

# Implications and Directions of Development of Web Business Intelligence Systems for Business Community

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## Abstract

*The concept of business intelligence has evolved in recent years, from yesterday solutions for transmitting information on company intranet and data management systems to today strategic tools, highly integrated offering support in daily decisions taken by management to achieve objectives. This paper details the architecture of business intelligence solutions, the stages of development and implementation within a company. We discuss the implications of implementation of IA solutions for business community and trends in recent years in this field.*

**Key words:** *Business Intelligence, web intelligence, data warehouse*

**JEL Classification:** *A12, M15, L21*

## Introduction

Business Intelligence (BI) is a concept that evolved in the last two decades, referring to support technologies for the organization and economic organizations operation and management. The concept of Business Intelligence implies the existence of operational databases, systems of decision assistance and applications platform that facilitates access to economic information to persons involved in business management. Through a process of acquisition and analysis of multiple sources of information, Business Intelligence systems help to substantiate decisions in a company. BI platforms incorporate multiple technologies: multidimensional analysis, data mining, knowledge management and assist decision making by providing: trend forecasts, reports, graphs and analysis as result of querying the system.

## Concepts and Benefits of Business Intelligence Systems

Currently, any company that wants to be competitive in the market has implemented a computerized system for the management of activities, based primarily on financial accounting activities. The most popular systems used in organizations today are resource planning systems (ERP - Enterprise Resource Planning) and customer relationship management systems (CRM - Customer Relationship Management). These systems are not sufficient; it is only the first step to implementing a decision support system. These systems, called operational or transactional, facilitate a number of operations within a company (data entry, inputs and outputs management,

production processes, invoices) but the reporting tool is not very advanced (usually we can obtain inventory reports, charged invoices / collected invoices, clients, expenses, sales by customer size). If for small companies this information is sufficient, they cannot respond to more complex issues such as profit margin of a product over time, reduce operational costs without affecting performance, streamline production and distribution, volume of business with one provider or performance achieved by distributors. In the current economic climate, where the economic recession has focused on achieving maximum performance with minimum costs, obtaining such answers to support decision-making process has become more important.

So, in such conditions, a system is required to facilitate access to information necessary for those involved in decision making, to ensure easy interaction with data and complex analysis and generate reports easily and in a short time.

The concept of business intelligence has evolved in recent years, from notion which accounted for solutions of transmitting information in company intranet and data management systems (CMS - Content Management System) to what today are strategic tools, offering highly integrated decision support for daily actions taken by management to achieve objectives.

The BI process access and analyze data integrity in an organization. Through various processes of transformation, applied to data, are obtained useful information to help management of a company to understand the actual status and the coverage of the economic decisions<sup>1</sup>.

We can see Business Intelligence as a process of analyzing large volumes of data within companies, usually stored in data warehouses, business development performance analysis, to determine patterns and trends, designated for users involved in the leading process, to make the best decisions for the company's growth<sup>2</sup>.

A BI system facilitates in a company:

- Identification of market opportunities
- Understanding consumer behavior;
- Identification of deficient market segments;
- Determining which products get maximum profit;
- Determination of unsustainable cost processes
- Analysis of sales and distribution costs on different types of reports (about the distribution, customers, transactions, time periods)
- Identifying potential business segments
- Identifying opportunities for earning and saving costs
- Determining the exact state of affairs on sales, commissions paid, volume of sales
- Determine the key indicators for measuring performance
- Improving decision making
- Analyze large amounts of historical data to identify trends that may affect business
- Monitoring the market effects of the strategies decided
- Exact profitability of operations
- Determine at any time of the situation and indicators of a company
- Reduce time spent on regular reporting activities
- Reducing the role of IT departments in reporting activities
- Shortening the period of taking a decision.

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<sup>1</sup> Lungu, I., Botha, I., Bâra, A., Velicanu, A., Rednic, E., Velicanu, M., *Evolved database systems, 8th ed.*: Ed. ASE, 2009

<sup>2</sup> \*\*\* *The Business Intelligence Guide*. [2011, April Online].

