CONCEPTUAL MODEL OF BUSINESS VALUE OF BUSINESS INTELLIGENCE SYSTEMS

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With advances in the business intelligence area, there is an increasing interest for the introduction of business intelligence systems into organizations. Although the opinion about business intelligence and its creation of business value is generally accepted, economic justification of investments into business intelligence systems is not always clear. Measuring the business value of business intelligence in practice is often not carried out due to the lack of measurement methods and resources. Even though the perceived benefits from business intelligence systems, in terms of better information quality or achievement of information quality improvement goals, are far from being neglected, these are only indirect business benefits or the business value of such systems. The true business value of business intelligence systems hides in improved business processes and thus in improved business performance. The aim of the paper is to propose a conceptual model to assess business value of business intelligence systems that was developed on extensive literature review, in-depth interviews, and case study analysis for researching business intelligence systems' absorbability capabilities or key factors facilitating usage of quality information provided by such systems respectively.

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1. INTRODUCTION

Since its beginnings, information technology (IT) has been transforming the nature of products, processes, companies, industries, and even competition itself (Porter & Millar, 1985). For today's organizations, in order to succeed, it is important to understand how this technology can create substantial and sustainable competitive advantages. IT not only affects how individual process activities are performed, but, through new information flows, it is also greatly enhancing a company's ability to exploit linkages between activities, both inside and outside the company (Porter & Millar, 1985, p. 152).

Several studies showed how IT investments impact organizational characteristics and outcomes, the way process activities are performed, and organizations' ability to exploit linkages between activities, both inside and outside the organization. For organizations, especially those that lack actionable information, to get a better grasp on the internal and external forces that are driving their business, and to measure and improve their performance, business intelligence systems (BIS) are the kind of IT investment to focus on. In terms of BIS as IT investment, Chamoni & Gluchowski (2004) and Williams (2004b) suggest that it is important for organizations to strive after mature BIS in order to capture true benefits of business intelligence (BI) investments.

Today, BI has an important role in the creation of current information for operational and strategic business decision-making. Although business decisions are made at different organizational levels, in daily operations they are based upon business politics and rules respectively. BIS, on the other hand, support specifically decision processes at the analytical level. According to a research by IT Strategies, Inc. (2008), BIS have one of the greatest potentials in achieving information asymmetry (Marchand et al., 2002) and differentiation from competitors respectively and thus achieve competitive advantage with IT. Regardless of this, we perceived that when organizations think about introducing BIS, the key factor is improvement of information processes – a different way for providing information. Information quality improvement goals, such as increased self-service access to data, data integration from different sources, and interactive and convenient access to data are important, but their analysis is just the first step towards BIS' investment justification.

To ensure a return on an investment in BI, it is important to identify and manage those technological and business factors that make a difference in whether the investment pays off (Williams & Williams, 2007). For that reason, there is a need to further investigate the connection between investments into BI

technology and business performance, and to determine factors influencing this connection. A conceptual model for researching key factors facilitating the use of information provided by BIS to generate business value from business processes is proposed in this paper based on extensive literature review, in-depth interviews, and case study analysis.

The paper is structured as follows: section 2 provides definitions of BI, BIS, and their business value. In section 3, information quality improvement goals of BIS and the relevance of quality information for business decision-making are presented. In section 4, we present our conceptual model for researching business value of BIS. The last section sums up our findings and presents some suggestions for future work.

2. BUSINESS INTELLIGENCE SYSTEMS AND THEIR BUSINESS VALUE

2.1. Business intelligence broadly defined

Arnott & Pervan (2005, p. 71) argue *"BI is a poorly defined term and its industry origin means that different software vendors and consulting organizations have defined it to suit their products; some even use 'BI' for the entire range of decision support approaches."* Scientific and professional literature reviews show no lack of BI definitions, either:

- The process of gathering and analyzing internal and external business information (Okkonen et al., 2002).
- BI is neither a product nor a system. It is an architecture and a collection of integrated operational as well as decision-support applications and databases that provide the business community easy access to business data (Moss & Atre, 2003).
- BI is a general term for applications, platforms, tools, and technologies that support the process of exploring business data, data relationships, and trends. BI provides an executive with timely and accurate information to better understand his or her business and to make more informed, real-time business decisions (Raisinghani, 2004).
- An organized and systematic process by which organizations acquire, analyze, and disseminate information from both internal and external information sources significant for their business activities and for decision-making (Lonnqvist & Pirttimaki, 2006, p. 32).
- BI is a set of business information and business analyses within the context of key business processes that lead to decisions and actions. In

> particular, BI means leveraging information assets within key business processes to achieve improved business performance (Williams & Williams, 2007).

English (2005) ascertains that the problem with many BI definitions is that they speak only to the software or technology components. However, the essential element of BI is the understanding of what is happening within an organization and its business environment, as well as appropriate action-taking for achieving organizational goals. From this, derives the importance of the human factor within BI. There is no such thing as business intelligence without the people to interpret the meaning and significance of information and to act on their knowledge gained (English, 2005). This is also consistent with the findings from Finnish research (Hannula & Pirttimäki, 2003) where around 75% of interviewees felt content and humane approaches are the key aspects of BI. Hence, English (op. cit.) defines BI as "the ability of an enterprise to act effectively through the exploitation of its human and information resources." Of course, here, technology is the component that adds to quality information with which business users can analyze business operations: what has happened, what is happening, and what will happen in the future.

