

# Business Intelligence and Service Oriented Architectures

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# Business Intelligence and Service Oriented Architectures

## INTRODUCTION

For several years the Service Oriented Architecture (SOA) paradigm has promised to deliver unprecedented levels of business agility by enabling organizations to rapidly develop and adapt business processes across existing IT services and infrastructure. At the same time there has been a significant growth in demand for the pervasive use of business intelligence (BI) in order to gain improved insight and visibility into business processes performance and to enable better decision making at all levels of an organization. Today, as demonstrated in a recent CIO survey<sup>1</sup>, BI and SOA respectively are the top strategic focus areas for many CIOs.

The simultaneous growth of investment in business intelligence and SOA technologies is no coincidence. As organizations seek greater growth and the ability to adapt more quickly to change, there arises a greater need for insight into the impact business processes have in terms of business performance and the ability to achieve organizational goals. Improved business insight in turn drives a further demand for more rapid growth and change.

This paper examines the essential synergies between service oriented architectures and business intelligence and explains how the Oracle's Business Intelligence and SOA technologies can be used to gain insight into the impact of business process performance, empower business intelligence users to invoke automated business processes, and use business intelligence as a service to drive business processes towards business goals.

We will first examine the IT environment driving the growth in adoption of business intelligence and SOA technologies, and the business requirements for the integration of business intelligence within a service oriented architecture. We will then briefly examine the components of a SOA and BI platform. Finally, we explain, at a high level, how the Oracle Business Intelligence and SOA technologies and infrastructure can be used to address the key business requirements.

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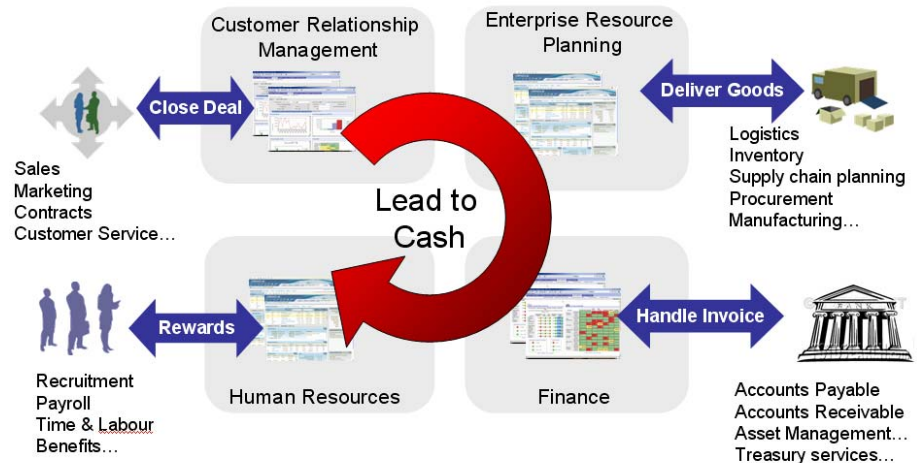
<sup>1</sup> Business Intelligence Tops the Strategic Technology List.  
[http://www.cioinsight.com/slideshow\\_viewer/0,1205,1=&s=300&a=198529&po=2,00.asp](http://www.cioinsight.com/slideshow_viewer/0,1205,1=&s=300&a=198529&po=2,00.asp)

## THE IT ENVIRONMENT

Medium and large organizations use some form of software to manage most of their key business functions. However, the complexity and heterogeneity of IT infrastructure and applications present a significant challenge to many organizations seeking to orchestrate enterprise business processes that span departments, applications and technologies. These complex heterogeneous environments also present a challenge when organizations need to gain insight into business performance since the data that can collectively provide that information will typically be stored in many places.

Consider a “lead to cash” process for example as illustrated in figure 1. This is a business process that models and orchestrates the process of closing a sale, delivering the goods or service to a customer, arranging for payment and rewarding employees.

Such a process may have to integrate functionality and services from a sales automation system (e.g. Siebel CRM), an Enterprise Resource Planning system (e.g. Oracle E-Business Suite or SAP), a finance system (e.g. Oracle EBusiness Suite) and an HR system (e.g. PSFT) – as well as specialized software packages and in-house developed systems. These systems in turn may be running on different middleware infrastructure (e.g. Oracle, IBM, BEA, Microsoft, SAP) and different platforms (e.g. HP, Sun, Microsoft, IBM) and will store key business data in different data storages systems (e.g. Oracle, IBM, Microsoft, Teradata).



