

# Business Intelligence Process Model Revisited

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**Abstract:** Today many organizations have come to value knowledge as a production factor. Thus, there is a constant need for getting the information in and sorted. Business intelligence (BI) is a process for systematic acquiring, analyzing, and disseminating data and information from various sources to gain understanding about the business's environment. This is required for supporting decisions for achieving organization's business objectives. Literature has introduced models for planning and executing BI. However, as business environments and technologies evolve in a rapid pace, are the models still applicable? Not all recent issues are taken into consideration in the previous models. BI is considered to be integrated into business processes, so the similar evolution is expected to take place. There are two studies investigating BI instigating this study, but there are still questions to be answered. Literature on different models and findings of these studies were combined to form a vision to better match reality. Various issues like users' active involvement, real-time analysis and presentation, and social media resources were brought up. Practitioners can use the approach to assess their current state of BI activities or planning the organization of BI program.

## 1 INTRODUCTION

“When my information changes, I change my mind. What do you do?”<sup>1</sup> What indeed and how does this changed information get to the decision maker? We know that organizations are struggling with data and information overflow (Schwarzkopf, 2019; Virkus et al., 2017). Information and communications technology (ICT), while helping the organizations in their tasks, is also creating vast amounts of data all the time. The amount of data is growing at exponential rate<sup>2</sup>. The trouble is no longer, whether one has the data and information for the decision-making, but to distinguish what is relevant. This phenomenon, among others, has caused the emergence of the business intelligence (BI) concept (Shollo and Galliers, 2016). Even though the BI as a discipline, and various models in that area, are not very old<sup>3</sup>, already during their lifespan the business

environment has undergone changes and developments. This may cause the need for updated thinking in this area. The ever-evolving environment, developed during recent years, has features that affect BI thinking. Features like even further networked businesses, newer and continuously changing technologies, Internet of Things, big and open data, and just the information overflow in general are transforming the operations. For example, social media as part of BI can provide improvements but also bring up novel challenges (Ketonen-Oksi et al., 2016; Xue et al., 2018).

Literature defines BI as a systematic process for knowingly collecting and analyzing data and information from all possible sources to produce insights of the competitive environment, business trends and daily operations (Murphy, 2016). These insights aim to support decisions that promote organization's business goals. BI also includes

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<sup>1</sup> Credits for this quote have been given, in addition to Economist J.M. Keynes, to at least Paul Samuelson and Winston Churchill. However, according to our opinion, the reasoning favours John Maynard Keynes (1883-1946), c.f. <http://quoteinvestigator.com/2011/07/22/keynes-change-mind/>

<sup>2</sup> According to IBM 2.5 quintillion bytes of data is created every day. <http://www-01.ibm.com/software/data/bigdata/what-is-big-data.html>

<sup>3</sup> On the origins of the phrase, there is more than one theory. According to one, the phrase BI was introduced in organized manner in late nineties by IBM as they connected it with their database and data warehouse solutions.

assessing both the quality of the information sources and the significance of the insights (Brody, 2008; Fleisher and Bensoussan, 2015). However, our studies show that organizations claiming to be executing BI do actually a variety of things more or less related to processing data and information into knowledge and insights.

BI is nothing new. Already one of the most first writings of management, Sunzi<sup>4</sup> (2012), dating back some two and a half millennia, stressed the importance of information and knowledge used to promote the set objectives. No organization can operate in vacuum. All organizations need, and have, information and knowledge about their operating environment and stakeholders therein. However, there are differences on in how an organized manner it is done, on which level it is done and by whom. Literature presents several BI frameworks and process models. They all are based on certain interpretations and presumptions of their makers. The models mirror findings of cases of the time the studies were conducted in.

Changes and trends described above affect the whole organization. BI must be connected to all business processes of an organization, because only by this connection it is able to draw high quality information from everyday operations and information products formed from this empirical material to bring value to decision-making. Hence, we claim that there is a need for revision or even an updated process model. We ask 'how theoretical consideration of BI is suitable for BI practice'.

Based on both the literature and empirical findings our goal is to present a comparison between models for BI and execution of these actions in organizations. The study bases on theoretical findings of BI, i.e. process models, in the literature and empirical studies of organizations' use of BI. Based on empirical evidence we point out trends, phenomena and practices that have an influence on BI. Thus, justifying useful re-thinking of BI framework.

