Business Intelligence and Its Use for Human Resource Management

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ABSTRACT

Business intelligence plays a crucial role to achieve competitive edge over competitors in the challenging economy we are in. Businesses using a business intelligence methodology are able to develop intelligence-based information systems to gain useful business insight and make faster and more reliable business decisions. While many organizations are starting to use business intelligence in many areas of their businesses and make substantial gains, they have not taken advantage of this in Human Resource Management area. In this paper we examine leading BI vendors to look into the business intelligence and data analytics features incorporated in their Human Resource Management modules.

Keywords: Business Intelligence, Data Analytics, Data Warehouse, Data Mart, Data Mining, Business Performance Management, Key Performance Indicators, Dashboards.

INTRODUCTION

Business Intelligence (BI) refers to the ability to use information to gain a competitive edge over competitors. It is rated as the most wanted technology by businesses across the world. Even in current times of economic downturn, when IT budgets are being cut, BI is still among the top of executive’s priorities (Gartner, 2009).

Business Intelligence is a broad field that combines people skills, technologies, applications, and business processes to make better strategic and tactical business decisions. The technologies and applications include data management methods for planning, collecting, storing, and structuring data into data warehouses and data marts as well as analytical tasks for querying, reporting, visualizing, generating online active reports, and running advanced analytical techniques for clustering, classification, segmentation, and prediction. Data warehouse focuses on enterprise-wide data, and data mart is restricted to a single process or a department, such as Human Resources (HR) department.

Modern businesses face several challenges, and the challenges almost always bring some opportunities along side. The goal of BI is to help businesses face many of the challenges and seize opportunities that exist in the market place. Due to advances in technologies (e.g., improved data storage capabilities, wide use of the Internet and Intranets) and regulatory changes (e.g., the Sarbanes Oxley act of 2002, which mandates advance and accurate reporting capabilities in corporate setting), businesses are collecting and storing data at an alarming rate. Companies collect large volumes of data on their employees, such as salary information, performance reviews, and education level. As a result, most organizations face an information overload. By 2020, the amount of data generated each year is projected to reach 35 zettabytes (1 zettabyte = 1 billion terabytes, 1 terabyte = 1000 gigabytes) (International data
Corporation, May 2010). And yet this same data, through proper management and analysis, will afford companies the opportunity to optimize HR and other business operations. Organizations are competing on Business Intelligence not just because they can-business today is awash in data and data crunchers-but also because they should (Davenport, 2006). For example, data on education, skills and past performance of their employees will help companies identify the critical talent within the organization and ensure HR retains it. The data management and analytics components of Business Intelligence systems are designed to be able to collect data from various sources, convert the raw data into useful actionable information or knowledge. Employee data is generally housed in separate HR systems based on vertical HR functions, such as benefits, payroll and compensation, leave, training and surveys and/or horizontally across functional areas. Companies need to identify all internal and external data sources and then consolidate the data into a HR data mart. Some examples of external data sources are US Bureau of Labor Statistics, Employment and Earnings, Collective agreements, Industry benchmarks, and Labor regulations. There are numerous Extract, Transform, and Load (ETL) tools on the market to extract data from both internal and external sources and combine them into a data mart or a data warehouse (IBM White Paper, March 2009).

Another challenge contemporary businesses are facing today is that the business environment is constantly evolving into a more complex system. And with global competition and the flat and connected new world (Friedman, 2004), decision-making in organizations has become increasingly intricate and convoluted. The availability of relatively cheap labor and growing consumers in developing countries, and aging population in the US, has put pressure on the organizations to go global for business opportunities. This creates challenges for global organizations’ HR departments to manage workforce diverse in cultures, time zones, expertise, benefits, and compensations. Given that total workforce compensation represents 60% to 70% of the general expenses, businesses are under pressures to respond quickly to the dynamic conditions of the business environment. The response often involves redesigning organizational structures, redefining value propositions, and streamlining processes. Business Intelligence and analytics can aid in making informed decisions based on knowledge extracted from the data and options at hand. Organizations that have successfully implemented BI are able to make decisions quickly and with more accuracy. They have better and faster access to the key activities and processes that the organizations and its functional departments must pursue to meets its goals and objectives.

