BUSINESS INTELLIGENCE IN THE PROCESS OF DECISION MAKING: CHANGES AND TRENDS

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Abstract. *The concept of business intelligence has drawn substantial attention of both academicians and practitioners. As one of the fastest developing business application areas, business intelligence has also created a trail of confusion regarding its role, potential, sources of value creation. This study aimed at elucidating the role of business intelligence in the near future through the analysis of the current research and practical trends. The current prevailing trends in business intelligence technologies and systems are mobile business intelligence, location intelligence, software as a service, big data and predictive analytics. The paper points out that human factors in business intelligence are often underestimated, while a thorough consideration of their role should create additional ground for effective business intelligence applications. Some of the important considerations regarding human factors, such as support of problem-solving patterns and an efficient coordination of business intelligence activities, are presented.*

Key words: *business intelligence, decision making, human-centred approach*

Introduction

Since its first mentioning in 1958 by the pioneer of information science H. P. Luhn (Luhn, 1958), business intelligence (BI) has been defined in a myriad of ways, and the concept is still evolving. BI is an umbrella term covering many technologies, e.g., online analytical processing, data mining, business performance management, data warehousing, business analytic tools, etc., which are complex enough to be stand-alone images of information science. A careful selection of a few accurate outlines from the retrospective renders a broad BI definition which, later on, might be visually summarised to facilitate the general understanding of the term.

The Data Warehousing Institute, a provider of education and training in BI and data warehouse industry, defines business intelligence as the processes, technologies, and tools needed to turn data into information, information into knowledge, and knowledge into plans that drive profitable business action (Loshin, 2003).

The Knowledge Management and Business Intelligence Workshop defines BI as an active, model-based, and prospective approach to discover and explain hidden, decision-

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relevant aspects in large amounts of business data to better inform business decision processes (Liebowitz, 2006).

Forrester, rather typically, uses the following broad definition: business intelligence is a set of methodologies, processes, architectures, and technologies that transform raw data into meaningful and useful information used to enable more effective strategic, tactical, and operational insights and decision-making (Evelson, Nicolson, 2008).

Decomposing these few selected definitions empowers to comprehend the underlying structure of BI. First of all, business intelligence gathers a set of technologies, processes or approaches that function together as a complex system. Moreover, BI involves certain changes from various data sources into information, knowledge, insight and preferably decisions that turn out to profitable actions. In other words, to put it simply, BI provides the ability to gain insights and perform better in decision making by using a particular set of technologies and tools. And finally, the human factor has to be included in the definition.

Figure 1 provides a visual summary of previously covered definitions. To complete the transformation from data to knowledge and decisions, people use certain technologies, processes, tools and rules.

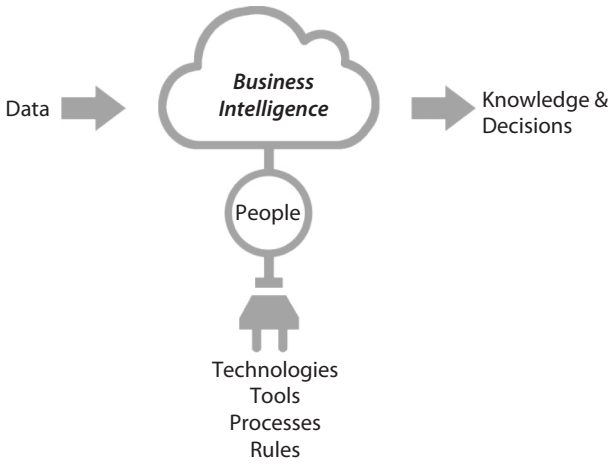

FIG. 1. **Concept of business intelligence**

Semantically, BI has not evolved too far from its predecessing decision support systems (DSS). In fact, the borderline between the two is thin and vague, both are based on using data and empower better (informed) decisions. The difference is then perhaps in the choice of a particular technology and its application. In essence, BI works as a complex DSS or at least that is what executives and managers expect to receive in the end – better decisions. Nevertheless, changes in development and maturity exist, and certain conclusions for trends are addressed in this paper. Both decision support and business

intelligence are geared towards better awareness, probably the most obvious difference being in their procedural nature: business intelligence is supposed to provide an ongoing insight into one's own activities and their environment, while decision support has to address a certain problem.