In a typical organization environment, transactional applications and other enterprise applications are designed to present business information to business users. Most of the information presented is about the current state of the business. It is organized to support structured decisions, instead of meeting the complex requirements that BI addresses. BI services the whole "decision spectrum", from strategic decisions, through tactical decisions, to operational decisions (Taylor & Raden, 2007). Therefore, the BI environment (English, 2005) can be defined as *"quality information in well-designed data stores, coupled with business-friendly software tools that provide knowledge workers timely access, effective analysis and intuitive presentation of the right information, enabling them to take the right actions or make the right decisions."*

The BI environment encompasses all of the development, information processing, and support activities required to deliver reliable and highly relevant business information and business analytical capabilities to the business (Williams & Williams, 2007, p. 131). Within their BI environments, organizations look for designing and implementing successful BIS. These can be defined as information systems providing quality information for analytical decision-making as a source for guiding the business towards achieving organizational goals. BIS analyze business operations and produce information

to help business users understand, improve and optimize business operations (White, 2005).

BIS, although sometimes used as synonyms for decision support systems, represent a technologically broader concept, including knowledge management, data mining, etc. BI solutions consist of query and reporting, OLAP, statistical analysis, forecasting and data mining tools. Architecturally, we can divide BIS into two parts: a) data warehousing and b) access to data, data analysis, reporting and delivery. The main difference between traditional information support (e.g. decision support systems, executive information systems, etc.) and BIS is that traditional information support is more application oriented. Technologies used in BIS (e.g. dashboards, graphical interfaces, KPI, drill-down, filtering, etc.) have been previously used in executive information systems; however, organizational data was scattered around different data sources often connected to a single decision support solution. The key problem was providing a uniform and integral view on the data. Data warehousing and the later broader concept of BIS try to solve this problem with a data-oriented approach (Frolick & Ariyachandra, 2006) where the centre of the architecture represents integral data sources for analytical decision-taking. A state-of-the-art BIS thus includes infrastructure (data warehouse) and analytical tools. Understanding of BI also differs on its content's focus as well as on several related terms used for referring to BI (including competitive intelligence, competitor intelligence, strategic intelligence, etc.). Figure 1. shows what areas the term BI relates to.

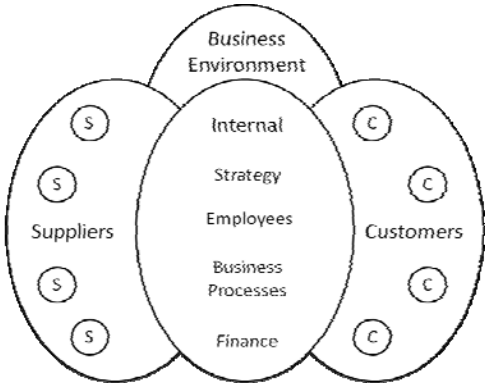

Figure 1. Broad concept of the term BI

In North American literature, the term competitive intelligence (CI) is frequently used and the external environment and external information sources are emphasized. In

European literature, the term BI is considered a broad concept for CI and other intelligence-related terms mentioned before, focusing on the external (e.g. markets, competition, suppliers, customers) and internal (e.g. strategy, technology, culture, employees) environment (Lonnqvist & Pirttimaki, 2006).

Although BIS offer the tools necessary to improve decision-making within organizations, they provide no systematic means of planning, monitoring, controlling, and managing the implementation of strategic business objectives (Frolick & Ariyachandra, 2006). This can be, however, done through embracing the concept of business performance management (BPM) which provides a means of combining business strategy and technological structure to direct the entire organization toward accomplishing common organizational objectives.

In the past few years, both fields – BI and BPM – have grown closer and closer together. In fact, some people think they are now one and the same, which they are not (Schiff, 2006). They are, however, very intertwined and share a synergistic relationship. BI provides tools essential to the delivery of BPM applications. BPM, in turn, helps drive the adoption of BI by tying it to a strategic business initiative. BPM can thus be regarded as BIS services (i.e. prepared information for business decision-making) with domain expertise added.

2.2. Business value of business intelligence

A major agenda of both practitioners and researchers within the area of IT management is the determination of added value through investment in new technology. This critical link has not been consistently established due to a variety of methodological approaches, the existence of intervening variables, inconsistent measurement of productivity, and the treatment of IT investment as a 'lump sum' (Grover et al., 1998, p. 157). Most of IT investment in the past decade has been in what amounts to better systems for managing day-to-day operations, and more frequent and voluminous reports (Williams, 2004b; Williams & Williams, 2007). There is little debate that these investments are necessary to operate many modern enterprises (Davenport & Short, 2003; Dewett & Jones, 2001; Li & Ye, 1999; Williams & Williams, 2007), but findings from scientific and professional researchers suggest that these organizations are still data-rich but information-poor (Forslund, 2007; Gibson et al., 2004; Williams, 2004b; Williams & Williams, 2007). This means that these organizations lack the kind of actionable information and analytical tools needed to improve profits and performance.