[http://thebusinessintelligenceguide.com/About\\_Business\\_Intelligence.php](http://thebusinessintelligenceguide.com/About_Business_Intelligence.php)

## BI Systems' Role in Improving Efficiency in a Company

Business intelligence solutions can help companies streamline business, reduce costs and identify new business opportunities by:

1. Eliminating uncertainty – due to the lack of accurate data about the state company managers are faced with making decisions based on instinct and assumptions; ensuring accurate data, providing real-time updates and overviews, trends and forecasts help to taking informed decision<sup>3</sup>.
2. Rapid provision of information - a BI system that allows for rapid information obtaining helps managers to answer questions, much easier than spending much time studying large volumes of information in printed reports.
3. Understanding customer behavior - access to information about what customers prefer enable profitable growth through customer loyalty and attracting new ones.
4. Easy access to economic indicators anywhere, anytime - modern BI solutions allow users to access the desired reporting on mobile devices, providing sales and marketing personnel critical data anywhere they are
5. Identifying market opportunities - information collected about customers helps sales representatives to use appropriate techniques like up-selling and cross-selling in the product sale.
6. Identifying ways to streamline operations - getting detailed information about a company's operations department helps determine where changes should be made for operational efficiency
7. Improving efficiency - obtaining data from various departments of a company, integration and processing it, verifying accuracy and performance analysis requires very long time. Using a BI system, information is centralized and can be quickly converted into time saving reports, eliminating the inefficiencies due to the amount of time wasted.
8. Determination of actual costs - BI solution provides accurate information on production costs, allowing to adjust production on the fly to ensure increased profitability.
9. Storage management - knowing the exact quantity of goods required by customers helps to lower costs of products storage and surplus stock, adjusting it to meet consumer requirements.
10. Accurately determine the market position of the company - a BI system gives a clear picture of the evolution of a company in a period of time. It can analyze the exact quantities of products sold, the most profitable distribution channels, locations with the best sales and most profitable market segment for the company.
11. Impact on businesses development - even in small companies BI system can have a major impact on growth and profitability, helping to understand situations that favored the upward trend, supporting informed decision making in this context.
12. Determining the areas of profitability – it is very important to have a clear picture of those customers, products, regions and market segments that make up the profit, just as important is the identification of the most unprofitable. The Pareto principle observes the rule that a small percentage of customers of a company generate almost half of the profit, while half of the unprofitable customers of a company bring less than a tenth of the total profit. Identification of a customer belonging to one of the two classes is difficult in the absence of BI solutions that can provide such a response instantly.

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<sup>3</sup> Sch iff, J., *Ten Benefits of Business Intelligence Software*. [April, 2011 Online].  
<http://www.enterpriseappstoday.com/business-intelligence/ten-benefits-of-business-intelligence-software-1.html>

13. Identifying the competition - market information can help identify segments and competitors to determine measures needed to mitigate them and extending the segments covered by them<sup>4</sup>.
14. Extending BI solutions implementation – initially the BI solutions were inaccessible to small businesses due to implementation costs and resources for starting and running, but current systems have become increasingly competitive, with lower costs, being easier to use and having a greater ability to analyze.

The area of influence of a BI solution within a company extends in most departments, including:

*Marketing* – it helps to identify market opportunities and areas where market rates are unsatisfactory. The analysis can identify products that sell better in certain demographic areas. The information received helps managers evaluate the effectiveness of marketing campaigns for a certain range of customers and market segments.

*Financial* - using a BI system one can identify and better understand the profitability indicators and identify areas with unsustainable costs.

*Sales* - you can get an overview of sales and distribution costs on various segments, time units and customers. Agencies can identify performers and those with bad performance, sales and related fees. You can determine the exact profit of each sale made.

*Operational* - BI systems facilitate identification of performance areas in an organization and establish key indicators to measure performance<sup>5</sup>.

## Functionality of a BI Solution

IA platforms help users to understand better the processes which are taking place in their organization. To better serve this purpose, a BI platform provides functionality that can be grouped into three categories: integration, information delivery and analysis<sup>6</sup>.

*Integration* implies the existence of an infrastructure where all platform applications are integrated into a single interface with management, metadata, object model, the query engine and all use the same protocol. Metadata management means not only using the same metadata but also the existence of search solutions, efficient storage and publishing. In terms of development tools, a BI platform should provide a set of tools and a visual environment for development of integrated applications. Collaboration functionality allows users to communicate between them and to report through an integrated platform or through integration with an external system.