**Figure 1. Lead to Cash Business Process**

## BUSINESS REQUIREMENTS

We identify 3 common requirements that organizations using Service Oriented Architecture technologies to achieve greater business agility need to address:

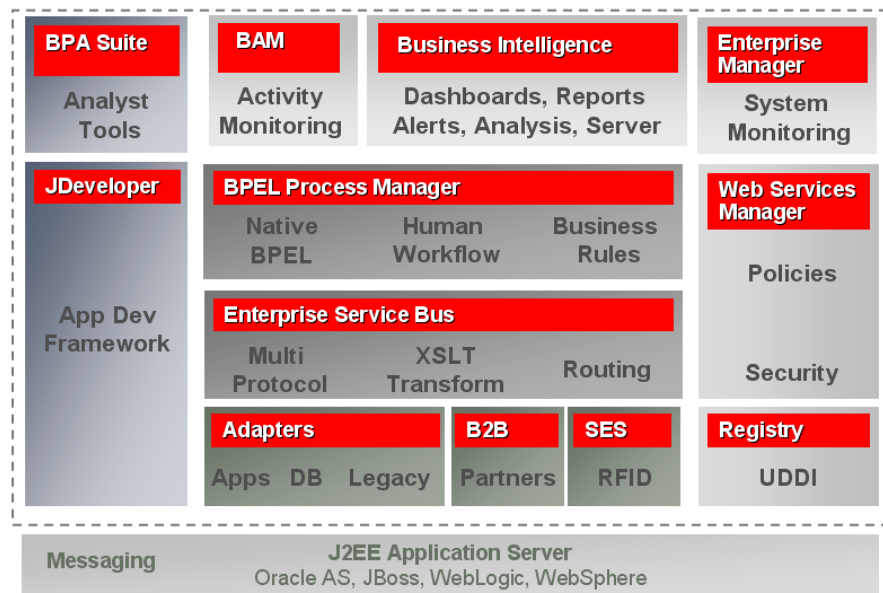
- **Understand the business performance impact of business processes.** Greater business agility requires business insight and visibility. If you have no insight or visibility into the impact a business process has on business goals then it will be difficult to determine what changes should be made to a business process to improve business performance. This paper describes how business intelligence can be used to gain insight into business process performance.
- **Empower business users to take action as a result of insight.** When a business user gains insights that flag a business performance problem, some kind of action will typically need to be taken in order to address the problem. Often the action may involve invoking a business process. If this is difficult to achieve then there is often less value to the insight. This paper describes how Oracle Business Intelligence tools can be used to invoke business processes directly from business intelligence dashboards and alerts.
- **Orientate business process towards business goals.** A common business requirement is to define business processes that drive the organization towards key business goals defined in terms of key performance indicators (KPIs) and business metrics (e.g. customer profitability, supplier performance, customer satisfaction or employee performance). These KPIs often derive from information scattered in many data sources throughout the organization. We will examine how we can use business intelligence as a service to optimize business processes towards business goals.

## **SERVICE ORIENTED ARCHITECTURE TECHNOLOGIES**

The need to be able to build and adapt enterprise business processes that can leverage existing heterogeneous infrastructure and services has led to the use of SOA platform infrastructure and technologies. Oracle's SOA technologies are illustrated in figure 2<sup>2</sup>.

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<sup>2</sup> Oracle SOA Suite. <http://www.oracle.com/technologies/soa/index.html>



**Figure 2. Oracle’s SOA technologies**

SOA platform infrastructure enables rapid development and adaptation of business processes defined using the standard Business Process Execution Language (BPEL). The Oracle SOA Suite allows business processes to be orchestrated across many complex systems using web services interfaces and pre-built adapters to connect to heterogeneous infrastructure and middleware. The ability to rapidly develop and change business processes is key to delivering on the SOA promise of greater business agility.

The Oracle SOA suite also includes infrastructure for defining and executing business rules, human workflows, orchestrating business event routing and transformation using an enterprise service bus (ESB), as well as services to secure and manage SOA components and services. A common authoring environment is also provided within the JDeveloper tool.

