TRENDS IN THE DEVELOPMENT OF BUSINESS INTELLIGENCE SYSTEMS

Assist. Prof. Latinka Todoranova

Information technology is a highly dynamic field of research. As part of it, business intelligence systems (BIS) also develop very quickly. In this paper we shall adhere to the following definition of BIS: “BIS combine the activities of data mining and data processing and knowledge management through analytical means in order to present complex competitive information to consumers who draw plans and make decisions.”

Under conditions of ever increasing competition organizations aim to apply various management strategies for achieving competitive advantages. One of these strategies is the implementation and use of BIS in the organization. In their own turn, accounting for the growing demand for these systems, leading organizations from the field of information technologies deploy their resources and efforts in the enhancing of business intelligence (BI) solutions they offer.

The purpose of this paper is to offer an improvement of the existing capabilities of BI solutions and development of their maturity model.

To achieve this goal the following tasks have been solved: basic capabilities of BI platforms have been examined – the ones owned by leading BI developers, as well as the new capabilities added due to the revolutionary breakthrough in the BI solutions market. The leading manufacturers of such solutions have been identified, the features they emphasize when they develop and enhance BIS, with an evaluation made of the degree to which they have been implemented. Three new opportunities for BI solutions have been offered. The maturity model, developed by Adam Getz in 2010 has been further developed.

1. Analysis of today’s capabilities of BI platforms

Before we examine the maturity model of BI solutions and the guidelines for its development, it is necessary to perform an analysis of the capabilities of BI solutions, as well as the market for these solutions.

As a starting point for this research we take Gartner’s “Magic Quadrants for BI platforms”, published in 2007 (fig. 1). In it Gartner defines BI platforms as software platforms providing 12 capabilities, divided into 3 basic categories:

- Delivery of information;
- Integration;
- Analytics.

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To the first category belong the capacities for:
- Generating reports;
- Navigation panes;
- Ad hoc queries;
- Integration with MS Office.

The second group includes:
- BI infrastructure;
- Metadata management;
- Developing environments;
- Workflows;
- Cooperation.

The third category covers the capabilities for:
- Online analytical processing;
- Visualization;
- Delivery of knowledge and forecasting;
- Maps of results.

Five years later Gartner published a new “Magic Quadrant for BI platforms”, that is still current for 2012. In this document BI platforms continue to be viewed as software platforms, delivering the capabilities described above. But two more features have been added to the “delivery of knowledge” category, namely search-based BI and mobile BI.

The basic capabilities of BI platforms have been widely discussed and studied, so for this reason they will not be considered in detail in this paper. More attention will be paid to the two new characteristics, offered by Gartner.

The first opportunity is search-based BI. Essentially it is an application of a search-index in structured and unstructured data sources and their division (organization) into a classification structure of measures and dimensions, which consumers can easily navigate and explore, using a Google-like interface.

The basic difference between search engines and data warehouses is that search engines are very flexible and support any kind of format and type of information – be it structured or unstructured. Thus search engines can cope with increasingly evolving data structures. The indexing of both existing and new data (unknown so far) does not require additional data modeling. Conventional data warehousing architecture has limited capabilities for dealing with unstructured data that are necessary for facilitating decision-making and search engines “fill this gap”. In comparison, data warehouses require time not only for creating the warehouse model, but also for adding new data. Another positive feature of search engines is their ease of “navigation” through contents. At each step of the navigation, search engines provide different opportunities for filtering the results according to contents into the multitude of data that have been indexed and analyzed in nearly real time. Relational database management systems (RDBMS) have no capacity for data analysis unless they possess some knowledge about different type of data. That is, a search engine can easily follow any event that happened at a certain moment in time, while using conventional RDBMS a search can be performed only within strictly defined data fields.
Search engines also include functionality for automatic generation of clusters and categories, which improves contextual reference and data semantics. Besides, today’s search engines possess functionality for aggregating and data analysis, which enables end users to discover the data links and models without the need for a precise formulation of a request or a query.

Concerning integration, search engines can operate with the existing information systems (data warehouses, data showcases, manufacturing systems, etc.) and provide a general view on data, a view that can include new sources and facilitate cross navigation between data domains.

Last, but not least comes the fact, that end users working with software with a user-friendly, intuitive interface have the considerable advantage of being relatively independent from IT departments.

Having analyzed this new opportunity offered by BI platforms, we come to the conclusion that search engines can be used together with data warehouses to improve BI platforms performance.

The other new opportunity – mobile BI - refers to the delivery of reports and contents from the navigation panes of mobile devices such as smart phones and tablets in both a publishing mode and interactive mode, using the advantages of these devices, as well as their other capabilities which are not available in desktop computers or laptops, e.g. location awareness. The huge advantage of using mobile devices is the faster and more convenient access to BI reports and panes which speed up informed decision-making at any time and any place.