*Reporting* requires information delivery functionality that creates interactive or preformatted reports, making control panels (Dashboards) a subset of reports with more intuitive and interactive visual interface presented on the web or mobile devices. Ad-hoc reports allow users to access reports outside of preformatted ones in the system. A BI must allow integration with office applications used in an organization. In many cases the system is used as an intermediate level, result being placed in an office application (e.g. Microsoft Office). Search functionality

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<sup>4</sup> Cabiro, B., *Can Small Companies Justify Investing in Business Analytics?* [2011, April Online]. <http://blog.strat-wise.com/2011/06/26/can-small-companies-justify-investing-in-business-analytics.aspx>

<sup>5</sup> \*\*\* *Using BI To Power Jump Corporate Performance*. [2011, April Online]. [http://thebusinessintelligenceguide.com/resources/articles/0710\\_Using\\_BI\\_To\\_Jump\\_Start\\_Corporate\\_Performance.php](http://thebusinessintelligenceguide.com/resources/articles/0710_Using_BI_To_Jump_Start_Corporate_Performance.php)

<sup>6</sup> Sallam, R.L, Richardson, J., Hagerty, J., *Magic Quadrant for Business Intelligence*. [2012, February Online]. <http://businessintelligence.info>

provides users with an interface for navigation and exploration like a web engine to access data in the system. Mobility is essential functionality in a BI system that allows delivery of reports and control panels in mobile devices (phones, tablets) using the various functions of devices to improve their transmitted data (site-specific interactive reports which tracks the location the request was made).

*Analysis* involves using OLAP-type applications that allow quick analysis of data with queries across multiple dimensions. Interactive views offer the ability to present many aspects of data by using interactive graphics and images more efficiently than by classical data tables. Applications of predictive modeling and data mining allow the categorization of data and monitoring various indicators using advanced mathematical techniques. This analysis fits easily in interactive reporting modules.

## Development Trend in BI Systems

The trend of global market of business intelligence solutions is growing in recent years, many applications developers offering better and cheaper applications, trying to attract customers from the small and medium companies. Worldwide market revenues of business intelligence software systems, analysis and management reached a value of 12.2 billion dollars in 2011, up by 16.4% percent of the amount of 10.5 billion dollars in 2010. This sector was ranked second among the fastest growing sectors in the software market for global business sector. The strong growth was due to the fact that despite budgetary constraints companies continued to invest in IT and increased interest in new technologies for knowledge discovery.

One of the development directions in the coming years is to continue the implementation of *mobile Business Intelligence solutions*. A study by Gartner (<http://www.gartner.com/technology/home.jsp>) reveals that by 2013 one third of the functionality of a BI solution will be accessed on mobile devices, like smartphones and tablets. The ease of accessing a remote BI system by employees of a company from anywhere they are, has become a necessity today.

*Moving BI solutions in cloud* is another trend of recent years. Development of telecommunications technologies and speed up of data transmission technologies have favored the emergence of cloud computing. Solutions based on cloud technology offers the advantage of being easy to install. Cloud solutions are easy to scale and allow access to BI systems to all users in a company, anywhere and with any type of technology. Security measures are continuously improving providing increased security over sensitive companies data stored in the cloud.

Another trend is the *development of BI systems as intuitive tools*, easy to use by employees. Companies extend employee access area to BI systems making them accessible to all, thus streamlining the work. The possibility of extending certain functions of the BI system internally without the assistance of developers is important.

**Table 1.** World market revenues for BI, Analysis and Performance Management 2010-2011 (millions \$)

Companies	Incomes 2011	Market Share (%) 2011	Incomes 2010	Market Share (%) 2010	Growth (%) 2010-2011
SAP	2,883.5	23.6	2,413.1	23.0	19.5
Oracle	1,913.5	15.6	1,645.8	15.7	16.3
SAS Institute	1,542.8	12.6	1,386.5	13.2	11.3
IBM	1,477.6	12.1	1,222.0	11.6	20.9
Microsoft	1,059.9	8.7	913.7	8.7	16.0
Others	3,363.8	27.5	2,931.1	27.9	14.8
<b>Total</b>	<b>12,241.0</b>	<b>100.0</b>	<b>10,512.2</b>	<b>100.0</b>	<b>16.4</b>

Source: Gartner (March 2012)

Another trend is *operational BI systems*, currently used in real-time tracking of economic indicators on business, unlike the earlier practice in which the information was used in the reports reviewed in the context of management meetings<sup>7</sup>.

BI systems market is dominated by five large competitors lately. They strengthened their position through a series of acquisitions, integration and mergers having reached almost three quarters of the entire market. But this segment is very dynamic and expanding, with over 100 developers with innovative ideas, some with high growth potential.

Table 1 presents the worldwide situation of market of decision assistance systems in the past two years. As shown in table top position is occupied in the last years of SAP, which has about 24% of the market, followed by Oracle, SAS and IBM with a similar market share; the last major competitor is Microsoft. In this market all three sub segments (BI, analysis and performance management systems) had approximately equal increases in line with global growth rate of the market by 16%, demonstrating that the customers prefer a balanced implementation of the three sub segments of the market. Note that BI systems occupy the largest percentage of this market, 63.6% of an amount of 7.7934 billion dollars last year<sup>8</sup>.