Applying BI takes resources, and the benefits actually occurring in practice are not always clear (Lonnqvist & Pirttimaki, 2006, p. 32). Thus, two important questions organizations face nowadays are: why measure BI, and how. According to the literature, BI measurements serve two main purposes. The first and most common reason for measuring BI is to prove that it is worth the investment (e.g. Sawka, 2000). Williams & Williams (2007) suggest that IT investments deliver greater value when the responsibility for business value capture resides on the business side. The second main purpose for the measurement of BI activities is to help manage the BI process: that is, to ensure that the BI products satisfy the users' needs and that the process is efficient (Herring, 1996). Current measurement approaches for determining the value of BIS and measures for managing the BI process are summarized by Lonnqvist & Pirttimaki (2006, pp. 34-36). Currently, measuring in practice is not being done as either no suitable measurement methods have been identified or the companies having no resources for such activity. With the help of appropriate measurement methods, BI activities could be more easily proved beneficial and valuable; for instance, to a management board not yet committed to the operations.

We can ascertain that for BIS it is relatively simple to determine the costs and harder to define the benefits (Lonnqvist & Pirttimaki, 2006; Turk et al., 2006; Williams & Williams, 2007). The latter usually cannot be directly measured on the market. Benefits deriving from BIS are hard to define in terms of greater productivity, which is a general presumption with investments in IT. When many executives, managers, and knowledge workers think of IT in general, they have a strictly utilitarian view of IT. As a result of this orientation and because of the magnitude and importance of the BI investment, it is important for business leaders and managers to expand their understanding of the nature of BI initiatives (Williams & Williams, 2007, pp. 122-123).

There are several researches and frameworks in the area of justifying investments in data warehouses, which represent an important technological element of BIS. Watson and Haley (1998), Watson et al. (2002), Sentry Market research and IDC study (Power, 1997) present possible sources of benefits of such investments. Wu (2000) draws our attention to the importance of evaluating both tangible and intangible benefits before a BI project is undertaken. Morris (2003) presents a comparative study of building one’s own data warehouse and analytic application vs. buying one. To further support our findings presented in this paper, the research of Taub is important (1999) where the author establishes that sources for return of data warehousing investments

do not arise from the data warehouse itself but rather from new or improved business processes that such a data warehouse enables.

Related to its business value, we can view the development path of BIS within organizations through different BIS maturity stages. These are commonly presented with models. A maturity model assumes progress comes in stages, ultimately reaching an end goal. BIS maturity model illustrates how BIS evolve from low-value, cost-centre operations to high-value, strategic utilities that drive market share (TDWI, 2005). In the current business environment, there is no scarcity of BIS (and BI) maturity models (TDWI, 2005; Williams & Williams, 2007). They provide organizations an 'instant perspective' on the status and the perspectives of their BIS initiative. For example, the TDWI institute (2005) proposes a six-stage BI maturity model (see Table 1).

Table 1. Six-stage BI Maturity Model (TDWI, 2005)

Stage	Architecture	Analytics	
1 Parental	Reporting	Paper Report	**INSIGHT**
2 Infant	Spreadmarts	Briefing Book	
3 Child	Data Marts	Interactive Report	
4 Teenager	Data Warehousing	Dashboard	**ACTION**
5 Adult	Enterprise DW	Cascading Scorecards	
6 Sage	Analytical Services	Embedded BI	

In the proposed model, maturity is defined through the system's architecture, attainment of the system, its users, and through the focus of the system (to what questions BIS provide answers).

3. INFORMATION QUALITY IMPROVEMENT GOALS OF BIS

In general, it is relatively easy to assess the benefits deriving from information quality improvement goals of BIS. These aim at reducing the gap between the amount of data organizations collect and the amount of quality information available to users on the tactical and strategic level of business decisions. It is important to note that the amount of information increases slower than the number of decisions that (should) have appropriate information support. The intuition in business decisions is still important; however, its role has shifted towards a more supplementary element within the structured decision process that is based on information in all phases, i.e. fact-based decision-making.

In business practice, this information gap comes in different forms. Among others, the most common are:

- Data required for analysis is located in different sources that are hard to integrate. Data sources are inconsistent.
- Management gets extensive reports that are rarely used or inappropriate.
- There is quite some data within organizations they are unaware of.
- Data within operational databases is not properly arranged to support management's decision.
- For "non-technical" analysts, it is a complicated and time consuming activity to prepare reports and execute queries. Traditional tools for querying and reports are, despite a graphical user interface, hard to use.
- Due to an increased need for information in analytical decision processes, IS staff plays a role of data steward: integrate data from different sources, prepare reports, aggregate data, etc.
- Analysts take too much time to gather the required information instead of its analysis.
- There is lack of external and/or competitive information to support decision-making, data owners are too protective of information, and there are limitations of incompatible software/hardware systems.