However, mobile BI differs from conventional BI. Both needs and devices are different. Mobile BI does not mean presentation of already developed mobile devices navigation panels, or representation of essential panes for any specific device. The feasible approach is as follows: once developed, navigation panes can be represented – with no alteration whatsoever, or with minimal adjustments – on all relevant devices. Furthermore, in mobile devices design, we should first consider the smaller screen size, which in turn calls for smaller font size and only basic functionalities presentation. Hence the necessity of a detailed survey of consumers who will use mobile devices to access BIS. Another aspect to consider is the fact that mobile BI has to provide opportunities for effective concurrent work of consumers of BI solutions.

The emergence of these new opportunities, as well as the need for the further development of the model Getz offered, are a result of the upsurge in the market for BI solutions.

Gartner Magic Quadrants for BI platforms (fig. 1) features leading providers of BI platforms for 2007 and 2012 respectively. We can observe the dynamics of the market for BI solutions and thus in 2012 companies like SAP, Microsoft, Information Builders, which were categorized as challengers in 2007, made it to the leaders section. Microstrategy and QlickTeh also made progress.

2 Devices can find their geographical location by themselves.
Leading vendors of BI platforms as of February 2012, as well as the evaluation of the degree to which they delivered the capabilities already described in 2007 (grades ranging in the 0 - 4 interval, where 0 stands for ‘not available’ and 4 - for excellent delivery), have been presented in the following tables:

### Table 1

#### Delivery of Information

<table>
<thead>
<tr>
<th>Vendor</th>
<th>Reporting</th>
<th>Dashboards</th>
<th>Ad hoc queries</th>
<th>Integration with MS Office</th>
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<tr>
<td>SAP</td>
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<td>4</td>
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<td>Information Builders</td>
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<td>4</td>
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<td>Microstrategy</td>
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<table>
<thead>
<tr>
<th>Vendor</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>BI infrastructure</td>
<td>Metadata management</td>
<td>Developing environment</td>
<td>Workflow and cooperation</td>
<td></td>
</tr>
<tr>
<td>Oracle</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td></td>
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<tr>
<td>QlickTech</td>
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<tr>
<td>SAS</td>
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</table>

**Table 2**

### Integration

<table>
<thead>
<tr>
<th>Vendor</th>
<th>Functionality</th>
<th>BI infrastructure</th>
<th>Metadata management</th>
<th>Developing environment</th>
<th>Workflow and cooperation</th>
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<td>Information Builders</td>
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**Table 3**

### Analytics

<table>
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<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Online analytical processing</td>
<td>Visualization</td>
<td>Knowledge delivery and forecasting</td>
<td>Maps of results</td>
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<td>Microsoft</td>
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</tbody>
</table>
As we see from the tables, companies that were not among the leaders in 2007, nevertheless provided excellent capabilities for which even leaders did not score that high.

When delivery of information is considered, navigation panes rank first and in analytics maps of results are best developed. But delivery of knowledge and forecasting, which are among the most valuable capabilities of BIS, are not fully guaranteed by any of the leading technology providers of BI solutions. The development of the analytical in-memory devices, however, makes it clear that a lot of efforts are put in enhancing analytical capabilities. Besides, it is very important that BI platforms provide opportunities for concurrent work and cooperation, though that is not secured to a maximal degree either. BI platforms need to develop their capabilities in order to meet today’s consumer demands.

2. Enhancing the capabilities of BI platforms

What allows the vendors of BI solutions to better plan, evaluate and manage their BI solutions is the availability of the BI model of maturity. This is so, because evaluation of the maturity of software solutions enables the creation of quality software⁶. In December 2010 Adam Getz⁷ offered such a model. This consists of 6 levels (fig. 2) and in it the business value of the device used is measured against its complexity.

![Fig. 2. Levels of BI maturity](1.06.2012)

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⁸ The Figure was adapted from http://bi-insider.com/portfolio/bi-maturity-model/ (1.06.2012).
In the presented model, the lowest maturity level equals 0 and is characterized by generating one-off, inconsistent report at different time. For this task different data sources and performance metrics are used in the organization. Thus, an inconsistent and inaccurate view of the organization is created. At the other end of the spectrum is the highest level of maturity (level 5). It is characterized by strategic, tactical and operating decision-making in situations that include a large number of factors and variables. The author of the model concludes that organizations which use level 5 devices can create an effective business model for their companies and accurately predict future results. It is important to note that the first 4 levels of the model refer to capabilities of the BI platforms in the “Delivery of Information” category, shown above. These platforms employ lower-complexity tools, which, however, bring little value for the business. The last two levels refer to the capabilities of BI platforms in the “Analytics” category – more sophisticated tools and higher business value accordingly. That is to say the BI maturity model offered by Adam Getz is directly related to the BI platforms capabilities as defined by Gartner.

The model shown above, however, does not include modern BIS capabilities that today’s business needs in the environment of global markets and tough competition. It is necessary, therefore, for the model to be further developed, so that it is up-to-date and provides the foundation for better quality BI decisions.