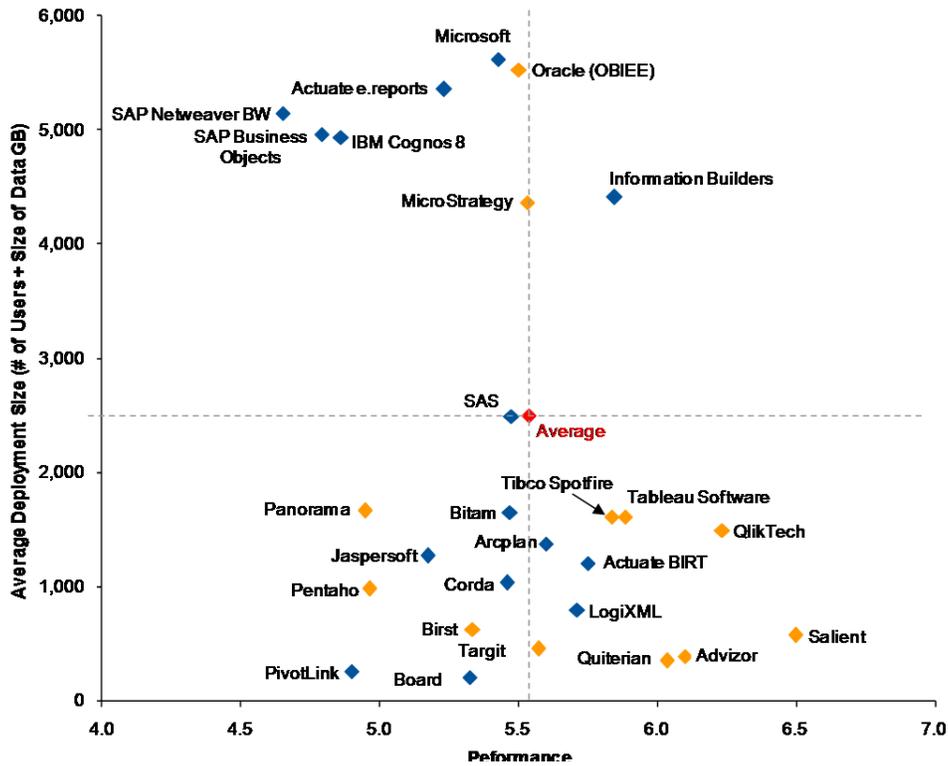


Fig. 1. Analysis of BI platforms by performance and implementation size

The market segmentation trend is observed in the analysis published by Gartner on BI systems performance compared to the size of implementation<sup>9</sup>. Fig. 1 shows the main competitors in the market under the given circumstances. Size of implementation is a combined measure of the

<sup>7</sup> Taylor, J., *Business Intelligence Trends for 2012*. [2012, April Online]. <http://www.klipfolio.com/resources/business-intelligence-trends-2012>

<sup>8</sup> \*\*\* Gartner Says Worldwide Business Intelligence, Analytics and Performance Management Software Market Surpassed the \$12 Billion Mark in 2011, <http://www.gartner.com/it/page.jsp?id=1971516>

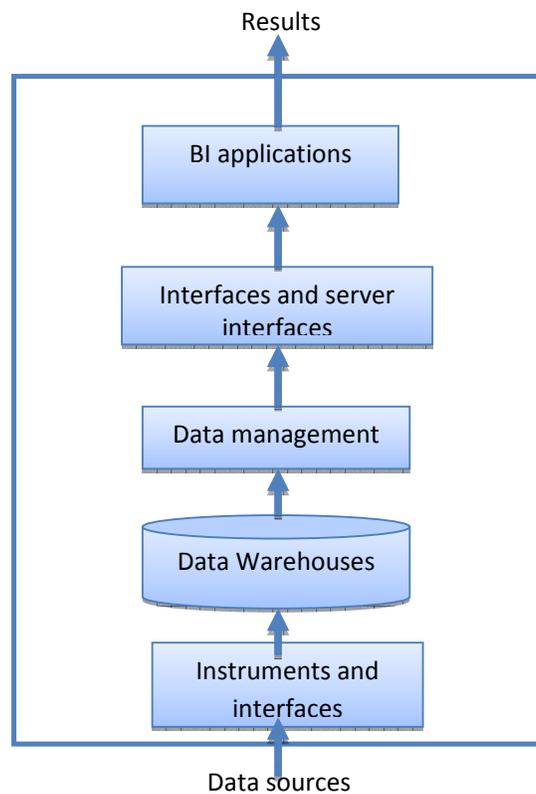
<sup>9</sup> Saliam, R.L., *BI Platforms User Survey, 2011: Customers Rate their BI Platform Functionality*, Gartner, March 2011

average level of system users and size of implementation. Marked in orange are competitors who have an above average complexity score (supports complex types of analysis). We note that the main competitors on the market, discussed above in terms of sales, have the best support for very large deployments, but performance scores are weaker, also except Oracle, supports lower complexity analysis than other competitors in the market.