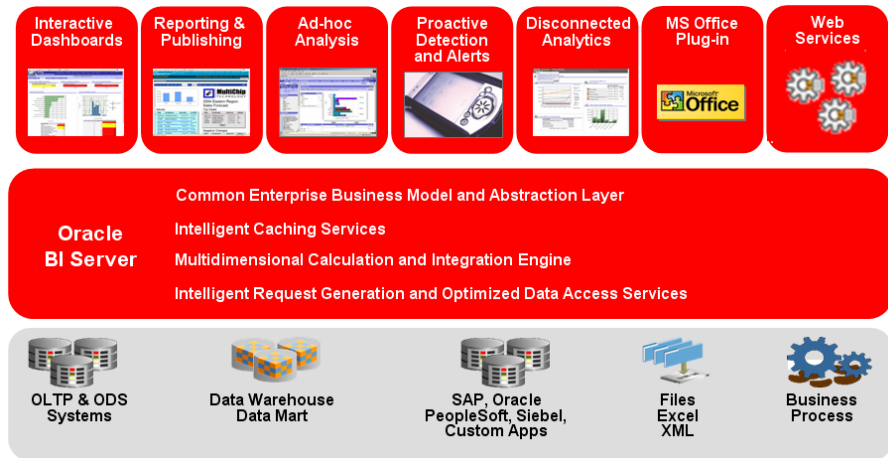
**BUSINESS INTELLIGENCE TECHNOLOGIES**

Understanding the information generated by the applications and systems within complex heterogeneous IT environments is a major objective for mid-large scale businesses today. Timely access to high quality, reliable business data and metrics is often essential for reporting and good decision making - whether dealing with customers, suppliers or internal processes.

An enterprise business intelligence system must have the capability to provide an integrated, consistent and responsive view of data – across all departments, integrating data from many different data sources and applications. As in the case of business process integration, this can be challenging when companies have

complex, heterogeneous environments since the data generated by the application and systems within these environments is often stored in application or system specific databases, data stores, flat files, data marts and data warehouses.

The Oracle Business Intelligence Enterprise Edition (OBI EE)<sup>3</sup>, illustrated in figure 3 enables the integration of data from many data sources to provide a consistent, enterprise view of information that can be accessed from interactive dashboards, pixel perfect reports, pro-active alerts, and Microsoft Office plug-ins for Word, Excel and PowerPoint. Additionally, and of key interest for SOA developers, this enterprise view of information can also be accessed using web services interfaces.



**Figure 3. Oracle Business Intelligence Enterprise Edition**

OBI EE is able to provide this consistent, enterprise view of information by using an Enterprise Business Model – also termed an enterprise metadata . Business users (and as we shall see, business processes) are able to access data in terms of this model without having to understand where or how the data is stored.

The Enterprise Business Model enables people to understand and interact with business data in terms of the business vocabulary they are familiar with and isolates users from the complexity of the underlying data storage architecture and the semantics of business calculations, dimension and hierarchies. A typical Enterprise Business Model may contain many thousands of key business metrics, dimensions and definitions (e.g. for “product”, “region”, “cost”, “profit”, “lead time”, “customer”, “year”, “quarter” and so on).

<sup>3</sup> Oracle Business Intelligence Enterprise Edition  
<http://www.oracle.com/appserver/business-intelligence/index.html>



OBI EE is also the platform for Oracle's Business Intelligence Applications<sup>4</sup> as shown in figure 4. These applications consist of a pre-packaged data warehouse, ETL, metadata, dashboards and reports, targeted for specific business functions (e.g. sales, marketing, supply chain, human resources) and specialized for specific vertical industries. The BI applications are certified with heterogeneous middleware, databases, and operational application sources (Peoplesoft, Oracle EBS, SAP, Siebel CRM).

