PERVASIVE BUSINESS INTELLIGENCE SOLUTIONS

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Abstract

The utility of BI solutions is accepted all over the world in the modern organizations. However, the BI solutions do not offer a constant feedback in line with the organizational activities. In this context, there have been developed pervasive BI solutions which are present at different levels of the organization, so that employees can observe only what is most relevant to their day-to-day tasks. They are organized in vertical silos, with clearly identified performance and expectations. The paper emphasizes the role of pervasive BI solutions in reaching the key performance indicators of the modern organizations, more important in the context of crisis.

Key-words: *pervasive business intelligence, dashboard, metrics, KPI*

JEL Classification: L_{86}

Introduction

The present has familiarized us with the technology that facilitates the accomplishment of daily repetitive activities of a company, such as:

✓ constant awareness of their stocks and balancing the company stocks by sending requests to suppliers, if the systems are programmed to do that;
✓ profiling the typical consumer, knowing their preferences and needs and continuous adaptation to their requirements;
✓ product and activities knowledge of competitive companies and suggesting possible ways of action, etc.

All these are routine activities that can be performed successfully by robots built on the principles of artificial intelligence. These facilities are provided by ubiquitous and context-sensitive systems. In these systems, robots learn by continuously assimilating certain contexts. At first, they consult the owner in making decisions, but when they find themselves in a similar situation they act on the learned behaviour.

Literature Review

A system able to adapt to the context is called a *context-aware system*, a term introduced by B. Schilit, N. Adams, and R. Want (1994). A context-aware application has the ability to adapt to the position, the people and objects nearby, as well as movements of these objects and persons. Pervasive and context-aware systems have been developed by different communities of specialists, although based on the same technology and having the same goal. They only differ because the first ones are focused on continuous presence in the daily activities, while the others rather emphasize the adaptation to contextual situations.

Traditional BI solutions evolves towards pervasive BI (PBI – Pervasive Business Intelligence), which allow to all the organization's employees at all levels the access to statistics, alerts and feedback mechanisms. It's a new paradigm, with enormous potential benefits and major cultural implications.

Dave Mittereder (Mittereder, 2005) states PBI benefits as follows:

✓ provides a more efficient way to influence the strengths of the organization as a whole, because every employee has the opportunity to improve key performance indicators (KPI), established by management;

✓ provides a sustainable competitive advantage, facilitating seamless integration of each employee as the organization itself would have been able to make the right decisions at the right time, in line with corporate goals and objectives of the client;

✓ improving operational efficiency by discovering new and best management practices to those practices from the bottom up and top down.

Theoretical Background

The BI term refers to technologies, applications and practices for the collection, integration, analysis and presentation of information used in business, in order to facilitate the decision-making process. BI provides the "X-rays of the operational business process" of the present, historical or projected, using data stored in data warehouses and/or databases. BI software contains elements which assist the extraction, analysis and reporting of information. BI solutions are designed in modules that respond to business sales, manufacturing, financial, human resources, accounting, etc.

BI technologies use intensive statistical and mathematical algorithms, linear, exponential, logarithmic, multivariate regression models, time series with or without trend, the correlation coefficient, Fisher test, Durbin-Watson test, Jarque-Bera indicator (skewness, kurtosis), clusters, etc. To achieve in depth statistical analysis and forecasts on economic developments in environmental characteristics outside/inside the company, the indicators characterizing the market research on the characteristics of market segments, the final consumer behaviour changes. The BI solution can provide conclusive information on the flow of logistics activities, to maximize profit by choosing the best solutions to transport problems, or by choosing the critical path to obtaining relevant and timely knowledge to enhance competitive advantage.

Pervasive BI is a powerful tool for measuring progress against strategic corporate objectives and key performance indicators (KPIs) that were determined by management and communicated throughout the organization. Individual employees may have a greater impact on organizational goals because when they may work with PBI in real time, they are able to take their own initiative. The employees have greater freedom to express their entrepreneurial skills in supporting the organization.

In Business Intelligence circles, "Pervasive BI" has gotten a lot of airplay lately. The image of everyone in an organization embracing the new analytic tools is quite appealing to C-level managers, and vendors froth at the mouth when they think of line-level employees logging into their portal every morning to look at the most recent production reports and analytics. (Larson, 2008)

This model involves cultural challenges. For example, in establishing and communicating the strategy of the organization, managers may need to anticipate and address problems such as a reluctance due to fear of loss of control and uncertainty about how to use the information to which the access of those who are not accustomed to act on its own initiative has increased.