COMPONENTS OF A BUSINESS INTELLIGENCE SYSTEM

The BI system consists of a number of component systems that are interdependent. For the system to function effectively the components must work in an integrated and coordinated way. The various BI components may be broadly classified into the following four sub-systems: Data Management, Advanced Analytics, Business Performance Management, and Information Delivery.

1. The Data Management sub-system includes components, relating to Data warehouses, Data marts, and Online Analytical Processing (OLAP). The people who work mainly in this area are “technologists”, who specialize in Computer Science, Management Information Systems (MIS), or a related discipline.

This sub-system deals with all aspects of managing the development, implementation and operations of a data warehouse or data mart including extraction, transformation, cleaning, and
loading of data from different sources. The subsystem also includes meta-data management, security management, backup and recovery, and data distribution.

The data warehouse is the foundation for business intelligence system operations, two of which are multi dimensional analysis through OLAP and data analytics. The core of any OLAP system is an OLAP cube (also called a ‘multidimensional cube’ or a hypercube). An OLAP cube is a data structure that allows fast and efficient analysis of large volumes of data from multiple dimensional views.

Online analytical processing, as defined by the OLAP Council, is a category of software technology that enables analysts, managers and executives to gain insight into data through fast, consistent, and interactive access to a wide variety of possible views of information that have been transformed from raw data to reflect real dimensionality of the enterprise as understood by the user. OLAP functionality is characterized by dynamic multi-dimensional analysis of consolidated enterprise data supporting end user analytical and navigational activities including calculations and modeling applied across dimensions, through hierarchies and/or across members, trend analysis over sequential time periods, slicing subsets for on-screen viewing, drill down to deeper levels of consolidation, reach-through to underlying detail data, and rotation to new dimensional comparisons in the viewing area. OLAP is implemented in a multiuser environment and offers consistent, quick response, regardless of database size and complexity. OLAP helps the user synthesize information through comparative, personalized viewing, as well as through analysis of historical and projected data in various "what-if" data model scenarios. This is achieved through use of an OLAP server.

The data warehousing and OLAP focus on gaining insight into their historic data stored in their data warehouses. They use the past data to answer questions, such as - What happened? Why did it happen? For example, the employees’ past data can shed light on employee attrition fluctuations and factors that were responsible for the fluctuations.

While there is value in knowing what happened in the past, The Advanced Analytics subsystem enables organizations to answer deeper questions, such as - What if the trend continues? What are the best actions to take? What will happen as a result of these actions?

2. **The Advanced Analytics sub-system** includes analytic functions based on statistics, data mining, forecasting, predictive modeling, predictive analytics, and optimization. The people who work mainly in this area are “super users”, who specialize in Mathematics, Statistics, Management Science or a related discipline.

Large BI vendors have incorporated comprehensive statistics packages within their BI software system. For example, IBM has incorporated the SPSS with their BI Cognos system, and SAS Inc. has developed their BI software with a core consisting of their celebrated statistical packaged software. Microsoft has developed XLSTAT, an add-on to Excel for Statistics and multivariate data analysis. Along with the inclusion of statistical capabilities, BI vendors have also incorporated Data mining capabilities in their software. Data mining is an extension of statistical techniques such as, classical and artificial intelligence. Statistical techniques are generally applied to relatively small size random sample data specifically collected to validate a hypothesis, and the techniques conform to a set of assumptions about the population. These statistical techniques are called ‘verification driven techniques’. Data mining includes techniques - called ‘discovery driven techniques’ - that can attempt to discover information by using appropriate algorithms automatically. These techniques can be regarded as discovering information by exploration (Kim, 2002; tan, Steinbach, Kumar, 2006; Shmueli, Patel, Bruce, 2010).
3. **The Business Performance Management sub-system** consists of processes for strategic goals and objectives, performance measurement and mentoring, analyzing performance and making decisions to improve business performance.