It becomes obvious the trend of sharing of business intelligence market, between traditional BI platforms present in Figure 1 in the top left square and the new alternative solutions (bottom right square). In terms of ease of use, also one can observe a correlation between the above two trends. So, traditional solutions of large competitors in the market have a lower score in terms of ease of use while emerging alternative platforms get a score above average in this case.

## Business Intelligence System Architecture

To operate a BI platform requires several interconnected modules<sup>10</sup>. Available data within a company, together with other external data are aggregated for the analysis in very large databases - data warehouses. A BI platform within a company has access to all data sources (data on internal operations, market data, sales, customer data) available in transactional systems or other applications. They are organized in platform as data marts and data warehouses and are managed together.



**Fig. 2.** BI system modules

Access to managed data is made through the application interfaces and applications servers. BI application module takes the data from access module and processes them with OLAP (On Line

<sup>10</sup> Lungu I., Muntean, M., Ionescu, S. Velicanu, M., Towards new digital economy through business intelligence, in *Informatică Economică*, vol. nr. 3(23), pp. 24-30, 2002

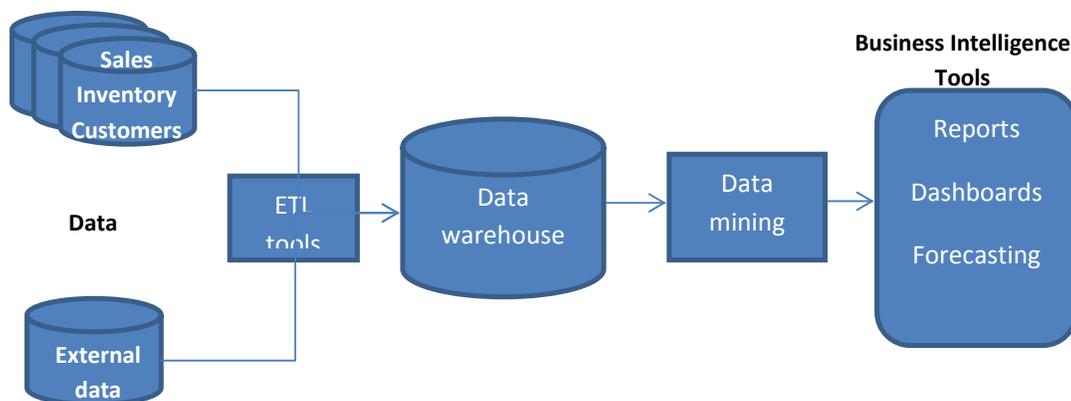
Analytical Processing), Data Mining systems. This provides the necessary knowledge to decision support systems that transmit results to the users of the platform.

Business intelligence system architecture shown in Figure 3 implies the existence of several components<sup>11</sup>:

*Data sources.* Data sources can be operational databases, historical data and external data (market research). These data are heterogeneous both as storage and as content. May come from structured information (tables, spreadsheets) and unstructured (text files, multimedia information, e-mail). BI platform can contain both relational databases and multidimensional databases. These sources of data need processing to be integrated IA systems.

*Data warehouses (Data warehouse).* Data warehouses and data marts are a significant component of the BI system. These deposits provide physical propagation of data and records management of corporate data through integration, cleansing, aggregation and query. Data from multiple sources are integrated into the data warehouse platform using tools called ETL (extract, transform, load tools).

*OLAP (On-Line Analytical Processing) - OLAP* is an essential component of a BI platform, providing extensive analysis of the data to determine trends and to make informed decisions. Analysis can be exploratory over the data, time series analysis or analysis of multidimensional cubes.



**Fig. 3.** Typical architecture of a BI system

*Data Mining* - are technologies that use mathematical models to determine the relationship or correlation between different data or data groups. There are used inductive learning techniques and optimization models. Using statistical analysis techniques one can predict or obtain information on the facts.

## Measuring Efficiency of BI Systems

Effectiveness of implementing a BI system in a company is difficult to measure; there are no specific methods to determine improving of decisions by investment into the system. Also there is an inability to compare the decisions made with the support of BI and taken without assistance with consequences that could result.

