their collection runs much more frequently getting closer to real time visibility and response to execution changes.

The value proposition is also in being able to use a single hardware platform to support a larger volume of transactions and end users. Companies continue to transition from multiple disconnected planning systems to more consolidated corporate planning solutions. Whether this is an upgrade of older planning systems or a rollout of a new planning process across multiple regions or business units, such initiatives drive cost saving in managing infrastructure, alignment of business processes, corporate visibility to the overall supply chain, and synergies across the business units to optimize the global supply chain. Oracle In-Memory Performance Driven Planning is designed to handle the scalability required for such planning systems. Additionally, Exadata features including Resource Manager, Smart Flash Cache, Smart Flash Log and Smart Scan, make the Exadata Database Machine an excellent choice on which to consolidate multiple databases. Exadata features significantly improve both the performance and the control of a consolidated database environment.

Large systems become more complex and drive the need for the simplicity provided by Oracle Engineered Systems which enables a company to scale to meet their needs without the growth in complexity of managed systems or having to replace hardware as limitations are reached.

Benefit #3: Increased User Satisfaction

Improved performance and scalability not only applies to batch processing, but to overall user experience as well. Planners and business analysts deal with large amounts of data that needs to be transformed into usable information expressed in terms of business impact at appropriate levels of aggregation. Much of the user interaction with planning systems is in the form of complex queries and displays. Examples of this include the complex aggregate worksheets used for demand analysis, queries of filtered demand and supply data for supply analysis, queries of plan recommendations for manipulation and release to execution systems, and business analytics for plan analysis. Oracle In-Memory Performance Driven Planning provides consistently better performance across all the user interactions with large complex queries experiencing 10x or more performance improvement. While these types of complex and performance sensitive user interactions are typical across all of the Oracle Value Chain Planning modules, one example that best illustrates the business benefits of performance and scalability as it relates to usability and user satisfaction is business performance management as enabled by Oracle Advanced Planning Command Center.

One key function of Oracle Advanced Planning Command Center is to provide the embedded analytics as well as the analysis layer for all of the Oracle Value Chain Planning products. There is a

critical process step between runs of the various planning processes and the analysis, where the plan output is archived and transformed into pre-aggregated business metrics for the dashboards, reports, and ad-hoc queries. In addition, the seeded reports and queries, as well as any user defined or ad-hoc queries and reports, perform additional complex processing of large amounts of planning data to render complex visualizations like pivot tables and charts for analysis.

Oracle Value Chain Planning's Advanced Planning Command Center provides a significant amount of pre-aggregation and transformation of raw plan output from the various Oracle Value Chain Planning modules to optimize the performance and interactivity of the seeded reports and dashboards delivered out-of-the-box with the product. Creating the pre-aggregation however, takes time and delays the planner's analysis.

The new Value Chain Planning In-Memory Performance Driven Planning application, designed uniquely for Oracle's Engineered Systems, enables significant improvements in several areas. First, it dramatically reduces the archival process between the end of a plan or simulation run, and the availability for viewing and reporting in the dashboards, as discussed above. Second, one of the most powerful capabilities of Value Chain Planning's Oracle Advanced Planning Command Center is the configurability and the ease by which users can create their own complex measures and analyses. Often however, as these personalized analyses have not been pre-engineered for optimal performance, the response time is noticeably less than the seeded reports. Besides improving the performance of existing reports and dashboards, this enables users to create even more complex reports that previously would not be rendered with acceptable performance. And finally, it provides dramatically increased performance in the responsiveness of the end user reports and queries with up to 29x improvement seen in complex analyses.

Oracle In-Memory Performance Driven Planning enables near real-time planning, simulation, and analysis.

Benefit #4: Improved Decision Making

One indirect benefit, which may have the most profound impact on business performance, is improved decision making. Shorter planning cycles and more comprehensive real time analytics can translate into more what-if scenarios or business alternatives evaluated for any given business decision and a more comprehensive analysis of which specific alternative has the most significant impact on the strategic objectives of the company. Increasing the productivity of planners and business analysts translates into having your knowledge workers spending more time analyzing and driving business results instead of waiting for planning processes or trying to compile the data required to make informed decisions. Some examples of how Oracle In-Memory Performance Driven Planning enables improved decision making includes new visualizations for complex analysis, productivity enhancements, and interactive in memory planning and analysis.