In all of the above cases, we can see examples of poor information quality (IQ). Thus, an important issue concerning both BI and BIS regards IQ which such an environment provides (English, 2005). In connection with the BIS maturity stage, an important issue on the path of achieving business value is the IQ which such a system provides for decision-making. Organizations are nowadays recognizing that the provision of quality information is a key to gaining competitive advantage (English, 2007; Redman, 1995, 1998; Ruževičius & Gedminaitė, 2007; Salaun & Flores, 2001).

In the IQ field, researchers have pondered the question of what can be qualified as "good information". Regardless of the differences of their research contexts, goals, and methods, researchers have built an astonishing consensus in regard to the criteria that can be used to describe the value of information (Eppler, 2003, p. 41). Conceptual frameworks and simple lists of IQ criteria (i.e., adjectives that describe information characteristics which make information useful for its users) abound in management, communication, and IT literature (Davenport, 1997; Eppler, 1997; Kahn et al., 2002; Lesca & Lesca, 1995; Morris et al., 1996). According to Eppler (Eppler, 2003) an IQ framework should provide a systematic and concise set of criteria according to which

information can be evaluated, a scheme to solve IQ problems, and the basis for IQ measurement and benchmarking.

Huang et al. (1999, p. 43) define IQ as "information that is fit for use by information consumers"; Kahn et al. (2002) see IQ as the characteristic of information to meet or exceed customer expectations; and Lesca & Lesca (1995) define IQ as "characteristic of information to be of high value to its users". Early important studies on IQ date back to the 1970s and 1980s: Grotz-Martin (1976) conducted a study on IQ and its effects on decision processes, whereas Deming (1986) established 14 quality points for management for transforming business effectiveness.

Other more recent studies (Crump, 2002; English, 1999; Ferguson & Lim, 2001; Lillrank, 2003) address the issue of IQ from numerous disciplines, ranging from pedagogy, legal studies, to rhetoric, medicine and accounting. The definition of IQ in these disciplines – whether explicitly stated or not – depends on the use of information. Huang et al. (1999, p. 17) point out this aspect in their study on IQ from an IS perspective: *"Clearly, the notion of IQ depends on the actual use of information"*.

Some of these frameworks are also suitable for evaluating IQ provided by BIS. One of the broadest and most thorough analyses is provided Eppler (2003), who by reviewing relevant literature on IQ identified 70 criteria for quality with some of these partially or fully overlapping. The review of 20 selected IQ frameworks showed that most of the frameworks are often domain-specific, and that they rarely analyze interdependencies between the IQ criteria. Furthermore, these frameworks do not take into account the specifics of information in knowledge-intensive processes, and the cost dimension of IQ which are very important in evaluating IQ in the field of BIS.

The outcome is the Eppler's framework, with 16 criteria covering all aspects of IQ, which can be divided into criteria affecting information content quality and those affecting information access quality. Conceived as a management issue (and not only as an IT topic), IQ must be related to the investments that are needed to achieve that quality. Thus, for analyzing the attainability of information quality improvement goals of BIS, we adopt Eppler's IQ framework (Eppler, 2003, p. 68) with 16 criteria covering all aspects of IQ (see Table 2).

Table 2. Information quality criteria (adapted from Eppler, 2003)

	Criterion name	Description
QUALITY OF INFORMATION CONTENT	Comprehensiveness	Is the scope of information adequate? (not too much nor too little)
	Conciseness	Is the information to the point, void of unnecessary elements?
	Clarity	Is the information understandable or comprehensible to the target group?
	Correctness	Is the information free of distortion, bias, or error?
	Accuracy	Is the information precise enough and close enough to reality?
	Consistency	Is the information free of contradictions or convention breaks?
	Applicability	Can the information be directly applied? Is it useful?
	Timeliness	Is the information processed and delivered rapidly without delays?
QUALITY OF INFORMATION ACCESS	Traceability	Is the background of the information visible (author, date etc.)?
	Maintainability	Can all of the information be organized and updated on on-going basis?
	Interactivity	Can the information process be adapted by the information consumer?
	Speed	Can the infrastructure match the user's working pace?
	Security	Is the information protected against loss or unauthorized access?
	Currency	Is the information up-to-date and not obsolete?
	Accessibility	Is there a continuous and unobstructed way to get to the information?
	Convenience	Does the information provision correspond to the user's needs and habits?

With the help of the analysis of the connections between BI solutions and IQ criteria, we can define and later check fulfillment of information quality improvement goals. Thus, for example, data warehouse can contribute to information versatility (comprehensiveness criterion) since, by integrating data sources, we can acquire a whole view of business operations that are the subject of interest when solving a specific business problem.

From the information quality improvement goals' view, the most perceivable benefits include an increase of IQ through the convenience and speed of information gathering, interactivity, etc. As a result, there are shorter times for business decisions-taking, especially in the part of information gathering and analysis that are the basis for decision acceptance. The decision times can, however, also extend. It is important to note that the decision process can begin earlier since BIS contribute to earlier identification of events worth reacting to.