Business demands

First of all, let's consider business demands for BI. Contemporary business is conducted in a volatile environment which, naturally, influences the way companies and organisations operate and their effectiveness. In many cases, managers expect little effort – huge impact decisions that would provide a quality leap in their field. Such inclinations trigger high expectations towards BI. Besides the strategic decisions, BI is penetrating into all decision levels, down to operational level support.

In the long run, the difficulty of the problems increases, i.e. certain problems that were solved a decade ago have a ready-made solutions now, in forms of systems, add-ons, tools, methods, models, tutorials, etc. Many BI developers believe that BI has evolved from being only a reporting tool and should inform and educate the company. In fact, BI has gone far from being only part of IT department: BI has become agile, and business users demand more empowerment. Self-service analytics may be one of the possible solutions.

From the historical perspective, IT has been in charge of creating analytic applications, insightful reports and dashboards for business users, but the progress has not been rapid enough. Changing business needs raising new paradigms: analytical power and ownership are shifting from IT towards business. IT groups recognize an urgent need of collaboration or risk getting left behind. Likewise, the defined way of IT has changed from guarding the data to preparing it for actionable business decisions.

As the complexity of BI and demand increases, the market changes, and expansion is to be expected in the nearest future, despite the economic recession which has slowed down BI progression only a little. BI provides business guidance based on a deep data analysis, which is even more important in economically challenging times. As such, the BI market is much less affected by the economic crises than most of other software markets (Kisker et al., 2009). In addition, enterprises are learning to live with multiple BI tools, and the client inquiries about how to live with multiple BI tools by far exceed inquiries about platform consolidations. Consider the following BI predictions for 2012 and beyond.

Market highlights for BI predictions

BI has settled a place among the priorities in technological solutions for the last couple of years. Not surprisingly, BI and analytics are one of the top-ranked technologies for 2012 according to Gartner (Cearley, 2012).

Forrester predicts that in 2012 companies will spend $8 billion on BI, which is the largest amount within the information management applications category (Bartels et al., 2012). Since 2003, the market has grown from $1.6 billion, which accounts for an almost 500% growth.

Besides, a survey from the Morgan Franklin consultancy firm confirms the notion: 75% of respondents intend to maintain or increase BI spending during 2012 (Hargrove et al., 2011). Amid the current economic climate, an increase in BI investments is an indicator that organizations recognize the value of properly implemented BI solutions. BI has achieved this importance because it is an integral part of the decision making process, and this trend is expected to continue through 2012.

Tech Target's 2012 IT Priorities Survey – which polled more than 2,600 IT professionals and business analysts (more specifically, IT staffers, engineers and programmers to IT directors, managers and architects as well as CIOs and CTOs) – found that 50% of respondents planned increasing BI spending by 10% or more over the next year (Scanell, Johnston, 2012). According to the CIO Magazine research, in 2012, 53% of respondents are planning increasing investments for BI (Holmlund, 2012). Therefore, the vision of growth is clearly identified.

Additionally, the Corporate IT Forum's annual survey on corporate IT strategies has outlined positive developments for the BI market for the next twelve months. A study conducted in the end of 2011, summarized responses from almost 700 IT professionals and revealed a 10.7% increase in the number of survey participants planning to implement a BI strategy in the coming year, while 45.8% of respondents have indicated that they already have a BI strategy in place (Ross, 2012).

The TEK Systems research indicates that 35% of 1,500 IT leaders that participated in the research have their BI solutions in place and 44% are either currently implementing or planning to implement BI programs, while only 21% have no current plans for BI (Hayman, 2012).

According to the Information Week survey, 40% of more than 500 respondents plan to add process optimization to their BI/analytics mix in 2012 (Henschen, 2011). As the market matures, 47% (in 2011) and 41% (in 2012) of respondents indicate using one or a few standardized BI/analytics products; 20% (in 2011) and 22% (in 2012) deploy BI/analytics on the project-by-project basis.