New Visualizations

Oracle In-Memory Performance Driven Planning provides completely new visualization capabilities that eliminate a lot of manual steps in a typical planner's day only available when Oracle Advanced

Planning Command Center is used with Oracle In-Memory Performance Driven Planning. For example, users can create reports using the new pivot table heatmap to immediately highlight visually where important areas of concern are with guided navigation to the underlying issues. This enables planners to easily identify variations from plan to plan with configurable thresholding and get to the deviations very quickly avoiding all the manual comparison steps. The micro trellis charts would let users spot the outliers in terms of things like inventory trends or demand variations easily. Exadata hardware has proven to execute such complex reports with multiple queries in parallel and fetch results 10x faster.

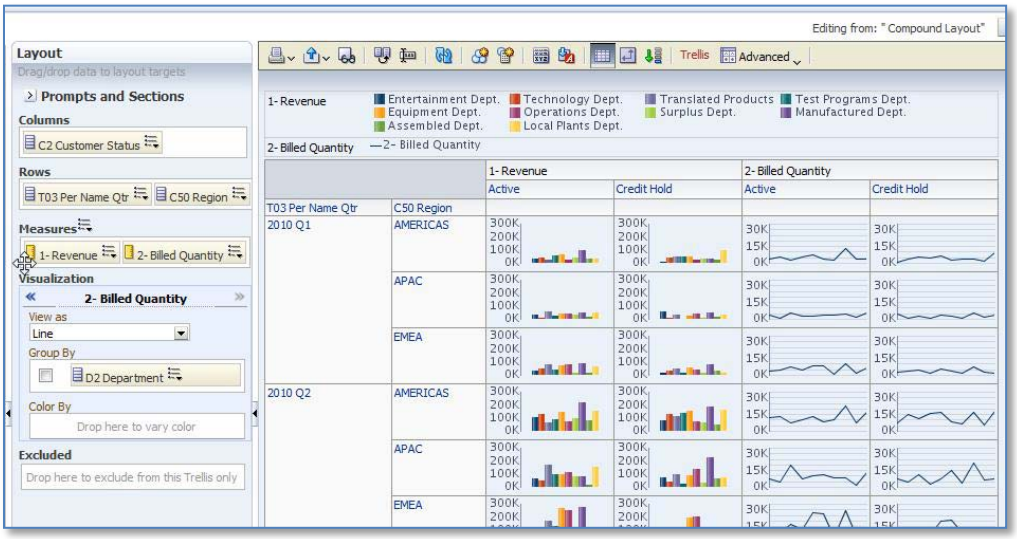

Figure 5 Dense Micro-Trellis Charts for Trend Analysis

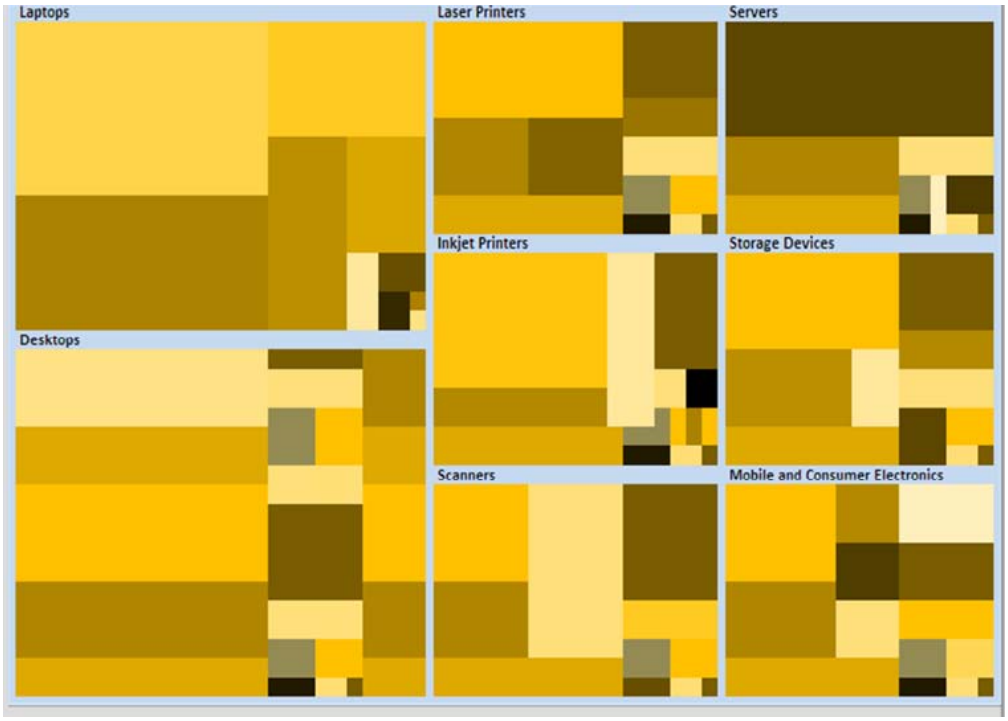

Figure 6 Heat-Map for Guided Navigation to Problem Areas

Productivity Enhancements

Oracle In-Memory Performance Driven Planning also takes advantage of the newest release of Oracle Business Intelligence Enterprise Edition which provides a number of user interface enhancements to promote interactivity and responsiveness. Features like Google style auto-text complete, cascaded prompts, dynamic user interface refresh and contextual right-click interactions makes it easier for the end user to analyze data and for the first time deliver some of the most commonly used web style interactions to an enterprise software solution.

Interactive In-Memory Planning and Analysis

Oracle In-Memory Performance Driven Planning enables a real-time analytics paradigm by using a fundamentally different architecture. It not only reduces run times of some key batch processes by 5x or more, but also totally eliminates many batch processes altogether. Instead of requiring the complete plan to be written out, it has a new capability to quickly surface just the key incremental changes to let planners complete a simulate-then-analyze cycle in seconds instead of hours. This is achieved by elevating most of the processing from disk to memory by leveraging the Exadata architecture. This enables planners to make better and more informed decisions by evaluating more scenarios with more comprehensive analysis and taking advantage of complex analytics and visualization.

Benefit #5: Lower Total Cost of Ownership

Oracle In-Memory Performance Driven Planning has been designed, built, scaled, and tested from the ground-up as a hardware and software package specifically and exclusively for Oracle Engineered Systems. This enables us to provide highly accelerated implementations because it was built only for the targeted platform and takes advantage of unique capabilities of the stack throughout the product design including development, testing, and performance tuning. When the system is then deployed for our customers the software and hardware are deployed in unison and operate as a designed cohesive solution.