In the research of Business Informatics in Slovenia (IPI, 2006), we also investigated the quality of information within Slovenian organizations. Although the situation within an individual organization can vary and IQ depends upon concrete decision activities (needs), our findings show an overall picture of IQ that information users deal with. We can note that within the criteria of information access, the interactivity criterion gets the lowest score; within the criteria of IQ, the lowest score is assigned to comprehensiveness and conciseness. The mentioned criteria are those where BI tools and technologies can significantly add to IQ. As an example, with OLAP tools, we can increase the interactivity and conciseness of information and with DW, we can improve comprehensiveness and the integrative view respectively.

4. IN SEARCH OF BUSINESS VALUE OF BIS

4.1. Exploitation ability of business intelligence systems

Providing that organizations strive after better quality of available information for decision-making, an important issue that arises is about the use of such information in organizations' business processes for the purpose of their improvement or change. Although the perceived benefits from BIS in terms of better IQ are far from being neglected and with their analysis to be reasonable and necessary, these are only an indirect goal to the business benefits or business value of such systems. Examples of questions that we can ask ourselves when verifying the economic justification of these systems within cost-benefit analysis are:

- Due to integrated data and the whole view of a customer, are we going to handle the customer differently? Will we, because of the whole information about our supplier, be able to negotiate better deals?
- Will we, because of faster access to data (without the need to hard-code the reports due to interactive information access), be able to respond to different events faster and thus lower the business risk and exploit business opportunities?
- Will a more customized access to information provide a proper format of information to a wider range of users on different levels of decision? Will this have an impact on organizational structure and business process execution?

Thus, we can say that the true business value of BIS does not hide only in better IQ but ultimately in improved business processes and thus in improved business performance as a result of improved IQ. If we think of BI as (quality)

business information and business analysis in support of fact-based decisions in the context of business processes, it becomes clear that BI is a broad concept (Williams & Williams, 2007), tightly linked to business processes when delivering business value. Industry case studies involving organizations that have achieved significant performance improvement through the use of BI show that these organizations not only aligned BI to support business goals, but also aligned their organizations and business processes to leverage the new BI capabilities (Williams & Thomann, 2004). In contrast, most organizations limit the preparation of the business community for new BI capabilities to user training activities.

There are several options for an organization to exploit better IQ and improve business processes, such as improved information processes (shorter delivery times), business process management (including business process change and optimization), supply chain optimization, changes in retail processes (customer segmentation, campaign management), cross selling, and changes in management processes (planning, decision taking, human resource management) (Williams, 2004a). For business process improvement, the use of BIS has to provide improvements in managerial processes and/or improvements in operational processes with the aim of increasing revenues and/or decreasing costs (Williams, 2003). Improvements in terms of shorter times for information preparation and with these linked savings are, as a rule, a minor part of the benefits BIS provide.

When we talk about changes in business processes, this does not necessarily mean radical changes in the sense of traditional business process reengineering (BPR), although findings from BI can serve as the basis for BPR projects. Changes can be limited to address the way a decision activity is performed within a process, to mitigate the decision risk due to better IQ, to enable faster response time to an event due to shorter data, analytical or decisional delay (Watson et al., 2002), to increase flexibility of process execution, etc. It is important that increased IQ brings about process changes that consecutively increase business value. With the help of process management, we can identify how BI solutions, used in conjunction with key management and operational processes, contribute to increased revenues and/or reduced costs (Williams, 2003). It helps to plan which business processes, in order to create business value with BI solutions, would need to be changed and how.

From a business perspective, we are primarily concerned that BI initiatives are focused on business processes that make a difference. We cannot expect

much of a return on investment on BI initiatives aimed at tangential parts of the business. To have a profit impact, BI investments must be directed at management processes and/or business processes that have the greatest impact on profits (private sector) or productivity and quality of service (public sector). Figure 2 (Williams & Williams, 2007) shows on what areas of different types of business processes can BI contribute to business performance.

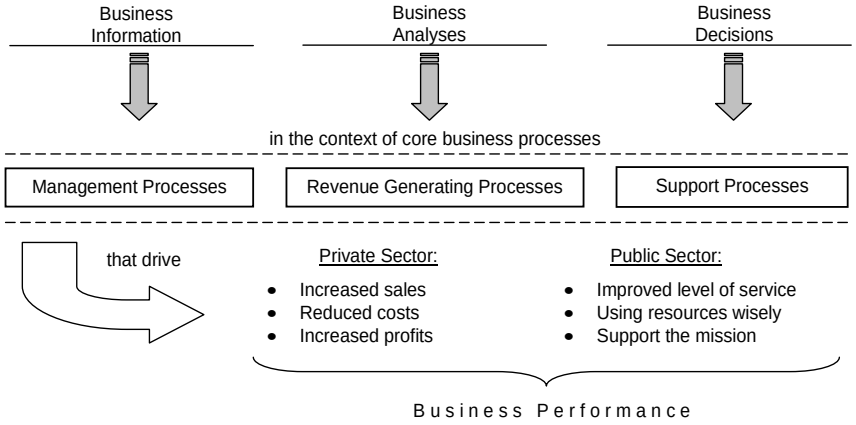

Figure 2. Business processes where BI can contribute to business performance (Williams & Williams, 2007)