Taking decision making into account once more, Gartner predicts that by 2013, 15% of BI deployments will combine BI, collaboration and social software into decision-making environments (Gassman et al., 2010).

As for a particular technology usage, the following predictions by Gartner should be taken into account. A recent study says that by 2013, 33% of BI functionality will be consumed via handheld devices. Additionally, by 2014, 30% of analytic applications will use in-memory functions to add scale and computational speed. By 2014, 30% of

analytic applications will use proactive, predictive and forecasting capabilities. And finally, by 2014, 40% of spending on business analytics will go to system integrators, not software vendors (Wise, 2011).

Having covered general a market overview, we may proceed by tackling some of the most prominent technologies used in BI.

Technologies and trends

Changes in technologies are perhaps the most visible BI component in buzzword-dominated IT society. In a sense, it seems that certain technology definitions are omnipresent. Consequently, major BI trends follow the general direction: the influence of social networks, moving to the cloud and mobile devices, using geographical data, etc. Let us proceed with a short overview of the technological advancements and trends that influence BI.

Mobile BI represents a single trend within business intelligence. Within mobile BI, however, many sub-trends are emerging, which affect overall adoption and use. Technological advancements allow widespread adoptions across multiple platforms (e.g., iOS and Android) and devices (e.g., smartphones and tablets). Developers claim that mobile offerings have finally reached the point where they can meet the diverse needs of BI users in terms of interaction and the ease of use (Wise, 2011). The key point to mobility is that vendors are trying to meet customer needs by developing interactive dashboards that give the same features and functionality as web-based or desktop alternatives. As expansions occur, these solutions will become standard and centralized so that mobile BI will be one access point independent of the medium.

However sound the technology is, mobile BI has certain limitations (Kelly, 2012): a) many mobile BI applications allow users to only view data without the possibility to manipulate it; b) these applications are tools of consumption, not analytics; c) the lack of interactivity in mobile BI applications in general restricts users from drilling down into data; and finally – d) companies often have more than one BI platform requiring mobile users to have multiple applications – and mobile access is sometimes a fee-based add-on to an existing BI platform, what sets additional costs.

Despite these limitations, according to Gartner's 2012 BI Magic Quadrant survey, the majority (53%) of organizations will deliver some form of mobile analytics by year's end (Hagerty et al, 2012).

Location intelligence (LI) is another popular buzzword that covers a broad topic area and requires some level of definition. LI uses fundamental concepts and methods that have evolved in the BI domain combined with Geographic information systems (GIS) concepts and methods to develop a platform for enabling a more comprehensive location data analysis. The compound encompasses tagging and storing pieces of raw data with their specific location in time and turning these data into actionable insight

using analytics. Basically, merging BI and GIS creates certain values (Milton, 2011): a) it allows business to better understand external characteristics and how they affect their operations – gaining a much more complete picture, and b) it enables an analysis of location and time dimensions of business and external data to gain a much finer grained understanding of the phenomenon.

While LI goals seem promising, raw data sensing, data storage and processing capacity and cost have relegated activities to small or localized solutions. Nevertheless, massive quantities of global sensor data are starting to be captured and made commercially available at a marginal cost. The areas that should ripe for a high impact are healthcare, insurance fraud and catastrophe response, government, consumer-related and other.

Software as a Service (SaaS). BI does not stand out too much from the other SaaS applications. It basically is a delivery model for BI with outside-deployed applications (using a hosted location) and end user access via secure connection. SaaS BI is also known as on-demand BI or **cloud BI**. The technology and the services are sold by vendors on a subscription/pay-as-you-go basis instead of the more traditional software licensing model with annual maintenance fees. Saas BI is considered to be easier to set up and deploy and may be chosen if the company has no implementations or no current experience with BI.

To estimate the technology scope, consider the following research data. Nearly one third of 1,364 IT managers surveyed by Gartner said they planned to use some SaaS-based BI soon. Specifically, 27% of respondents said they had already used or planned to use cloud- or SaaS-based BI options in addition to their existing core in-house BI applications for some workloads in the next year. Another 17% indicated that they had already replaced or planned to replace their current BI solutions with SaaS (Pettey, Goasduff, 2012).