<sup>11</sup> Vercellis, C., *Business intelligence: data mining and optimization for decision making*, 1st ed.: John Wiley & Sons Ltd, 2009

In relation to efficiency and profitability of an investment, there are two frequently used measures, return on invested capital, (ROI - return on investment) and the total cost of implementation (TCO - total cost of ownership). However, in case of a BI system calculating these indicators involves difficulties due to inability to quantitatively evaluate the results produced by business intelligence systems, BI providing knowledge not salable products. There are also cases where certain modules of a BI system were prior implemented in the company before the current deployment, in which case it is debatable whether to include or not their costs.

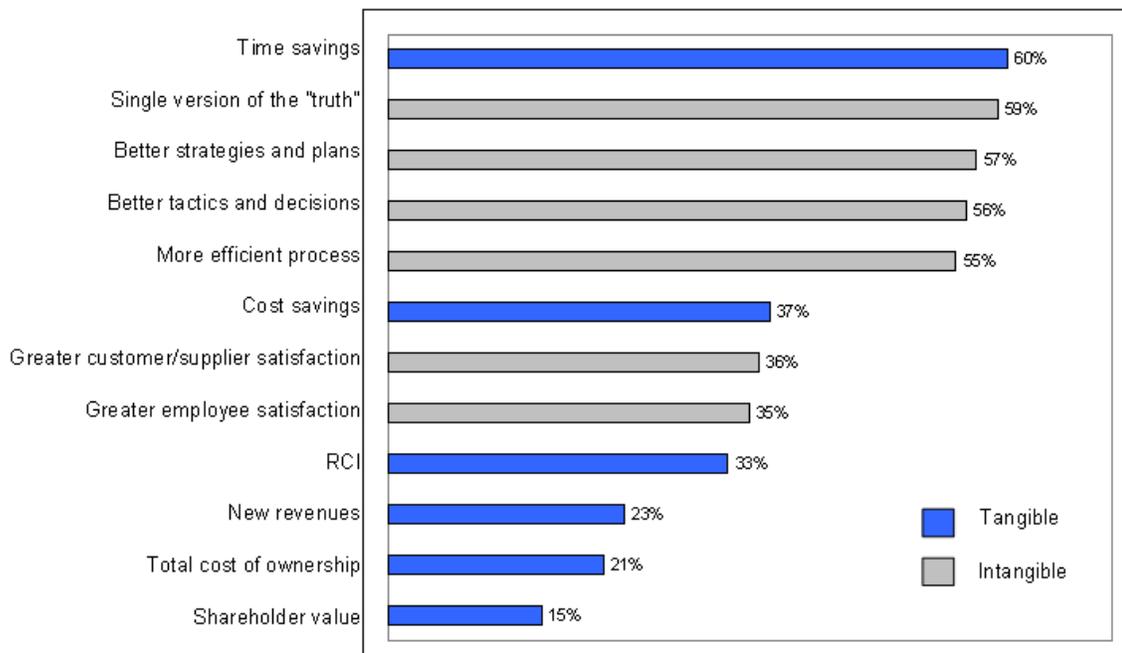
The formulas for the two indicators (1) and (2) are listed below:

$$ROI = \frac{\text{Gain from Investment} - \text{Cost of Investment}}{\text{Cost of Investment}} \quad (1)$$

$$TCO = \text{Purchase Price} + \text{Cost of Operation} \quad (2)$$

We note that none of these formulas can be applied for a BI system whose results cannot be measured quantitatively; it is best to establish some evaluation criteria and evaluating them in a period of time. Thus one can measure system costs compared to the speed of data collection, storage efficiency and ease in creating reports<sup>12</sup>.

The figure below shows the results of a study<sup>13</sup> conducted on 510 companies on what they believe to have been improved with the implementation of a BI system.



**Fig. 4.** User perceptions on the benefits of implementing a BI system

<sup>12</sup> Kelly, J., *Gartner: Business Intelligence ROI, value a matter of mind over money*. [2012, May Online]. <http://searchbusinessanalytics.techtarget.com/news/1507174/Gartner-Business-intelligence-ROI-value-a-matter-of-mind-over-money>

<sup>13</sup> Ramesh, S., Dursun, D., Fraim, T., *Decision Support and Business Intelligence Systems (9th Edition)*.: Prentice Hall, 2010

Results marked in blue are the tangible concrete results that can be measured. Thus, according to the study, benefits consist of better decisions making and time saving.

A study by Gartner on the perception of users of BI solutions on the effectiveness reveals that most of them are satisfied with their performance. Fig. 6 presents capabilities score graphical with bars; lines represent the percentage of respondents that use intensive that capability. Above bars are percentage changes in the use of capabilities in compare with the previous year.