The paper is organized as follows. BI concept is defined and selected in section two; in our opinion, centric process models for BI are introduced. In the next section, section three, findings of two studies are explained and they are further analyzed in section four in which the theme is also discussed. The fifth section summarizes the conclusions of the paper.

## 2 BUSINESS INTELLIGENCE MODELS AND RELATED RESEARCH

Theme of BI has been studied and used by researchers to talk about process that produces information for strategic decision-making for sometime now (Brijs, 2016; Intezari and Gressel, 2017). However, BI as a term became more popular in late 1990's (Chen et al., 2012). Defining the contents of BI has caused considerable debate (Calof and Wright, 2008). It can be seen as an umbrella-like phrase or term under which one combines different tools, applications and methods (Turban et al., 2008). Moreover, BI has many similar or related concepts and terms such as competitive intelligence, competitor intelligence, marketing intelligence, business analytics, business intelligence and analytics and big data analytics. Terms differ because of different nature of information (external – internal), scope of information gathering (narrow – broad), the way information is managed (technological – conceptual), or even because of its geographical location (cf. Fleisher and Bensoussan, 2015; Pirttimäki, 2007). Common for all terms is to process data and information to form and use that are more meaningful.

Pirttimäki (2007) defines BI as a dualistic concept. It refers to refined information and knowledge, means information about organization's business environment, and of the organization itself, and its state in relation to its markets (customers, competitors, and economic issues). In addition, a process produces refined information and knowledge (information products) for the management and decision-makers. Therefore, BI may be defined as a framework for refining information to knowledge and a framework for refining data masses to information products used in operations and decision-making.

When taking the narrower approach of BI considering only the internal sources of information, the discussion often turns to different information systems, data warehousing, and reporting and analytics tools. These are important in all BI activities and should be considered within them. For example, data warehouses are used to store the information gathered from various sources and analytics tools offer aid in handling that information. Furthermore, the so-called ETL (Extract, Transform and Load) operation is highly relevant in BI process as the data

<sup>4</sup> There are multiple ways to write the originally Chinese name with Latin letters: Sun Zi, Sun Tsu, Sun Tzu, Sunzi.

Either way, it is valued reading in many institutions and by many influencers

compiled and gathered usually is in different source systems and forms and thus it is not possible to use or compare it directly (Dayal et al., 2009; Debortoli et al., 2014). In ETL the data is first extracted from the desired sources (homogeneous or heterogeneous), then transformed into chosen proper format for analysis and querying purposes, and finally loaded into its final destination where it is applied. Often, in practice, these phases are executed in parallel in order to improve efficiency and cut off idle time from the process. (Chaudhuri and Dayal, 1997)

BI relies largely on data warehousing. Without well organized and executed, effective if one will, data warehouse, BI will not able to perform in the expected, most efficient way. Previously introduced ETL plays a centric role in data warehousing, simultaneously crystallizing the link between the two. However, in this study the concept of BI does not refer just to internal or external information, and neither to any specific information type. BI refers to the processes, techniques and tools, which support faster and better decision-making.

As shown, BI briefly means systematically deriving knowledge and insights from data and information to support decision-making (Brody, 2008; Fleisher and Bensoussan, 2015). Knowledge in this context refers to the outcome of human actions that take place e.g. in decision-making situations. Knowledge is based on information combined with experiences. It is acquired from information, which in turn is processed from data (Choo, 2002). Knowledge is essential for decision-makers (Thierauf, 2001). In other words, decision makers pursue these meaningful insights in order to better make sense of proceedings and ultimately to add value to the organization.

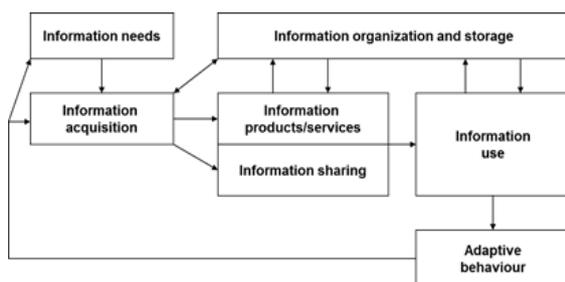


Figure 1: Process model of information management (Choo, 2002).

There are various different models and descriptions for BI. Understood in wider sense, BI process is close to management of any information. Hence, we will start by introducing Choo's (2002) established process model for information

management and set the ground for our argumentation. This model is presented in Figure 2.