However, Saas BI should be critically evaluated if a particular organization is not comfortable with processing business intelligence data outside of the corporate firewall, regardless of security assurances, or require a lot of customization and deals with large data amounts that are apt to change quickly. Besides, Saas BI solutions should be skipped if they do not fit the broader business model or culture (Mitchell, 2010). Balancing departmental and enterprise needs is essential. A myopic view of BI needs can lead to application-specific silos of BI data that might be difficult to integrate in the future. Services might not have an API or support standards that would allow the company to easily bring data back on-premises. Additionally, 63% of survey respondents worried about data security in using SaaS/cloud-based BI/analytics (Henschen, 2011), and these numbers should be taken into account seriously.

Big data is another catch phrase of 2012 that has been visible in research results, press releases and BI-related blogs. Business and consumer life create 2.5 quintillion bytes of data per day. This makes 90% of current data in the world, created during the last two

years alone, according to IBM. Big data is a general term used to describe the voluminous amount of unstructured/semi-structured data a company creates. Although no specific quantity line has been set to separate Big data from *just* data, it usually refers to petabytes and exabytes of data. Naturally, this amount of data would take too much time and cost too much money to load into a relational database for analysis. Nevertheless, looking at it provides the possibility to discover repeatable business patterns. Furthermore, Big data analytics is often associated with cloud computing, because the analysis of such large data sets in real time requires a specific framework to distribute the work among multiple, hundreds or thousands of computers.

Big data analysis may be useful in the public sector, healthcare, retail, manufacturing, personal-location services and many other fields. According to Information Week, 27% of respondents are already handling high-scale data marts/warehouses on an extensive or limited basis, and another 17% planning to add them (Henschen, 2011). These are the types of marts and warehouses used for in-database analytics and big data analyses of things like click-streams, machine-generated sensor data and server log files. Finally, the issues that have to be addressed to capture the full potential of big data are (Manyika et al., 2011) policies related to privacy, security, intellectual property and liability.

Predictive analytics, a branch of Data mining, is regarded to be the next big BI trend (according to Robb, 2012). Predictive analytics concentrate on the prediction of future probabilities and trends.

Even if analytics have traditionally been employed to track and visualize performance using conventional measures, soon a move toward more simulation and extrapolation will be taken. Sometimes regarded as advanced, predictive analytics is the analysis of both structured and unstructured data using statistics, descriptive and predictive data mining, simulation and optimization to produce insights that query and reporting tools are unlikely to discover. In other words, if BI is able to provide results on what has happened, predictive analytics is supposed to give suggestions on the possible actions to take. Both are important to making better business decisions.

Predictive analytics also focuses on distilling insight from data, but its main purpose is to explicitly direct individual decisions. To apply predictive analytics, organizations need to support new data volume, variety and velocity requirements. In addition, highly-trained specialists are crucial, too. According to McKinsey Global Institute research (Manyika et al, 2011), US alone faces a shortage of 140,000–190,000 people with deep analytical skills.

There many other technological innovations and trends, that are not covered in this paper. On the other hand, having these new outstanding technologies does not prevent 70% of respondents from using Spreadsheets/Microsoft Excel extensively (Henschen, 2011).

Human factor

People are certainly the most vital part of the BI structure: their technology choice and development, provision of raw data and the expectations towards results provide a great link from BI to decision making.

We might consider that the necessary amount of information required to make a particular decision has decreased over time either due to the general shift in management itself or to speculations with higher-meaning terms, such as knowledge, insight, and ideas. We might also suggest that managers are leaving their *comfort zone* and making decisions based on less information they normally would require. This is a well-known notion when a sufficient information curve is taken into account: at some point, information becomes excessive and is of a too little value.