Note that no capability is perceived as very effective and there is no capability with a very bad perception (the lower scores have the capabilities of predictive modeling and metadata management). The less performing capabilities are those about integration, infrastructure, metadata management and development tools.

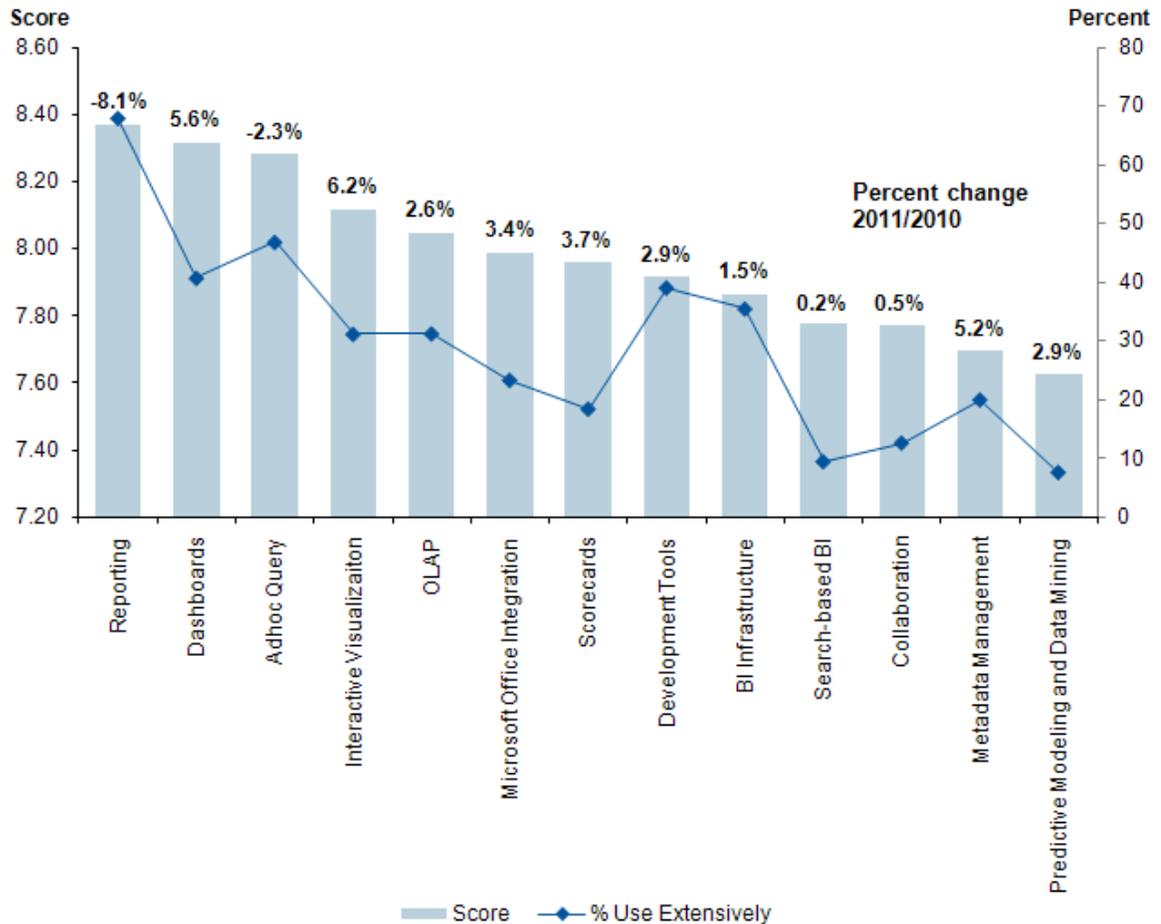


Fig. 5. The overall score of BI platforms over the expectations of users

Note that in general not all the capabilities of a BI system are used equally, but some are used even less than a quarter of users. Most users use reporting capabilities (68% of users). In contrast we have 6 capabilities used by less than 25%. There is a downward trend in recent years in the use of ad hoc reports and analyzes and a growth trend for graphical reporting tools (control panel - increased by 5.6% and 6.2% interactive graphics). This increase in use of graphic capabilities is in trend with development of interactive-visual type solutions that will become even more widely used in the coming years.

## The Implications Extend BI Systems Web

BI systems in the last decade allowed managers to access business knowledge within their organizations, achieved through the various technologies. In recent years there is a trend to use data from the Web in BI applications, and also in moving of BI applications from internal company to Web systems, for example, BI platforms hosted online (or as web services) for small and medium size companies.