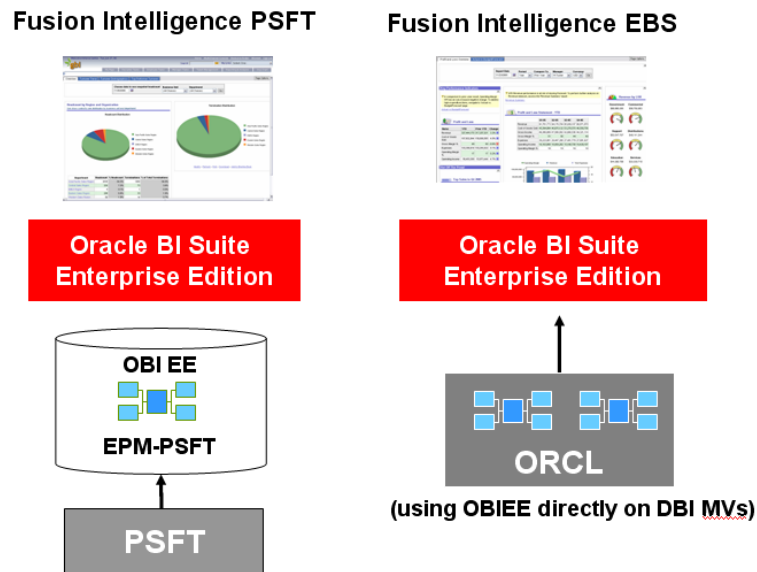
Auto	Comms & Media	Complex Mfg	Consumer Sector	Energy	Financial Services	High Tech	Insurance & Health	Life Sciences	Public Sector	Travel & Trans
Sales	Service & Contact Center	Marketing	Order Management & Fulfillment	Supply Chain	Financials	Human Resources				
Pipeline Analysis	Churn Propensity	Campaign Scorecard	Order Linearity	Supplier Performance	A/R & A/P Analysis	Employee Productivity				
Triangulated Forecasting	Customer Satisfaction	Response Rates	Orders vs. Available Inventory	Spend Analysis	GL / Balance Sheet Analysis	Compensation Analysis				
Sales Team Effectiveness	Resolution Rates	Product Propensity	Cycle Time Analysis	Procurement Cycle Times	Customer & Product Profitability	HR Compliance Reporting				
Up-sell / Cross-sell	Service Rep Effectiveness	Loyalty and Attrition	Backlog Analysis	Inventory Availability	P&L Analysis	Workforce Profile				
Cycle Time Analysis	Service Cost Analysis	Market Basket Analysis	Fulfillment Status	Employee Expenses	Expense Management	Turnover Trends				
Lead Conversion	Service Trends	Campaign ROI	Customer Receivables	BOM Analysis	Cash Flow Analysis	Return on Human Capital				
<b>Prebuilt adapters:</b> ORACLE PeopleSoft. SIEBEL SAP Other Operational & Analytic Sources										
<b>Oracle BI Suite Enterprise Edition</b>										

**Figure 4. Oracle Business Intelligence Applications**

Fusion Intelligence Applications<sup>5</sup> for Oracle Daily Business Intelligence and Peoplesoft EPM also provide source specific prepackaged applications using OBIEE for the respective source applications as shown in figure 5.

<sup>4</sup> Oracle Business Intelligence Applications  
<http://www.oracle.com/appserver/business-intelligence/bi-applications.html>

<sup>5</sup> Oracle Fusion Intelligence Applications  
<http://www.oracle.com/applications/performance-management.html>



**Figure 5. Oracle Fusion Intelligence Applications**

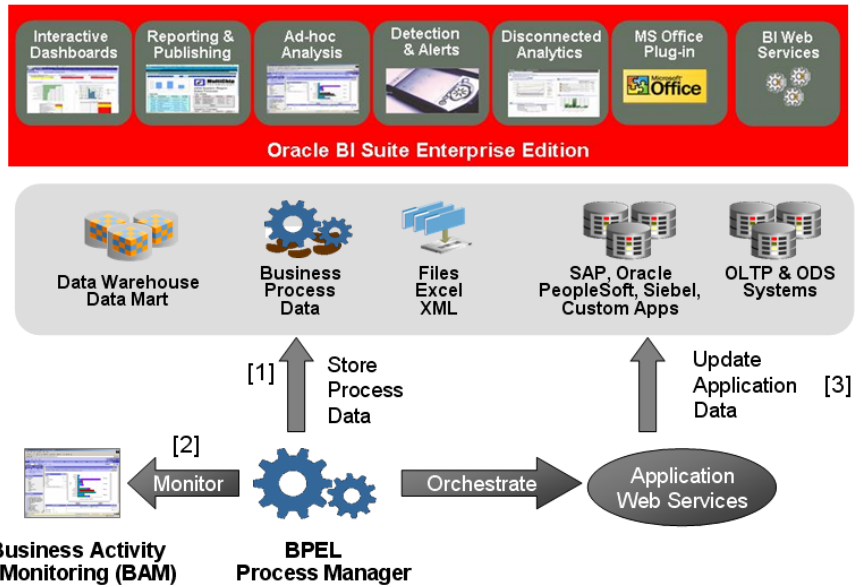
From the perspective of SOA integration, BI applications are significant in a number of ways. Firstly, the BI applications have a pre-built integration capability with much of the data generated by the applications and services that automated business processes invoke. This data is usually critical to understanding the business impact of a business process.