When the human factor is considered, the difference between reactive and proactive decision-making is usually described by the level of sophistication on the spectrum between BI and advanced analytics. Summary statistics, reports and queries, even threshold-triggered alerts and low-latency dashboards are based on historical information. These are merely a rear-view mirror showing where a particular organization has been in a particular period of past time. There is a middle ground of simple analytics, e.g., trending or algebraic predictions that give approximate answers what to expect in terms of production, sales, etc. Advanced analytics are far more sophisticated, supporting techniques such as forecasting, statistical analysis, correlation and prediction. Where trend analysis will simply extrapolate the last quarter's sales velocity into the next quarter, a sophisticated predictive model takes into account seasonality, historical sales patterns, and correlations between strong and weak quarters. Even if certain sophisticated prebuilt algorithms can be built into applications and tools, advanced analytics is mostly a matter of company or domain-specific work that is taken on by data modellers and statisticians, many of them with the PhD-level training.

Time dimension addressing past performance versus future trends is not the only one important in business intelligence and analytics. Other dimensions are also possible:

- narrow scope versus wide scope, the first one addressing a specific problem and its narrow environment in significant depth, and the second one being targeted at the monitoring or discovery of large-scale trends;
- certain industry versus related industries (inside the same integrated value chain), other industries (e.g., unexpectedly showing similar trends, although being unrelated or remotely related) or all industries (to pay attention to economy-wide trends) and so on.

Let us look at decision making from another angle. Suppose we want to analyse what happens in our brain when we are making decisions. From a logical perspective, whenever our brain is given an unfamiliar task, it strives to make logical assumptions estimating the input, the possible actions vs. outcomes, and tries to find the best solution.

When the brain is given a similar problem again, it most likely revisits the old task, the action and the solution and, before trying to find the right one for the current problem, evaluates what has worked previously and what has not. After a certain number of tasks, the brain becomes accustomed to solving a particular type of tasks: the time of revisiting the old solutions and finding the right one for the new task considerably shortens. The brain creates certain patterns. This is, thus, the learning process of decision making. The Human brain likes patterns and creates patterns for decision making. That is where intuitive, user-friendly technologies and usability solutions stand in. The more the technology is able to fit into certain thinking patterns and facilitate them, the more effective it will be. This is also substantial for BI solutions.

Alongside with the issues of supporting human decision-making patterns, the organizational setup of business intelligence system should be carefully considered. A number of sources with published research indicate that intelligence works best when organized as a group effort among involved people. This effort has to be properly coordinated in terms of priorities, procedures, responsibilities, and at the same time the intelligence setup should support and motivate an efficient horizontal exchange of information among the participants. Thus, there should be more chances that some interesting information will be supported by related information from another point in the system, or a fresh insight will be complemented by ideas from other participants, possibly creating a kind of business intelligence culture in the organization. There are just too many cases reported where a state-of-the-art BI technology has not delivered as expected because of the reluctance of people to "feed" the system and perform the extra procedures required.

Nevertheless, taking into account the learning curve, patterns and capabilities, the intricate ways of human learning and capacity still surpass machine learning in many areas. People have never been more flexible in understanding, taking in and using certain technologies. The generations to come find technologies less alien and assume the human–technology connection as more natural and unquestionable. With the right deployment within an organization, BI technologies increase their chances to blend in by facilitating day-to-day decisions.

Conclusions

Business intelligence is an umbrella term that covers transformation from data to knowledge, insight, decisions and (preferably) profitable actions conducted by people using certain technologies, tools, rules, methods, and processes.

There exists a general shift in the analytical power and ownership from IT towards business, empowering the business to put pressure on BI producers. High business expectations and the increasing complexity of decisions spur the development and usage of more advanced technologies, such as mobile BI, cloud BI, SaaS, LI, Big data,

predictive analytics and many others that function across multiple platforms and devices. Despite the advanced technological solutions, the majority of BI users still struggle by using spreadsheets extensively.

As the market is becoming more mature and mergers / acquisitions occur, the human factor has to be taken into account: only the high-usability and user-friendly solutions that follow human thinking patterns are meant to survive in the long run. One of the key prerequisites for a successful implementation of such solutions would be support for the coordination of intelligence activities among the people involved, eventually leading to the creation of some kind of intelligence culture in the organization.

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