Since Oracle In-Memory Performance Driven Planning is pre-engineered to work on Exadata and Exalogic, it frees up IT administrators requiring fewer man-hours to install, configure and deploy. The tight integration of hardware, network and software significantly reduces the need for on-site tuning and related costs. Also, Exadata's Hybrid Columnar Compression and Advanced Compression capabilities significantly reduce storage costs while increasing the number of plans or archives that can be used by planners. Additionally, Exadata features including Resource Manager, Smart Flash Cache, Smart Flash Log and Smart Scan, make the Exadata Database Machine an excellent choice on which to consolidate multiple databases. Exadata features significantly improve both the performance and the control of a consolidated database environment reducing the cost of managing environments.

Conclusion

Value Chain Planning is a critical opportunity area for many companies as they look to improve the efficiency and reliability of their global supply chains. Significant supply chain inventory cost reduction, increased on-time delivery, and business performance analysis are three primary areas of business value. Oracle Value Chain Planning is a complete, modular, integrated, and open set of best in class planning applications to enable best in class business processes. Oracle Engineered Systems are the preferred platform for deploying Oracle Value Chain Planning and offer un-paralleled performance and scalability. Oracle In-Memory Performance Driven Planning takes this to a whole new level by engineering the applications specifically to take full advantage of all the unique features of the Oracle Engineered Systems to enable the next generation of interactive planning, simulation, and analysis to dramatically improve the performance of existing planning processes and enable new processes that were not previously feasible. This provides a unique value proposition in terms of reduced planning cycle time and data latency; increased application availability and transaction scalability; increased user satisfaction via improved response time; improved decision making with improved planning analytics; and, lower total cost of ownership and faster time to value. Oracle In-Memory Performance Driven Planning for Oracle Value Chain Planning on Oracle Engineered Systems should be considered whenever performance and scalability for complex planning processes are important considerations.

White Paper Title: Oracle In-Memory Performance Driven Planning
March 2013
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