There are six stages identified. The first stage is information needs definition. Information needs, composed based on changes and uncertainties between organization's industry, strategy and operational environment, have to be defined so they can be satisfied as well and efficiently as possible. The needs are defined by subject-matter requirements and situation-determined contingencies. The second stage, information acquisition, is conducted based on the previous definitions, i.e. it must adequately address the needs. The specified information sources act as a foundation for gathering the expedient information or data. It plays no role whether organization's information sources are external or internal.

Third stage is organizing and storing the information. The objective is the creation and build-up of organizational memory. The acquired information must be organized and stored systematically to enable organizational learning. This information must be analyzed and processed to a compact form into information products and services (e.g. reports, reviews) targeted at information users. This is the stage four. The goal of information distribution which follows as the stage five, is not only to increase the sharing the information to satisfy the needs of decision-makers but also to enable creation of new insights and knowledge based on the existing knowledge and know-how.

Information, in form of knowledge products, gets its final meaning when it is used. In the sixth stage of the process information and knowledge are formed into new information and understanding. After this, in the last stage, information is applied to practice in problem solving and decision making situations. By using the knowledge products and by adjusting the operation, the cycle starts anew. It should be noted, however, that processing data into information and knowledge is an iterative process and that the fluctuation between stages is not always straightforward (Choo, 2002; Vitt et al., 2002).

A generic model of five stages is based on multiple sources (Choo, 2002; Fleisher and Bensoussan, 2015; Pirttimäki, 2007). The framework takes into account the both views stated before: refining information to knowledge and refining data masses to information products. Pirttimäki (2007) reminds that the order and existence of stages are highly dependent on the organization and the intelligence effort at hand. The goal of the process is to produce organization-specific target-oriented

intelligence solutions instead of producing general business information or knowledge (ibid.).

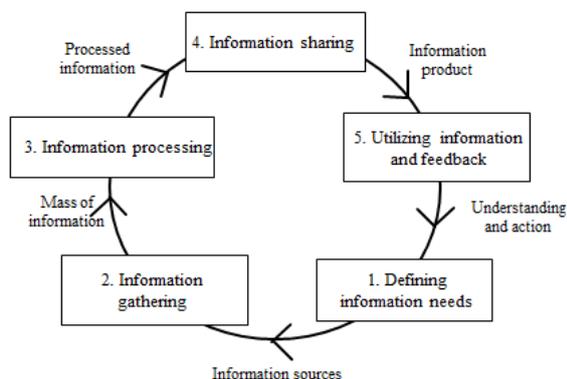


Figure 2: BI process (Myllärniemi et al., 2016).

The process starts with specification of information needs. It requires a clear statement of the key intelligence topics and more specific questions concerning the current issues, problems, or trends (Pirttimäki, 2007). The specified information needs to dictate the information sources that act as a foundation for gathering information or data after having first been evaluated. This means monitoring various sources and actually collecting the information. The collected information is stored in organization’s repositories.

Processing stage includes analyzing and evaluating the gathered information, and representing it in a compact form, i.e. information products. Collected information is assessed and connected to existing information, e.g. structured information of external environment is connected to the expertise of employees. This is where most BI tools come in handy. Yet, existence of information and information products is not enough. Dissemination stage is about sharing the knowledge and insights between the users. The results need to be communicated to the right recipient, at the right time and via most suitable tools. In the final stage, utilization, information is used in problem solving and decision-making. Utilizing information and knowledge creates understanding, and by subsequent adjusting of the operation, the BI cycle starts over.

Described general BI model does not significantly differ from Choo’s (2002) model. However, it takes a step further as it notices that there are some typical attributes and characteristics in BI, such as mass of information, compared to any information management.

Third model we will consider is a social media enabled process model (Beck et al., 2014; Vuori and Okkonen, 2012). We will not explain the process

itself as it fundamentally has the same stages as in the model presented previously. However, it adds an important dimension/attribute to the process: the different social media tools as a source for collecting data and channel for distributing insights. (Vuori and Okkonen, 2012) argue it is a swirl-like activity of overlapping processes. Personalization instead of codification, pull instead of push, and active employee participation in the process are fundamental issues in it.