Another cultural impact is that pervasive BI can create new levers for change. If management creates a clear strategy, defines it, implements a pervasive BI solution to monitor progress and employees whom it is addressed a specific task, such activities will have corporate and bottom-up structural impact. Instead of being frustrated by the inability of the organization to send the day-to-day executive initiatives, they can be implemented in measurable workflows and placed directly at work at every level. This approach also assumes that executive managers to employ an action, rather than to send vague "management messages" that few people can translate into everyday work. With pervasive BI solutions the company's executive management team can help employees at all levels understand exactly the degree to which these expectations are met.

So it is a good solution for organizations to incorporate these BI's in their business processes. This requires assistance from top to bottom for any pervasive BI solution, which is a major change program. Overcoming cultural resistance to pervasive BI, especially among first-line managers, will require a new vision for business and executive directors able to cope with the process. It also needs a specialist for pervasive BI solution that can understand the business organization to tailor the solution to respond in particular the deficiencies and weaknesses of the organization, and to continuously improve it.

Dashboard interface

Bringing all the information on the dashboard, on the same page, depends on how pervasive BI solution is used to measure results in line with targets for business activities, strategies and key performance indicators (KPI). Thus, every employee has an overview of the business and may discuss this issue, although he is only specialized on a specific type of activity.

Through dashboard interfaces with specific colour codes, employees can access their KPIs for specific tasks. For example, every employee in the department of logistics can have access to company stock, he will know which are the products, quantities and suppliers from which his colleagues have made the order, which are the products (with quantity, discounts, etc.) ordered by customers and the date the products to be delivered, which are delays in delivery, etc. This system, also, allows to measure employees performance against the objectives of their department and company goals. All this has led to many conversations employee-employee and employee-manager, conversations about sharing best practices and sharing workload to meet customer service level agreements.

At the next level, department managers can track the relative performance of individuals in the work of the basic daily and ability to react quickly to any changes, positive or negative. Pervasive BI solution also enables them to track trends in other branches, subsidiaries around the world, understand different situations and explore how different workflows can be extended successfully within their departments.

At the level of management can be seen the individual and departmental performance skills, where is added the ability to drill down, depending on requirements and the elements that contribute to achieving business goals. Since the data are collected and analyzed in real time to the lowest level of the organization, managers have the unprecedented ability to change faster propagation of an effect on the whole enterprise. Instead of implementing a policy and pending the submission and feedback, coordinated across the organization, managers can monitor the immediate effects of a decision and make changes proactively.

Each employee has access to many of the managers and executives' facilities, except that they are limited by their job responsibilities. Like managers, they can track the immediate effects of their decisions and make changes proactively. Like mid-level managers, they may see changes to their performance and can decide on how to improve them, without waiting for guidance from a higher level.

In a workflow context, pervasive BI solution measures the time for certain activities and send warning messages to employees, managers in accordance with business rules. Colours indicate the status of work, to provide 'at a glance' information about the prioritization of efforts. Employees should not be expected to communicate a task, being well known red flag, indicating that the activity needs immediate attention.

However, pervasive BI solutions must reflect what a particular business is, in real time. In fact, it's more about the "right time" than "in real time". Timing can vary from one business to another, from milliseconds to minutes, hours, days, etc.

In general, the faster pervasive BI becomes more operational, the need of timely information updates based on business requirements increase. It appears the requirement to update the information from several sources at the same pace, same time. Clearly, not all data are equal. In these cases one can choose the rotation upgrade, but would cause a latency of data that can lead to incorrect and undocumented decisions. In developing a pervasive BI, therefore, is critical to

properly define the 'timing/calendar' to ensure that key performance indicators for specific business activities are updated accordingly.

Over time it has been observed that one cannot manage what he cannot measure. Starting from this point of view the pervasive BI solution is based on continuous evaluation metrics, and where previous measurements are considered inadequate, new ones take their place. Initially, the company will define what metrics will be used for performance. An example is measuring the time required for an employee to do a task. This measurement is not relevant if the context is not taken into account. If an employee has to do one task at a time and other employee has to do several tasks in addition to that mentioned in the same period, the second employee might seem uncompetitive, because he needs more time. In this case the system can weigh the time required for performing the task, to take into account the complexity of jobs. This period may, also, vary from one department to another or from one geographical region to another, depending on the context. We draw the conclusion that these metrics are not perfect, but it must exist.