The Oracle BI applications also have many thousands of prepackaged business metrics, KPIs, queries and reports – all of which are accessible using the BI EE web services. These web services in effect provide a coarse grained, access to this data in terms of the enterprise business model that in effect decouples business processes from the underlying data sources and semantic definitions.

Finally the BI applications are often used by many thousands of users throughout an organization who may need to be able to take action (i.e. invoke business processes) in response to the insight they gain when using dashboards and alerts.

### **UNDERSTANDING BUSINESS PROCESS PERFORMANCE**

Being able to analyze the performance impact of business processes executing in a business process platforms is a key objective for organizations developing service oriented architectures. Business process engines such as the Oracle Process Manager (BPM) enable the capture of process data describing the runtime behavior of the processes.



**Figure 6. Integrating Business Intelligence and Business Process Data**

Figure 6 illustrates the relationship between the Oracle BPM, Oracle BAM, and Oracle Business Intelligence when integrated to detect the impact of business processes on business performance. As BPM executes a BPEL workflow, business process data (including process execution and service invocation times) is captured and stored in a repository [1]. BPM may be used in conjunction with Oracle Business Activity Monitoring to monitor the state of in-flight business processes [2]. The BPEL process will also typically invoke application specific web services that in turn will update data maintained by transactional application [3].

For data generated by the Oracle Business Process Manager there are two principal data capture mechanisms – BPEL sensors and the BPEL hydration store. BPEL sensors can be inserted at any point within a BPEL process to capture and store information by invoking application developer defined code. This code can be used to store information about the execution of a business process in a database and hence become accessible to the business intelligence tools.

Oracle BPM also stores some generic process data to a database – the BPEL hydration store. This data can be accessed by the business intelligence tools directly - or indirectly by extracting the data from the hydration store, transforming it and loading to a data warehouse. The hydration store includes data such as business process execution times but does not have the level of granularity or detail that can be achieved using sensors. The hydration store schema may also change from release to release so in general the use of sensors is preferred.

Once the business process data is captured in a database, data warehouse, or even flat files, its can be accessed by the Oracle Business Intelligence tools and further integrated with data from other sources.

Now lets put these pieces together. Consider, for example, a BPEL process orchestrating the delivery of a cell phone to a customer. This process may generate data such as the time spent provisioning the cell phone, updating the appropriate accounts (e.g. for billing), and delivering the product to the customer.

The business intelligence tools can combine this data with data stored in other systems. For example, call usage data may be stored in another relational database by a billing system and business intelligence dashboards may be used to present aggregate views of this information. Such a dashboard may contain a view displaying the average call usage for a customers with a given kind of service plan, over time.

By combining call usage data with process cycle time data captured from Oracle BPM the business intelligence tools can provide insight into the impact of process delays – for example our call usage dashboard can be extended to show how much lost revenue should be attributed to delays in the lead-to-cash process.

### ACTION FROM INSIGHT

Integrating business processes with business intelligence tools enables business users to take appropriate action in response to the insight they gain through interactive dashboards, reports and alerts.

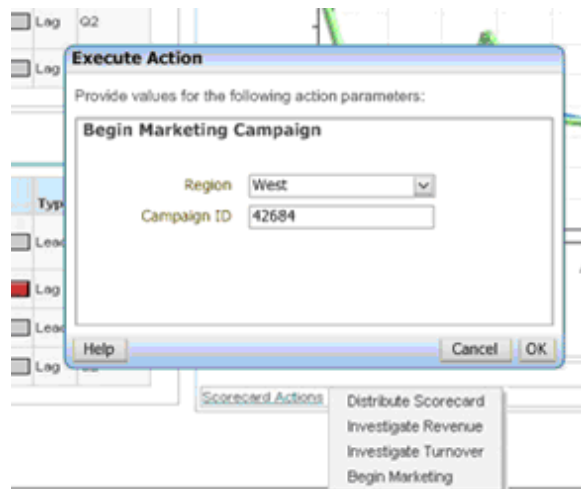
Let’s look at an example of this. Consider the business intelligence dashboard illustrated in Figure 7.