The process models introduced here are not built in a continuum, i.e. the latter ones are not meant to be directly developed from or adding to the earlier models. Instead, each represent process for information management with different background assumptions and objectives, e.g. Choo is based on organizational learning whereas the BI process (Figure 2.) has knowledge based value creation as a starting point.

### 3 THE BI STUDIES

The studies forming the empirical part behind this paper give practical view of BI on operative level as most of the respondents were working as analysts or in equivalent positions. It was investigated how different BI operations are executed in business environments and where they are headed in the future. (Helander et al., 2015, Helander et al., 2018, Tyrväinen 2013) In the first study participated 56 large Finnish companies (based on their turnover). The second study was targeted differently; to organizations in which the university graduates from a business information management program majoring in BI were employed. There were 78 respondents. Both were executed as surveys. In the next chapters we present the main findings and elaborate the results from our study’s perspective.

The results show that all the organizations consider having BI activities in place. These are often also called BI, yet also other names for similar activities are used (such as competitive intelligence, marketing intelligence, management by knowledge). BI is not always seen as an independent function but it is merged with other functions. This leads to BI being executed differently in different organizations. This might occur even within one organization. The precise number of people involved in BI activities is difficult to estimate. The responsibility of BI has been divided among two or more persons in over half of the organizations. Various parts of BI are being procured from outside operators or outsourced completely. For example, in 87% of cases the news

feed originates from outside the organizations and most of the bulk research is performed by specialized operators<sup>5</sup>. The BI work done within organizations is most often related to data and information processing based on organizations' internal systems or personnel. Top management is the main user of BI products – information products made with BI tools or methods. Nevertheless, middle management and various professionals use and participate in producing the information and knowledge products generated by the BI analysts.

Clear BI strategy or policy is absent in 69% of the cases and 63% of respondents state that the BI has no allocated budget. These statements underline the vagueness of the practice of BI. Other areas of business, e.g. customer relationship management (CRM) or financial reporting are more clearly understood, perhaps due to their longer existence or more tangible nature. In over half of the cases, the tasks are performed in unorganized manner; only in 47% of the organizations, the BI activities have appointed a dedicated professional to take responsibility over the related actions.

The BI products are meant for various decision-making situations. These include the rather obvious strategic planning and business development but also sales and marketing alongside with CRM. In addition, the financial departments are among the users of the services provided by the BI specialists. Our studies show that majority of these products are predetermined: both the needs to be fulfilled and the products needed. The object for the products, i.e. information needs, are equally understandable; customers, profitability, and the overall state of the business in which the operation is performed. The most utilized ways to identify critical information needs are interaction with and interviews of the information users and producers.

Looking at different stages of BI process, organizations' procedures to execute BI can be shown. Information gathering is executed by surveys and personnel queries by using intranet and social media. Our second study shows that despite organizational way to gather information, BI professionals gather information personally from interviews, face-to-face discussions and workshops. Personnel is one of the main information sources, 71% organizations of the first study collect feedback from BI end-users. However, organizations have faced challenges in gathering information from personnel. Information gathering activities are not

conducted in a systematic way and the organization culture does not nurture such behavior.

Information processing methods vary significantly. The most utilized analysis techniques are financial analysis, risk analysis and SWOT<sup>6</sup>. When considering data and information processing from different information systems planning solutions, ad hoc queries, reporting and visualization are the most frequent methods. According to the second study the most used BI-tools are Microsoft Excel (50%), QlikView, SAP (both approx. 10%) and IBM Cognos (less than 10%). E-mail is the most used information sharing method. The studies emphasize the importance of visualization and analytics in the future. Social media is a rising field of application.

The studies show that benefits achieved by BI are more qualified information for decision-making, rationalization of information gathering and analyzing and raising knowledge capital. Unreached benefits are quicker response to competence and expedited decision-making processes. With BI organizations want answers to questions related to forecasting (e.g. so called subtle signals (Bird et al., 2018; Malan and Kriger, 1998)) and better understanding of markets.

Further investments to issues such as monitoring competitors and industry, reporting activities and customer management is planned by 83% of the organizations. The organizations' targets of developing BI include:

- Better and more efficient use of current BI systems
- Deepening degree of information processing
- Identifying critical information needs
- More effective knowledge sharing

The results have already some longitudinal confirmation as studies show similar results starting already in year 2003. Volume and velocity of information will increase. At the same time, organizations want more efficient utilization of current systems and BI-tools but demand is for more sophisticated and analytical BI methods. Based on our studies other trends in BI are mobilization, visualization and real-time capabilities. Every large company executes BI, the activities understood as them vary. These form challenges for modeling the BI-processes. In the next chapter, we will elaborate these thoughts to meet the organizations current demands and future trends.