Strategic Goals and Objectives – A strategic goal is a broad statement of what the management wants to achieve, and an objective is usually time bound specific course of action that contributes to the achievement of the strategic goal. There may be several objectives pertaining to a goal. Here is an example of a goal and its two objectives as planned by Human Resources department of the state of California (http://www.dpa.ca.gov/hr-mod/ accomplishments-and-goals/mission-statement-goals-and-objectives.htm):

*Goal: Improve and instill high performance in the workplace.*

The primary purpose of employee learning and performance management is to improve both employee and organizational performance. Within state service, staff development is too often considered an expense rather than an investment. This goal will establish performance management as a basic objective for improving service to internal and external customers including the citizens of California.

*Objective #1: Ensure supervisors/managers acquire, implement, and apply principles necessary to foster high performance in the workplace.*

Currently, employee appraisals are done irregularly, despite the requirements for annual appraisals and individual development plans. As we convert to a competency-based HR system, performance will be used to assess current competencies, identify training needs, and better align resources to achieve organizational effectiveness. It is essential supervisors/managers continually provide meaningful feedback.

Properly trained, informed and accountable management is the key to establish and foster high performance. To achieve this, performance management training and training assessment methods must be established to evaluate the effectiveness of the training received. Continuing education and resources (e.g. communication forums, webcasts) must be made available to keep supervisors/managers informed and apprised of industry best practices. Automated tools must also be created and made available to support improved methods for ascertaining the achievement of performance goals and objectives. These will further provide opportunities to more effectively measure management compliance. A compliant, consistent, and available 80-hour supervisor/manager training program will be deployed by winter 2009.

*Objective #2: Ensure supervisors/managers conduct meaningful timely performance appraisals.*

This objective will equip supervisors/managers with the skills necessary to provide constructive feedback to staff. Supervisors/managers will be held accountable in their personal performance appraisals for assessing their staff. Initial learning management tools will be available by summer 2009. Identification of performance management tool(s) will be accomplished by fall 2009.

Organizations make operational and financial plans to achieve organization’s strategic goals and objectives, and then initiate projects to implement the plans.

(1) Performance Measurement and Monitoring – During the entire period of the project, the outcomes are measured and trends are monitored in real time. The measurements are done according to certain key performance indicators (KPIs). The KPIs need to be designed for each functional area and for each of the levels in the organization starting from the highest, moving towards the lowest.
Performance indicators are leading indicators that gauge the outcome by examining incremental progress of the project. Performance indicators with respect to human resources may include employee retention, job satisfaction, compensation and rewards, employee training, accident levels, employee absenteeism, and employee performance.

2. Analyzing Performance – KPIs are compared to the strategic goals and objectives. The results are utilized to monitor, further analyze and act to improve performance. The Advanced Analytics subsystem enables organizations to make informed decisions to align their goals and objectives, as well as programs and budgets to the performance indicators.

3. Decision Making and Performance Feedback – The organizations are able to adjust their goals and objectives, modify programs, and re-allocate resources and funds. Performance measures in essence provide a feedback loop in the process of business performance management.

4. The Information Delivery sub-system gives the business users the ability to access reports and continuously monitor organizational performance at enterprise and lower levels. According to his or her role as a technocrat, super user, middle manager, executive manager, or operational user, he or she will be given role-based rights to access relevant reports in summary and/or detailed formats. End users are also able to monitor the key activities such as trends, metrics, and KPIs in easy-to-understand designs, such as configurable information portals, scorecards and dashboards. Depending on an individual's role and responsibility, he or she is presented with the trends, metrics, and KPIs at appropriate aggregate levels with security to block non-privileged items.