Figure 7 - Business Intelligence Dashboard

This interactive dashboard displays a set of key performance indicators that are used to monitor given areas of business performance. We can see that there are red lights against two of our key indicators – our product revenue drive is below target as is our objective to reduce employee turnover. The business intelligence dashboard provides insight into the company performance, but traditionally rectifying the problem would have required the user to jump out of the context of the business intelligence application to initiate some form of action – pick up the phone, write an email, or use another business application.

The scorecard actions menu on the bottom right of Figure 7 contains a set of actions that is relevant to (and conditional on) the data in the dashboard. In this case, because revenue is below target and staff turnover is above target, the menu contains actions to further investigate these areas by navigating to more detailed dashboards. Another action that is offered (because the revenue target is not being met) is the “Begin Marketing” option. Clicking this link can enable the user to initiate a business process that orchestrates the workflow of a marketing campaign directly from the business intelligence product.



**Figure 8 - Initiating a business process from a dashboard**

Thus a business user can directly take action as a result of the insight they gain from the business intelligence dashboard. Note that business processes defined in BPEL may not always be fully automated. The Oracle SOA Suite includes the ability to embed human workflows in business processes (e.g. for approvals, and human task management).

Business processes can also be invoked as a result of an alert using the Oracle BI Delivers component. In the case above we could automatically invoke the business

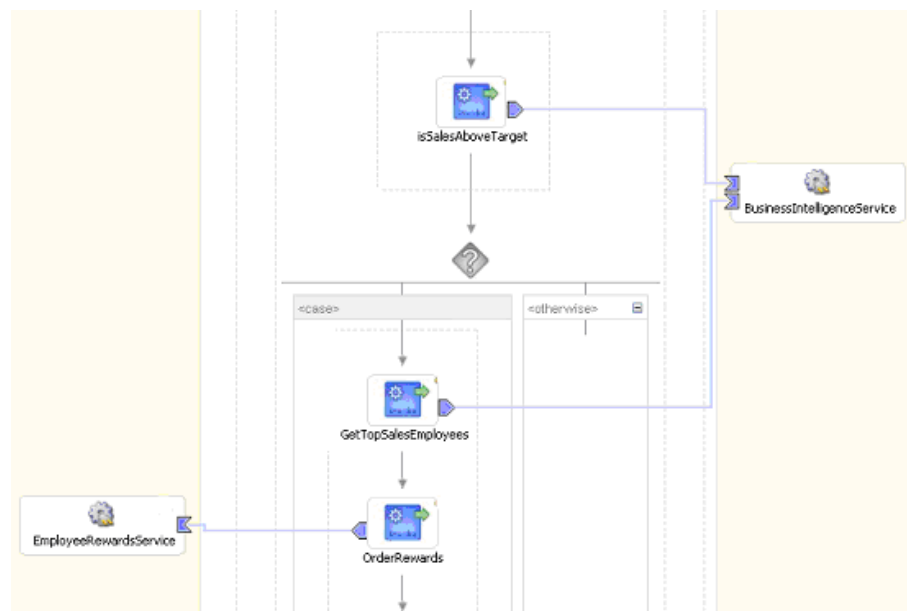
process by checking whether revenue was below target periodically or on specific dates using a Delivers iBot that calls a Java Job to invoke the business process.

### ORIENTING BUSINESS PROCESSES TO BUSINESS GOALS

In traditional manual business process implementations, business intelligence tools are used to make better decisions based on good business insight and quality data. For example, the selection of a supplier may be based on key business goals for driving down costs or improving customer satisfaction. Thus a supplier may be selected based on performance over a given period with respect to price, reliability or responsiveness. This kind of supplier performance information is frequently accessed by a person using business intelligence tools and enables decisions to be made that drive an organization towards key business goals.