<sup>5</sup> According to our study 87,5% of market research, 89% of customer research, and 94,5% of brand research are performed by outside operators.

<sup>6</sup> Strengths, Weaknesses, Opportunities, Threats. This and the two others belong to basic analysis tools to offer more understanding over the business-related matters.

#### 4 THE COMPARISON BETWEEN BI PROCESS MODEL AND PRACTICE

Essential factors behind effective decision-making are high-quality information and managements' proactivity (Thierauf, 2001). Organizations' ability to use information and knowledge in decision-making is based on users' personal characteristics and organizations' culture and way of working. Our studies, in addition to previously introduced literature, indicate that BI should be integrated to other business processes and information systems and connected to personnel. Integration intensifies knowledge availability, improves knowledge quality and thus makes information products more valuable through their use. In the end, all these help to improve decision-making.

Our studies show that organizations are planning to increase investments to BI activities. They are striving for goals such as deepening the degree of processing information and identifying critical information needs more effectively. In this chapter, we link the literature to practice and show how an updated conception of BI is needed when aiming to achieve those goals.

Top management is the main user of BI products, but BI products are used at almost every level of organizations. Problem formulation is not only top management's responsibility. Similarly, continuous feedback and active updating of information needs on all levels of operation improves the quality of information products and makes knowledge processing more fluent. This allows the analysis to dig deeper into actual problems behind the information needs - the users may also be relevant information sources. Based on our studies, BI analysts use quite often their personal inference skills to define information needs and to gather information from relevant sources. The information needs are based on subject-matter requirements and situation-determined contingencies (Choo, 2002). That is obvious as some classes of problems are best handled with the help of certain types of information. To define these more efficiently, seamless cooperation between BI users and analysts is necessitated. The question arises, whether all the needs are able to be anticipated. Developments both in business environment as well as in internal operations would need to be considered in advance. Only then, this form of methodicalness is possible to satisfy the needs without ad hoc –type of BI function.

Based on our studies, enabling and enhancing real-timeliness in decision-making and variability of fulfilling the information needs during BI processes are features of modern BI. BI processes introduced in chapter 2 are continuous in nature but do not explicitly take into consideration aforementioned features or active participation of BI users and analysts. In addition, integration to various information sources is not presented very clearly. Traditional classification of information sources is between internal and external sources. Newer trends, like social media and big and open data, outsourcing and personnel as an information source challenge organizations' traditional BI as well as constantly improved BI tools, i.e. social media based ways to share information.

Due to the flux of modern business environment and emerging trends introduced before, BI process model should be updated. Novel BI methods as well as various, heterogeneous information sources need to be adapted to practice in problem solving and decision-making situations. We acknowledge the need to integrate these thoughts, newer aspects and requirements, to the centric BI models (Choo, 2002; Pirttimäki, 2007; Vuori and Okkonen, 2012) and thus recognizing a need to construct a newer view of the BI process.

The previous BI models present the process as a continuum. As contrived as it may sometimes seem, the problem formulation is the starting point for the process. The action is originated by a need for more information; there is a problem, a decision needing to be made in a business case. A need for an information/knowledge product is formulated. The data needed for the decision is usually defined by the original problem. The problem may or may not be related to the actual business processes. The problem may as well be something completely different as the business environment is everything around the organization. The organizations interface to the environment is not always clearly defined or planned, nor limited solely to the top management. Thus the problem may arise also from elsewhere, which implies the need for empowering the middle management and even employees to initiate the process.

The required data defines the source. The source may be more traditional operational systems, such as ERP's or CRM's, which still are quite possible, and usable, sources for the business needs. The newer sources might include open data, i.e. data repositories made accessible by for example a public operator, or social media applications that have a purposeful

function for this special need. The format of the data may vary.

The studies showed that personnel is one of the most important information source. Organizations have faced difficulties in collecting information from personnel. The multiplicity and variety of data sources makes it necessary for an organization to build newer forms and ways of extracting the data from these sources, whether they are from internal or external sources. In addition, as the relevant information may as well come from people or from social media it is notable that information gathering is not solely a technical phase in the process.