BUSINESS INTELLIGENCE ADOPTION IN INDUSTRY AND HUMAN RESOURCES

BI is gaining rapidly in popularity, faster than most anticipated. In a report done in April 2010, it was found that the BI platforms, analytic applications and performance management (PM) software revenue surpassed $9.3 billion in 2009, a 4.2 percent increase from the 2008 revenue of $8.9 billion (Gartner, April 2010).

Table 1: Worldwide BI, Analytics and Performance Management Revenue Estimates for 2009 by Sub-segment (Millions of U.S. Dollars)

<table>
<thead>
<tr>
<th>Sub-segment</th>
<th>Revenue Estimate</th>
<th>Market Share</th>
</tr>
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<tbody>
<tr>
<td>BI Platform</td>
<td>5,982.4</td>
<td>64.2%</td>
</tr>
<tr>
<td>CPM Suites</td>
<td>1,937.1</td>
<td>20.8%</td>
</tr>
<tr>
<td>Analytic Applications &amp; Performance Management</td>
<td>1,402.4</td>
<td>15.0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>9,321.9</strong></td>
<td><strong>100.0%</strong></td>
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</table>

Source: Gartner (April 2010)

BI platforms were found to have a $5.98 billion (64.2%) market share of total worldwide BI software revenue. Corporate performance management (CPM) suites were found to have a $1.94 billion (20.8%) market share, and analytic applications and performance management software were found to have a $1.40 billion (15%) market share. Details are given in Table 1.

The BI software market significantly outperformed the overall enterprise software market in 2009. Seeing tremendous opportunities in Business Intelligence, there has been a large number of acquisitions and mergers of BI companies by software giant vendors reported in the past few years. Major software vendors have made business intelligence software their focal product to develop or acquire, and sell or
service. The top four vendors (SAP, SAS Institute, Oracle, and IBM) makeup most of the BI market with 64% market share in 2009 – SAP (23.4%), SAS Institute (14.4%), Oracle (14.4%), and IBM (11.1%) (Gartner, April 2010). The following table gives the major BI vendors, their recent BI acquisitions, and price paid.

**Table 2: Major Software Acquisitions in the recent past and Price Paid**

<table>
<thead>
<tr>
<th>Vendor</th>
<th>Select BI Acquisitions</th>
<th>Price Paid</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAP</td>
<td>Sybase (2010)</td>
<td>$5.8B</td>
</tr>
<tr>
<td></td>
<td>Business Objects (2007)</td>
<td>$6.8B</td>
</tr>
<tr>
<td></td>
<td>OutlookSoft (2007)</td>
<td>$200M</td>
</tr>
<tr>
<td></td>
<td>Pilot Software (2007)</td>
<td>NA</td>
</tr>
<tr>
<td>SAS Institute</td>
<td>Teragram (2008)</td>
<td>NA</td>
</tr>
<tr>
<td>Oracle</td>
<td>Sun Microsystems (2009)</td>
<td>7.4B</td>
</tr>
<tr>
<td></td>
<td>Hyperion (2007)</td>
<td>3.3B</td>
</tr>
<tr>
<td></td>
<td>Sigma Dynamics (2006)</td>
<td>10.3B</td>
</tr>
<tr>
<td></td>
<td>PeopleSoft (2005)</td>
<td></td>
</tr>
<tr>
<td>IBM</td>
<td>SPSS (2009)</td>
<td>1.2B</td>
</tr>
<tr>
<td></td>
<td>Cognos (2007)</td>
<td>5.0B</td>
</tr>
<tr>
<td></td>
<td>Telelogic AB (2007)</td>
<td>845M</td>
</tr>
</tbody>
</table>

Source: Gartner (April 2010), and vendors’ web sites and press releases.

SAP paid 6.8 billion to acquire Business Objects in 2007, which was number one in business intelligence at that time. The same year, Oracle bought Hyperion for 3.3 billion and IBM bought Cognos for 5 billion. Business Objects, Hyperion and Cognos were leaders in business intelligence before they were bought over by the software giants. IBM and Oracle acquired the most BI software and paid a hefty price for that. Each software giant has benefitted tremendously because of acquiring these BI focused companies. The software giant vendors now offer several BI products and are leaders in the area. Each one of them also offers HR modules along with business intelligence and data analytics capabilities. The following table gives HR module names, and names of the embedded BI and data analytics products.