In 2005, we conducted three case studies in Slovenian organizations (one of them from the public sector) about the current state of their BIS, organizations' understanding of business value of BIS, and the ways of assessing it. All three cases proved that organizations rather well and accurately evaluate the costs of BIS implementation. However, none of them quantitatively estimated the benefits, neither before implementation of the system nor afterwards. Interviews revealed the following key benefits for organizations:

- Unburden of analytical users, thus allowing them to focus on more complex analyses.
- Information specialists are less burdened by information preparation due to self-service access to data and now mainly maintain and expand the system, and focus more on strategic tasks.
- Information users save time previously devoted to data preparation and analysis.
- BIS allow the identification of problems (dashboards, sales follow-up...) that would otherwise likely be unnoticed.

- Planning process on lower hierarchical levels is supported.
- Data from different data sources is easier integrated and unified.
- Better data quality in the transactional system as a result of identified critical points within processes.
- Introduction of BIS partially contributed to a more flattened organizational structure.

We can clearly see that the organizations under study mainly identified benefits that were defined above as information benefits or information process improvements. Only exceptionally, these changes include the renovation of operational and managerial processes. Of course, we cannot conclude these changes did not occur, however, it is obvious that potential changes happened rather by chance or as a result of the appropriate use of BIS from its users. For achieving a higher business value of BIS, it is important for these changes to be systematic and stimulated at their introduction. Thus, if we want to link BIS maturity to business performance, we have to define BIS maturity as presented in section 2, where an emphasis on evaluating maturity was made on technological, architectural, and other information viewpoints of the system.

4.1. Assessing business intelligence systems maturity

Maturity of an organization's BI can therefore be defined as the ability of BIS to provide quality information according to all criteria (see Table 2) and the ability of using quality information to improve business performance (i.e. ability of BIS exploitation). In the latter case, we refer to BIS absorbability. An important question that arises regarding BIS absorbability is about the factors differentiating organizations among them in exploiting better IQ provided by BIS. Why can some organizations take better advantage of BIS and improve their performance, i.e. achieving higher business value of BIS, than others?

An organization's BI maturity can thus be assessed two-dimensionally. Maturity of BIS can be evaluated through the maturity of employed technologies, system's architecture, appropriateness of data management, number and type of users, and indirectly by IQ that BIS provide. The second dimension relates to the capability of exploitation of BIS. According to the two proposed dimensions, we can generally classify organizations as more or less mature; whereas in more detailed classification, they fit into one of the four groups (see Figure 3).

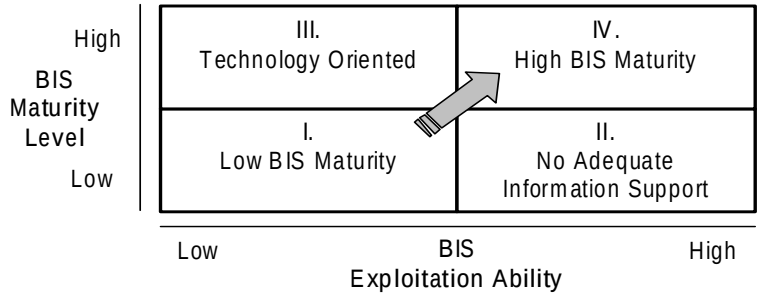

Figure 3. BIS maturity quadrant (Williams & Thomann, 2004)

Organizations situated in the 1st quadrant have a) poorly developed BIS that do not assure quality information and b) lack of ability of exploiting potential quality information resulting from the transition to a higher level of BIS' maturity. In such a case, there is no point of introducing new BI technologies without the ability of also increasing their utilization. Organizations residing in the 2nd and 3rd quadrant lack appropriate alignment of business operations and BI development. In the 2nd quadrant, the needs for quality information are great, but the system is not capable of supplying them. The 3rd quadrant comprises organizations with technology-driven development of BIS. For organizations with a high level of maturity, it is very important, in addition to a highly developed BI environment, to be able to exploit it. The natural and most appropriate move for organizations is from the 1st to the 4th quadrant since only this transition enables BIS to generate business value.

In contrast to the majority of BI maturity models that focus primarily on technological views, source integration, and use of state-of-the-art tools for data integration and their access, Williams and Thomann (2004) propose a maturity model emphasizing a change of ways information is used because of BIS.

Figure 4 shows a 4-stage model of dependence of the business value from the BI maturity stage. At the early stage (Stage 0), BI maturity is low (no data warehousing and BI tools are used). Due to improved and adaptable reporting, organizations move to the next stage (Stage 1) where greater maturity and business value are present, but there is still no change in the way information is used. Awareness of the importance of an organization's information wealth (first building then using) enables organizations to move on to Stage 2 where information usage is optimized at the business level (within one or more business functions).