The integration between Oracle Business Intelligence Enterprise Edition and business process platforms enables organizations to leverage business intelligence to create analytic, automated business processes.

Oracle Business Intelligence Enterprise Edition exposes its query and analysis capabilities via a set of web services. These services can be used to access business intelligence queries and metadata from business processes.



**Figure 9 - Analytic Business Process**

Figure 9 illustrates an example from a BPEL business process to orchestrate the provision of rewards to top performing sales employees. In this process a business intelligence service is invoked to execute a business intelligence query which determines whether the total sales achieved for an organization is above the sales

target for the year. If the sales total is above target, the process invokes a second business intelligence query to retrieve the list of the 10 highest performing sales people over the last 12 month period. The list is then passed to an external “Employee Rewards” service (provided by a business partner) to deliver rewards (e.g. a food hamper or a cases of wine) to the employees.

This kind of business process could further be invoked by a scheduled or event driven business intelligence alert (e.g. run this process after the financial close period).

The integration of business intelligence with business process platforms in this manner enables the use of business intelligence to make analytic decisions (e.g.. “should I reward my employees?”) in the context of automated business processes as well as providing access to key business data (e.g. “list of top 10 sales employees”) the process needs. Oracle Business Intelligence also provides web services interfaces to the automated report generation and delivery capabilities within Oracle Delivers.

## **ARCHITECTURE CONSIDERATIONS**

There are a number of architecture considerations that should be taken into account when integrating business intelligence within a service oriented architecture.

A key consideration when integrating business intelligence with business processes is the scalability and availability requirements of the underlying business process. A lead-to-cash process for a large company for example may have tens of thousands of concurrent instances (one for each deal being managed), and poor scalability or availability of the business intelligence services can severely impact the business.

Oracle Business Intelligence Enterprise Edition has a well established track record of being embedded within mission-critical business applications with proven scalability and availability results. These high-end scalability and availability of service figures allow the widespread deployment of business intelligence throughout a business process platform, although care must be taken to ensure the appropriate capacity planning is performed to take into account the additional level of use.

Care should also be taken to ensure that the performance of queries invoked by business processes is appropriate for the level of responsiveness demanded by the process. In cases where queries need to respond quickly (e.g. when handling a customer call in a call centre), Oracle Business Intelligence Enterprise Edition’s aggregate persistence and advanced caching mechanisms can be used to substantially increase query performance. The use of data warehousing technology and best practices to integrate business process data can also substantially improve the query performance.

Another consideration is the degree of coupling between the business process platform and the business intelligence system. In particular it is important to ensure

that business processes are loosely coupled from the physical data sources and the semantic metadata definitions of calculations, metrics, hierarchies and dimensions.

Oracle Business Intelligence Enterprise Edition's metadata layering within the Enterprise Business Model strictly layers and decouples metadata between presentation, logical and physical layers. This decoupling allows business processes to be strictly isolated from changes in the underlying data sources and the semantic definitions of business metadata.

## **SUMMARY**

The integration of Oracle Business Intelligence within a service oriented architectures provides an essential synergy – greater business agility requires greater business insight and vica versa. Further, the ability to access business intelligence via web services interfaces enables sophisticated analytic and reporting capabilities to be accessed from within automated business processes. Users can also take action when the gain business insight by invoking business processes directly from business intelligence dashboards.

Oracle Business Intelligence Enterprise 10.1.3.2 and the Oracle 10.1.3 SOA suite together provide a comprehensive suite of technologies for business intelligence and the development of service oriented architectures.

Well established levels of scalability and high availability, as well as the loose coupling enabled by coarse grained service delivery and strict layering in the Oracle Enterprise Information Model enable business intelligence to be embedded and invoked throughout business processes. In fact the same principals also allow business intelligence to be used within business event routing definitions and business rules.

The use of web services interfaces based on open standards to integrate Oracle Business Intelligence within service oriented architectures further enables a “hot-pluggable” capability to enable Oracle business intelligence to be used within third-party business process platforms and tools.





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Author: Phil Bates

Oracle Corporation  
World Headquarters  
500 Oracle Parkway  
Redwood Shores, CA 94065  
U.S.A.

Worldwide Inquiries:  
Phone: +1.650.506.7000  
Fax: +1.650.506.7200  
[oracle.com](http://oracle.com)

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