According to the author of this paper, the enhanced model should include not only the two new capabilities Gartner added, but three more:

- BI cloud-type solutions and software as a service (which can be referred to the “Integration” category);
- in-memory analyses;
- big data analyses (the last two can be referred to the “Analytics” category).

By all means, modern BI solutions need to possess these capabilities.

Regarding the BIS capabilities offered by the author, perhaps the greatest hurdles come with moving to cloud decisions, and more precisely, with the data transport within the cloud. This is so because organizations find it difficult to evaluate network security and determine the quality and amount of data to be transferred and analyzed. But when these obstacles are overcome and data is transferred within the cloud, a large number of effective BI tools can be applied with the aim of organizations getting the best from the data contained in the cloud.

New computer architectures support more than two terabyte RAM and multicore processors, which results in new opportunities for the development of BIS. One of them is the “in memory” analyses, suggested by the author.

Analytical “in-memory” tools enable queries generation and RAM data analysis. The result of using such instruments is the fast and easy research executed by BI and analytical applications, i.e. the most outstanding advantage of “in-memory” processing is speed. Another important point about “in-memory” technology is the better management of the business, which is due to decision making, based on the results of complex data analyses in real time.

The initial development of these technologies started by SAP with the HANA project – “in-memory” database that combines transactional and analytical data...
processing with logical processing in the memory. More precisely, HANA provides execution of OLAP analyses in real time of OLTP data structures. This way it is possible to overcome the constraints of the conventional data base architecture that have to do with working in real time mode. Other applications use HANA through standard SQL interface. The workflow model set in HANA allows the division of data into sections (groups), where processing of these data groups can be done in parallel, depending on the number of cores.

It is important to point out that following the analysis of these solutions we have come to the conclusion that “in-memory” tools do not replace conventional solutions based on data warehouses, but are used concurrently in order to provide quality BI and analytics.

The third and most important new capability, which also encompasses the other two, is the big data analyses. Under the term “big data” we mean structured, semi-structured, unstructured and unprocessed (raw) data in many different formats, over most of which standard SQL instruments cannot be applied. The emergence of this term is linked to the search of new value inside and outside conventional data sources. “Big data” analyses require a technology or a set of technologies that possess capabilities for:

- Scaling for an easy support of petabytes of data.
- Distributed processing among thousands of processors that may be heterogeneous and geographically distant.
- Embedding of user functions of various levels of sophistication.
- Execution of these functions over petabytes of data within several minutes.
- Support of a wide range of various types of data.
- Loading analysis-ready data. The speed has to be very high (gigabyte per second).
- Integration of multiple-source data, also at a very high speed (gigabyte per second);
- Loading data before their structure is declared or identified.
- Execution of analytical queries in real time upon booting the data, etc.

So far, there are two architectures for “big data” analyses – extended relational database management system (RDBMS) and MapReduce/Hadoop. They are implemented as separate systems, but there are hybrid models including both architectures. The development of “big data” analyses can be speeded up thanks to cloud services, which provide instant scalability without considerable investments in hardware.

One of the important characteristics of “big data” is that they are often used to store and process unstructured data such as web contents, text, social media contents. In order to make the use of such data practically possible, organizations have to link them to existing structured data from their in-company OLTP (Online Transaction Processing) systems, data warehouses and other systems in the organization, such as CRM (Customer relationship management), ERP (Enterprise resource planning). Linking these data enables the identification of new models and associations.

Before being used, these data have to be cleansed. It is impossible for data to be cleansed the moment they are used or when they have already been collected in
enormous data repositories. The right approach is for data to be cleansed where they are located – when the systems transaction flow starts. For example, when the consumer clicks OK in the web site, or when RSS informs of new publications in a blog in real time. Information from many systems has to be collated.

The author of this paper believes that another level of BI maturity has to be added to the BI maturity model offered by Adam Getz in 2010, and namely a level 6 big data analyses.

This new level is characterized by capabilities for:
• Working with large volumes of data, distributed over a large number of systems and execution of parallel analyses in a cloud environment;
• Access to transactional information at the moment the transaction is executed;
• Finalizing business deals at high speed and quicker response to events that influence business activities;
• Identifying trends and models in order to enhance planning and forecasting;
• Reducing response time for clients demands and complaints;
• Getting hold of up-to-date information that is needed to clinch deals.

Thus all kind of organizations can create new products and services, improve existing ones and come up with completely new business models. The Big data analyses level brings together the following capabilities: Cloud type BI solutions, in-memory analyses and big data analyses. The aim of this level of BI solutions is to facilitate decision-making, make work faster, increase productivity and efficiency.

Inevitably, as a result of the fast development of technologies, vendors of BI solutions will aim to reach this new level. To achieve it, they will have to rely on the enhanced capabilities of BI platforms that the author offered.

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Abstract

The aim of the present article is to trace the movement of the market of BI solutions, as well as the trends in their development. There are presented the main capabilities which those systems should provide, there are also put forward some new ones. There is analysed the maturity model of business intelligence solutions of Adam Getz. In addition to that there is made a suggestion for updating his model by way of adding another level.