**Table 3: HR Modules and BI & Data Analytics Software for Giant Vendors**

<table>
<thead>
<tr>
<th>Vendor</th>
<th>HR Module</th>
<th>BI &amp; Data Analytics</th>
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<tbody>
<tr>
<td>SAP</td>
<td>SAP ERP Human Capital Management</td>
<td>Workforce Analytics</td>
</tr>
<tr>
<td>SAS Institute</td>
<td>SAS Human Capital Intelligence</td>
<td>Human capital Predictive Analytics and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Retention Modeling</td>
</tr>
<tr>
<td>Oracle</td>
<td>Oracle Human Capital Management</td>
<td>Oracle Human Resources Analytics</td>
</tr>
<tr>
<td>IBM</td>
<td>IBM Cognos – Human Resources</td>
<td>Business Intelligence and Human Resource</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Performance Management</td>
</tr>
</tbody>
</table>

Source: Vendors’ web sites.

**BUSINESS INTELLIGENCE AND DATA ANALYTICS FEATURES IN HUMAN RESOURCES**

As stated in the previous section, the software joints offer many BI products, including HR embedded with business intelligence and data analytics capabilities. The vendors claim the following features and functions in their software:
SAP ERP Workforce Analytics

This product includes features and functions that support these business activities (http://www.sap.com/solutions/business-suite/erp/featuresfunctions/workforceanalysis/index.epx):

- **Workforce Planning**
  Understand current workforce trends – and plan future needs – by using workforce demographic data. Use predefined reports to analyze headcount development, turnover rates, and workforce composition. Link the results of this analysis directly into headcount planning, budgeting, and key talent processes, such as recruiting and learning.

- **Workforce Cost Planning and Simulation**
  Support HR professionals in all workforce cost-planning tasks, and empower HR executives to develop effective strategies. Provide access to a broad range of workforce-related data to support accurate planning, facilitate simulated planning scenarios, and enable continuous monitoring of actual performance relative to plan.

- **Workforce Benchmarking**
  Measure standard workforce processes. Compare the measurements with external benchmarks and internal operating thresholds.

- **Workforce Process Analytics and Measurement**
  Measure and analyze typical core HR processes, such as payroll, employee administration, time management, and benefits. Analyze organizational structures, relationships, and attributes of jobs and positions.

- **Talent Management Analytics and Measurement**
  Analyze employee skills and qualifications. Evaluate the efficiency of your recruiting processes. Measure the effectiveness of your learning programs. Assess how well your succession programs prepare your employees to assume key positions – and ensure continuity of operations. Monitor the progress of aligning employee goals with corporate goals. Analyze the cost-effectiveness of employee compensation programs.

- **Strategic Alignment**
  Ensure that all business activities are in line with the strategic goals of your organization. Help Employee teams work toward common objectives, regardless of location. Use a balanced scorecard framework, with predefined workforce scorecards that can be integrated into department and individual management-by-objective (MBO) documents to align employee goals with corporate strategy.

SAS Human Capital Predictive Analytics and Retention Modeling

This product includes the following features (http://www.sas.com/solutions/hci/hcretention):

- **Predicted Turnover Percentage**
  Ranking by high, medium and low risk of voluntary termination

- **Causes of Voluntary Termination**
  Showing each cause identified by the model in an individual report.

- **Organization Exposure**
  Looking at the high-risk group only and showing a hierarchical view starting at the top and drilling down through all organizational levels.

- **High Risk by Job Category**
  Identifying those in the high-risk group by EEO job category
Top 50 Employees at High Risk
Pinpointing the 50 employees most likely to voluntarily leave

Top Performer
Identify high-risk top performers and define their reasons for leaving.