Associated with trend described above are the following implications for research in the field of BI in recent years:

*BI applications using the Web as data source.* BI systems are no longer limited in the analysis made, only on the data within a single company but enrich data sources using useful information from online environment (e.g. information on competing products on the market price). A challenge is to extract knowledge from various Web sources to support, validate and analyze business models.

The volume and complexity of data available on the Web is increasing. In these circumstances, BI application developers face many problems. Among the most interesting challenges we find, for example, extracting and integrating heterogeneous data sources, development of Web repositories, addressing data quality, use Semantic Web technologies, Web mining application, the application of BI on unstructured data (for example, on text) or semi-structured (e.g. XML). Another challenge is Web Intelligence, exploring the use of artificial intelligence in combination with Web technologies, including new statistical methodology. Analysis and use in BI applications of information on access of web pages - Web Usage Data (e.g. logs, clicks, traffic, visitors, etc.) can provide information for developing Web applications with a high level of adaptability.

*Development of Web-based BI applications.* Moving BI applications from the company internal level to applications that are available on the Web involves the need for skills specific to development in the online environment. In this context, are developed new methodologies and techniques for implementing applications that allow decision makers access to data and functionality of BI systems via the web.

*A BI system used as Web services* is the trend in which significant investments and efforts are directed in research software industry. It is tried outsourcing of processing and analyzing of large volumes of data, and use of BI services in the online environment: the concept of *Cloud Intelligence*. It is estimated that the global market of software offered as SaaS services (Software as a Service) will have a steady growth in the following years, reaching in 2015 to 22.1 billion U.S. dollar's value. For 2012 this market will have an increase of 17.9% to the value of 14.5 billion dollars<sup>14</sup>. Currently the main revenue generator is the North American market, which is forecast to reach to 7.8 billion dollars in 2011 to 9.1 billion in 2012. The other regions have a much lower share in this market; values were 3.2 billion dollars in Europe, 934.1 million in Asia-Pacific and 495.2 million in Japan.

BI Web applications are accessed in real time and allow reaching to data anywhere, at any time, and through any medium. Thus, BI systems on the Web, also involves context specific technology, usability and accessibility issues, security in online systems issues.

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<sup>14</sup> Popa, A., *Gartner: SaaS market will grow with 17,9% in 2012, to 14,5 billion dollars*, [http://www.manager.ro/articole/itsic/gartner:-piata-saas-va-creste-cu-17\\_9procente-in-2012-la-14\\_5-miliarde-de-dolari-17671.html](http://www.manager.ro/articole/itsic/gartner:-piata-saas-va-creste-cu-17_9procente-in-2012-la-14_5-miliarde-de-dolari-17671.html), March 2012

## Conclusions

In the last decade we have been witnessing the increasing use of business intelligence (BI) solutions, which allow business people to question understand and analyze business data to make better decisions. Traditional BI applications allow obtaining of useful knowledge from corporate data through a variety of technologies such as data warehouses, data mining, business performance management, OLAP, business reports and other periodic reports. However, in recent years, a new trend emerged: BI applications not only limit analysis to the data within a company. They also use data sources outside the company, especially on the web, and complete data information in the company, adding value (for example, retail prices of products sold by the competition), in order to provide detailed analyzes on the dynamics of today's business.

Currently, business intelligence solutions market is still dominated by traditional systems running on PCs, but it is expected that in the next 10 years, emerging technologies, such as cloud computing and mobile technologies will play a central role in increasing deployment of intelligence business.

It is very important for companies, regardless of their size, to use efficiently the resources and to perform at maximum capacity. To do this managers need real-time picture of the market where they operate and the online state of company. Thus the benefits of implementing business intelligence solutions have become indispensable for a company that wants to be competitive.

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## Implicații și direcții de dezvoltare ale sistemelor web de Business Intelligence pentru mediul de afaceri

### Rezumat

*Conceptul "Inteligența Afacerii" a evoluat în ultimii ani de la ceea ce reprezentau pentru o companie soluțiile de transmitere a informațiilor în intranet și sistemele de management al datelor la ceea ce astăzi reprezintă instrumente strategice, puternic integrate, oferind sprijin în deciziile zilnice luate de managementul companiilor pentru atingerea obiectivelor propuse. Articolul prezintă în detaliu arhitectura unei soluții de Inteligența Afacerii și etapele de dezvoltare și implementare în cadrul unei companii. Sunt discutate implicațiile implementării unei soluții de IA pentru mediul de afaceri și tendințele din ultimii ani în acest domeniu.*