Pervasive BI solution enables companies to conduct thorough investigations down to very low levels in order to design metrics, refine systems and change business processes. What happens when someone focuses on information that has never been available – or not paid attention in the past – can be very interesting.

Trends in developing BI solutions

With pervasive BI, measurements with high accuracy lead to a correct behaviour and behavioural change in the benefit of the company.

The major factors that influence businesses are:
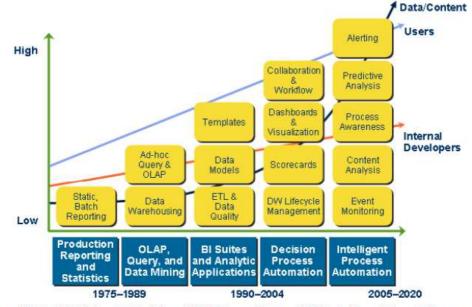
• *globalization* – market change continues;

• *virtualization* – source code sharing, collaboration between companies;

• *transparency* – it attaches great importance to the client and to the collaboration between employees;

• *technological changes* – which have the effect of customization for applications and adaptation of the web process for the client;

• *re-engineering of the management processes* – movement from operational excellence in personalized management.

The analysis of Figure 1, adapted from IDC (market research company) the software market tendency respond to two goals: more data, more users. Also it can be noted the openness to information technology manifested by an increase in the number of developers within company and the use of technologies that allow the applications customization (Semantic Web, service oriented, ubiquitous systems, etc.).

Fig. 1. *Trends in developing BI solutions (adapted from IDC)*

The market software for business analysis developed from processing, reporting to OLAP data-mining in the 90s, from applications based on ETL processes, on models, on templates to automate decision process in the 2000s, through dashboards, group decision support systems, for online collaboration, GDSS.

Modern BI solutions are turning to automation of the intelligent processes, monitoring events (pervasive and context-sensitive BI), content analysis, process monitoring, predictive analysis and alerting users regarding the occurrence of certain events.

Looking ahead, 2011 is likely to be a critical year regarding the easiness in use, the analysis complexity, the performance and total cost will continue to dominate the BI market, while the ability to create links between departmental marts and enterprise deployments will be a challenge for providers of IT and BI.

In 2011 the market is starting to be dominated by *cloud computing solutions*, reducing costs, whereas the applications, technologies and data are available on a virtual server, and customers pay only for what they consume. This diverts a lot of money out of Romania at Amazon (AWS, Amazon Web Services), Google Apps, Microsoft Azure. Revenues from cloud computing services were estimated in 2010 at 68,300,000,000 dollars globally, and in 2014 will reach about 148.8 billion dollars, according to a study presented in June 2010 by the research firm Gartner.

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Conclusions

Pervasive BI solution has the ability to retrieve relevant information that is usually reported to management, and to pass it down to users. Culturally, the pervasive BI success depends on the belief that the ability of employees to achieve set targets and KPI management is favourable for the entire enterprise, and that individuals may contribute more than they do today, with access to management control. Pervasive BI solution makes use of the fact that the employees knows their jobs better and depending on the circumstances, they themselves can interfere with their improvements. Another critical success factor is the 'right time' for the data in the pervasive BI so as to be synchronized with business processes. People will not pay attention to details that seem out of synchronization with what they are trying to do. As in traditional BI, also in pervasive BI it is important to develop appropriate metrics related to business processes. Also, pervasive BI is becoming increasingly accurate and powerful as the metrics evolve. However, individuals should consider metrics to discover their shortcomings and improve them accordingly. Moreover, pervasive BI solution provides an unprecedented mechanism for changing the existing organization. By embedding metrics for behaviour during the organization's work processes and people are rewarded for correct behaviour and leadership team will provide a powerful tool for change. Instead of controlling only the steering wheel, they can control the engine for the entire shift. From managers to new employees, everyone can work smarter when business information is pervasive.

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IV. SOCIAL, POLITICAL AND ENVIRONMENTAL FACTORS IN THE PROCESS OF DEVELOPMENT