Fleisher and Bensoussan (2015) claim that information analysis is just one step of a larger process. For example, problem formulation and purpose of using BI product guide the selection of BI tool. However, our studies show the shift towards more sophisticated BI tools and methods. For example, the study respondents say that significance of visualization, data discovery and social media tools will increase in the future. However, more traditional methods, e.g. email, are still prevailing ones in businesses. The range of BI tools may be offered and applied to satisfy the needs presented in the problem formulation. Basically this means to produce the information products. The range of these products cover a variety of various needs always case-specifically designed. The product may be a simple report, or a graphic re-presentation of data. Or it may be an elaborate presentation of the situational set of data and a forecast of the environmental changes. Obviously it varies how sometimes the 'client' is able to define his/her needs better and some other times less well. The bottom line is that the organization using these tools based on these data sets is able to do better and faster decisions that more accurately predicts and anticipates the needed responses to business needs set by the organizational strategy and the ever-changing business environment.

Our studies and recent literature show that nature of information decision-makers need has changed. Real-timeliness and proactiveness are emphasized. We have presented the BI process to be linear and straightforward. This is not, however, the case in practice. For example, problem formulation may get input from the following stages as the information needs be updated while either gathering the necessary information, analyzing it, or using the created knowledge in action. The feedback from the users and other actors involved in the process also flows both ways. Considering the need for evermore faster desire for knowledge and real-time requirements this is essential. It will not be efficient enough to always go

through the whole process; the activities in all phases may need to be modified on the fly.

Real-time requirements, continuous cooperation between BI producers and users, and demand for proactiveness considering information products and decisions are features BI must tackle. These features have come up in BI studies previously but are emphasized in the recent studies. Novel thinking is needed in the modern business environment where organizations are focusing more on monitoring competitors and industry, reporting activities and customer management. Diversity of information is emphasized and using only organizations' internal information is deficient.

## 5 CONCLUSIONS

Business intelligence (BI) is a part of organization's actions. BI is a working practice or a process in which data and information are refined into a more meaningful knowledge in order to support decision-making. The process itself retains various variables and stages that make the process complicated. The complexity is formed by the fact that the information needs of the people and processes involved change continuously, information sources are not limited to organizations' inner sources but vary and BI tools are more and more sophisticated and more demanding for their users. These along with facts that set pressure to BI process, like demand for quicker and more proactive decision-making, and organizations' unstable business environment, makes process hard to handle.

It is obvious that investing in BI activities organizations gain benefits, like better quality of information, faster decision-making and deeper understanding of business environment. However, BI does not suit for every organization. Organizations' maturity of BI and size of organizations do have an influence. With start-ups continuity of BI process might be different though stages of process are important to take into consideration. Our studies targeted large companies and the results are generalizable at some level concerning organizations that do BI regardless their maturity of it.

Organizations may take advantage of the BI model in various ways, for example, they may use it just to get the grip of their overall BI standing, what is their current state of affairs. The model may also be used in planning and organizing the BI programs and processes. Furthermore, the insights from the benchmarking in this work can assist in making better and more informed decisions, which is also the

fundamental purpose of BI thinking (Fleisher and Bensoussan, 2015; Pirttimäki, 2007; Thierauf, 2001; Vuori and Okkonen, 2012).

An important issue, that was not evident in the research nor in the literature covered, was the role of tacit knowledge. Obviously, organizations' employees from all levels possess knowledge and expertise that needs to be included in the insights produced in the BI activities. This further highlights the need to consider users of the BI products also as a relevant source. Moreover, the nature and characteristics of tacit knowledge, and challenges presented by these, should be noted in the distribution of insights. For example, an analyst is likely to form a comprehensive understanding of the problem at hand and issues related to it. Sharing this accumulated knowledge is vital in order to represent the best possible picture of reality for the decision-makers. However, articulating tacit knowledge is not always an easy task as there are several challenges (eg. Haldin-Herrgard, 2000; Riege, 2005).

In this paper, we tackled this challenging issue by representing more modern thinking of BI. Our goal was to present a comparison of the BI models and to point out some focal issues needing to be covered in order to address these issues in one's organization to answer to modern environment's requirements. The presented models support organizations' BI activities but need to be updated to face the modern requirements with some additional research.

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