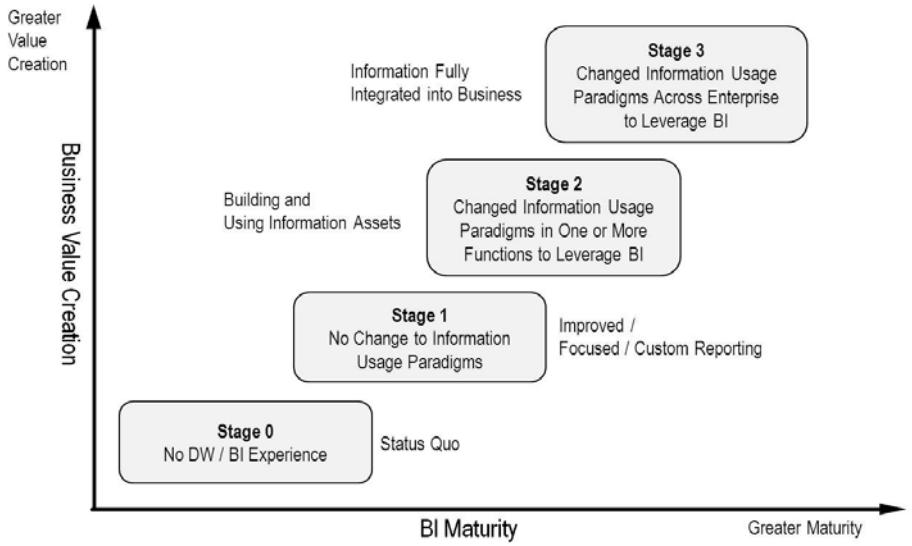

Figure 4. BI maturity (Williams, 2006)

When organizations are able to fully integrate the use of information into existing business processes, they achieve the last stage (Stage 3). Here, the information usage is optimized at the enterprise level which leads to the highest stage of BI maturity, thus the highest business value. The pace of evolution in BIS (and BI) maturity and the degree of success depends partly on organizations' ability to learn about, develop, and implement effective BI competencies (Williams & Williams, 2007).

Quality information must be therefore used within processes either to improve the decision-making (Raghunathan, 1999), business process execution (Najjar, 2002), or ultimately to fulfill consumer needs (Salaun & Flores, 2001). While IT was recognized early in the life of process renovation as a critical enabler of business process redesign (Davenport & Short, 1990), the role of information itself in business process management has rarely been addressed (Grover & Kettinger, 1997). Some of the attempts include Kettinger & Grover's (1995, p. 13) proposed descriptive model of business process change (BPC), where authors emphasize information as an important part of the information and technology subsystem, interacting with the business process subsystem. In their recent research about organizational learning and organizational performance, Škerlavaj et al. (2007, pp. 359-360) also stress the importance of information as a means for entrepreneurial opportunities recognition. The extensive literature on BPC (e.g. Burlton, 2001; Davenport, 1993; Hammer &

Champy, 1993; Harmon, 2003; McCormack & Johnson, 2000) further suggests that organizations can enhance their overall performance by adopting a process view of business. According to Kovačič & Bosilj-Vukšić (2005), quality information acts as a key element in business process management by enabling results follow-up, on-line process analysis and control, and consecutively dynamic adjustment of an organization. Cunningham (2005) similarly points out the link to business processes by asserting that BI enables process analysis to help understand real-time and historical performance, it enables users to define and share the best practices for the process, and helps look for bottlenecks and drive real-time adjustments if processing falls behind.

4.2. The conceptual model

Based on the previous discussion and analysis, we propose a conceptual model for researching business value and key factors of BIS absorbability (Figure 5). It starts by looking at BIS maturity as a source of true benefits of BI initiatives as suggested by many authors (Chamoni & Gluchowski, 2004; Williams, 2004b). In connection with the BIS maturity stage, an important issue on the path of achieving business value is the IQ such a system provides for decision-making. In order to be of value, quality information must be used within processes to improve decision-making (Raghunathan, 1999), to improve business process execution (Najjar, 2002), and ultimately to fulfill consumer needs (Salaun & Flores, 2001). The key question is to define key factors facilitating the usage of quality information provided by BIS, i.e. BIS absorbability.

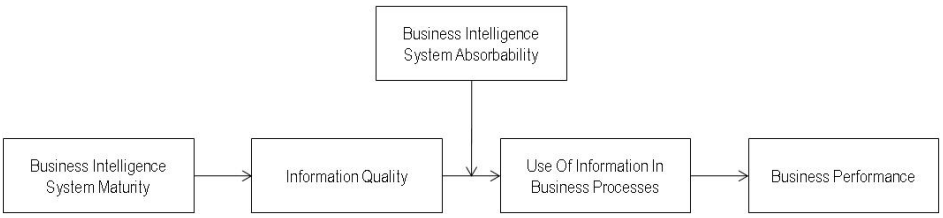

Figure 5. Conceptual model for researching business value of BIS

In the proposed conceptual model, we look at *BIS maturity* from the IT point of view by analyzing variables measuring the extent of data sources used within organizations (e.g. transactional systems, spreadsheets, databases, data marts, and data warehouses), the level of data integration for analytical decisions within organizations, and the extent of different analytics used within

organizations (e.g. paper reports, interactive reports, OLAP, analytical applications, data mining, dashboards, KPI, alerts).