Oracle Human Resources Analytics
This product includes the following features (http://www.oracle.com/us/solutions/ent-performance-bi/hr-analytics-066536.html):

Workforce Insight
Monitor workforce demographics in line with your recruitment and retention objectives. Analyze efficiency of the entire recruitment process lifecycle, understand and prevent the drivers of employee turnover.

Targeted Workforce Development
Gain insight into the movement of top and bottom performers in the organization to engage and develop internal talent. Gain insight into learning demand by analyzing course enrollments by job, delivery methods, and organizations.

Improved Compensation
Understand how compensation impacts performance, ensure compensation is equitable and consistent across roles, and align variable compensation with your organization's objectives and goals.

Leave and Absence
Get a comprehensive view into employees' current, planned, and historical absence events; monitor absence trends as a predictor for employee engagement.

Better Understanding of HR Performance
Assess HR's overall performance and employee productivity using industry benchmarks such as revenue per employee, contribution per headcount, and return on human capital.

US Statutory Compliance
Monitor US EEO, AAP, and Vets100 compliance reporting.

Workforce Planning
Monitor workforce demographics in line with your recruitment and retention objectives. Analyze efficiency of the entire recruitment process lifecycle, understand and prevent the drivers of employee turnover.

Workforce Cost Planning and Simulation
Support HR professionals in all workforce cost-planning tasks, and empower HR executives to develop effective strategies. Provide access to a broad range of workforce-related data to support accurate planning, facilitate simulated planning scenarios, and enable continuous monitoring of actual performance relative to plan.

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**IBM Cognos Business Intelligence and Human Resource Performance Management**

This product includes the following features pertaining to the following five HR core areas (http://www-01.ibm.com/software/data/cognos/solutions/human-resources/index.html):

• **Organization and Staffing**
  What job functions, positions, roles and capabilities are required to drive the business performance?

• **Compensation**
  How should we reward our employees to retain and motivate them for full performance?

• **Talent and Succession**
  What are the talent and succession gaps we must address to ensure sustained performance?

• **Training and Development**
  What training and development do we need to maximize employee performance? Is there a clear payback?

• **Benefits**
  How do we manage costs and incentives for better performance?

**SUMMARY AND CONCLUSION**

Business Intelligence is helping businesses become more competitive. Because of technological progress and regulatory changes, businesses are collecting and storing data at an alarming rate. Because the business environment is constantly changing, decision making in organizations has become increasingly intricate. Business Intelligence is helping organizations make faster and more reliable information based business decisions.

Business Intelligence is seen as consisting of four major inter-dependent sub-systems – Data Management, Advanced Analytics, Business Performance, and Information Delivery sub-system. The Data Management subsystem handles data storage into databases, data warehouses, and data marts. With On-line Analytical Processing (OLAP) built into the system, it is possible to do multi-dimensional analysis on the data. The Advanced Analytics processing system includes analytic methods based on statistics, data mining, forecasting, predictive modeling, predictive analytics, and optimization. The Business Performance system consists of processes for performance measurement and mentoring and making decisions to improve business performance. Key Performance Indicators (KPIs) take a prominent role in this sub system. KPIs are defined to measure progress toward organizational goals. The Information Delivery subsystem provides information to users in real time and in a format they want it. End users are able to monitor the key activities in easy-to-understand formats, such as configurable information portals, scorecards and dashboards.

Having seen Business Intelligence as the core enterprise strategy, the giant software vendors have spent billions on acquiring other business intelligence focused companies. The giant vendors have now business intelligence solutions for organizations of most types and sizes. While many organizations have
purchased their BI software and are starting to use in many areas of their businesses and make substantial gains, but they have not taken advantage of this in Human Resource Management area. Executives view Human Resources more of a cost center, and less of a strategic asset within their organizations. In the last section of the paper we have examined the leading vendors to look into the business intelligence and data analytics features incorporated in their Human Resource Management software. By taking advantage of the rich business intelligence features in these and other similar products, Human Resources can position itself as essential value-adding department of the organization.

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