Providing that a higher level of BIS maturity will likely lead to higher IQ, we then analyze variables measuring different aspects of *IQ* by adopting previously researched and tested criteria provided by Eppler (2003). In the IQ construct, we look at variables measuring different aspects of IQ, including: comprehensiveness, accuracy, clarity, conciseness, consistency, correctness, currency, convenience, timeliness, traceability, and interactivity.

A higher level of IQ does not generate business value by itself but this rather results from (higher) information usage within business processes. Thus, we look at the *use of information in business processes* through variables measuring business process management, use of information for decision-making, and information management within organizations.

From our findings from conducted case studies, we learnt that some organizations can better exploit higher IQ within their business processes than others. An important question to be answered is thus about the factors that facilitate the use of quality information enabled by BIS for changing business process execution. We define those factors as *BIS absorbability*. An interesting area to investigate is the moderating effect of BIS absorbability on the relationship between IQ improvement and the use of information in business processes for generating business value. To capture BIS absorbability characteristics, we propose variables measuring strategy alignment, culture of continuous process improvement, culture of information use and analysis, decision process management, cooperation between IT, and business and technological readiness. The proposed variables for BIS absorbability characteristics were established through previous case studies, literature review, and previous researches.

We provide the last construct of our conceptual model – business performance – for the completeness of the model of the business value of BIS. Its relationship to other constructs is not explored since it has been already previously researched (Grover & Kettinger, 1997; Guha et al., 1997; Škerlavaj et al., 2007).

5. CONCLUSIONS

As previously confirmed (Turk et al., 2006), BIS and their maturity respectively influence IQ from both the quality of access view and quality of

content view. However, there are also other factors important for assuring a higher level of IQ used in analytical decision activities. Such factors include (but are not limited to) process orientation and proper managerial and business knowledge of information specialists. Process orientation affects both the quality of access and quality of content. DWs enable organizations to better cover information needs, whereas process orientation increases their flexibility and comprehensiveness for change. Better quality of content also depends on proper managerial and business knowledge of information specialists, which conforms to the literature's findings that one of the most important critical success factors of BIS is to bridge the gap between IT and business. Management expects the "right answers" from BIS, whereas IT's job is to enable management to raise the right questions. Management and informatics have to identify together how the right questions might improve the business processes and develop an understanding on how technology enables raising the right questions. Management's task is then to exploit such findings at its best knowledge. Secondly, since the business value of BIS derives from improved business processes based on better information quality, a proper culture for business process improvement (perhaps even renovation) is mandatory for its achievement. Thirdly, important critical success factors are also appropriate organizational structure and culture, as well as its process orientation.

The proposed conceptual model enables researching BIS absorbability capabilities or key factors facilitating the usage of quality information provided by BIS to generate business value from business processes respectively. Based on the model, measurement instruments for individual constructs (BIS maturity level, IQ, BIS absorbability, and the use of information for improving business processes) will be developed.

In our future research, we will investigate the model in the direction of the analysis of the impact of IQ (quality of access and quality of content) on BPC and business performance. An empirical research will be carried out to confirm the proposed conceptual model (links from the model between individual constructs).

Based on the empirical research, our future work will focus on defining the key factors facilitating the usage of quality information provided by BIS to extract business value from business processes. We expect the analysis of the measurement data to provide an understanding of the relationship between stakeholder perceptions of IQ and perceptions of the use of information within organizations. The data collection and analysis together should also provide empirical evidence regarding the validity of our proposed conceptual model.

The findings should further serve as a base to prepare guidelines for organizations that can be directly used in practice to assure better IQ and then exploit this improved quality of information for business process execution improvement in practice.

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KONCEPTUALNI MODEL POSLOVNE VRIJEDNOSTI SUSTAVA POSLOVNE INTELIGENCIJE

Sažetak

S napretkom u području poslovne inteligencije, sve više se povećava interes za uvođenjem takvih sustava u organizacije. Iako postoji opće slaganje o stvaranju poslovne vrijednosti kroz sustave poslovne inteligencije, ekonomska opravdanost investicija u ovakve sustave nije uvijek jasna. Mjerenje poslovne vrijednosti poslovne inteligencije se često ne provodi zbog nepostojanja metoda i resursa za evaluaciju. Iako se percipirane koristi od sustava poslovne inteligencije, kao što su veća kvaliteta informacija ili dostizanje ciljeva unapređenja kvalitete informacija, ne mogu zanemariti, radi se samo o indirektnim koristima, tj. indirektnoj poslovnoj vrijednosti ovakvih sustava. „Prava“ poslovna vrijednost sustava poslovne inteligencije krije se u unapređenju poslovnih procesa te, samim tim, i unaprijeđenim performansama. Cilj ovog rada je predložiti konceptualni model za procjenu poslovne vrijednosti sustava poslovne inteligencije, i to na temelju opširnog pregleda literature, dubinskih intervjua i analize studija slučaja, uz pomoć kojih se istražuju sposobnosti za prihvaćanje sustava poslovne inteligencije, odnosno ključni čimbenici koji podupiru korištenje kvalitetnih informacija.