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# Business Intelligence Systems for Innovative Development of Organizations

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## Abstract

Today, it is believed that Business Intelligence (BI) systems have become a strategic tool for economic growth, determining the competitiveness of many organizations and their innovative development. A theory as well a practice show that BI systems are used mainly to: (a) develop modern strategies and business models; (b) creative sources of competitive advantage; (c) make fundamental transformations in organizations; and (d) integrate and develop the entire ecosystem. Unfortunately, the topic of components that determinate an innovative development of organizations based on BI is still a poorly understood issue. The study investigates a topic of BI and proposes a framework to provide BI-based innovative development of organizations. The framework contains four components: (a) digital strategy and support from top management; (b) BI infrastructure and tools; (c) information and knowledge repositories; and (d) organizational culture. The framework has been subjected to initial verification by conducting 150 direct interviews in small and medium enterprises among owners, top executives, and managers.

*Keywords: Business Intelligence; innovative development; ICT; organizations*

## 1. Information and Communication Technology a source of innovative development

For a long time, many researchers have been asking themselves what exactly Information and Communication Technology (ICT) is and how much it can actually contribute to the improvement of organizational efficiency or

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innovative development and business success [19], [32]. In response to these questions, a resource approach is partially helpful [13], [7], [6]. It says that only valuable and scarce resources can lead to competitive advantage. This advantage can be maintained in the long run if firms are able to protect their resources against imitation, transfer and substitutability. Therefore, it is hard not to notice that not all ICT solutions can be a source of innovative success [31]. Furthermore, business success cannot be automatically guaranteed by clean, technological innovations. This issue has been extensively described in various papers [31] which pointed out that technological innovations without a proper commercialization strategy will not be successful, on the contrary, they can quickly lead to self-destruction of a creative organization. Numerous examples can be quoted of firms which have achieved success in the field of technological innovation, but have not been able to link it with the right business model [11].

The experience of many organizations confirms that in implementing ICT, the answer to the question of how to deliver new value trough by ICT to the customers, suppliers, and how to transform it into benefits for the firm becomes crucial. Creating ICT-based value has been described in an interesting way by Ross et al. [28]. The authors analyzed ICT from the perspective of various assets. These include human assets (technical skills, business understanding, problem-solving orientation), technological (physical ICT infrastructure, databases, IS architecture, standards) and relationships between these assets (customer relationships, management support, risk and responsibility management). In turn, Fenny and Willcocks [12] identified nine key capabilities that are relevant to the development of ICT business value, which can be divided into four overlapping areas. These are: ICT business and vision, ICT architecture design, ICT service delivery and network capability, related to ICT leadership and acquisition (purchase) of information. In contrast, Bhardwaj [8] proposed six dimensions of ICT, relevant from the point of creating value. These are: ICT/business partnership, ICT external networks, strategic thinking in the ICT area, integration of ICT business processes, ICT management and ICT infrastructure.

Research carried out by the authors mentioned earlier shows that the ICT infrastructure is the easiest asset to be captured and copied by competitors and, therefore, represents the most "sensitive" resource in creating business value. ICT-based value is derived by organizations mainly from intangible values, such as new skills, new business models, and new products [34]. They are much harder to copy and follow by competitors. For example, Amazon Web Server has expanded on-line models for suppliers by providing services in the "cloud." Google, Netflix, Microsoft, Facebook, Twitter also operate in a similar way that builds their competitive advantage not only on advanced equipment, specialized software and applications, but also original Internet communication and multilateral business models. This means that the delivery of specific products and services is increasingly more closely associated with other firms, e.g., telecommunications operators, publishing houses and film producers.

Modern studies indicate that the greatest impact on the development of the organization will belong to Business Intelligence (BI). It is believed that BI systems have become a strategic tool for economic growth, determining the competitiveness of many organizations and their innovative development [11]. They can be applied to: (a) develop modern strategies and business models; (b) creative sources of competitive advantage; (c) make crucial transformations in organizations and create new values for an organizations and the whole society; as well as (d) integrate and develop the entire ecosystem [27].

Unfortunately, there is still too little research focused on exploring an issue of using BI systems in organizations, mainly on components shaping an innovative development of organizations based on BI.

## 2. Business Intelligence issue

In the opinion of many authors, the solution that responds to the needs of modern organizations is Business Intelligence (BI) systems [33]. Global reports from firms such as the Gartner Group, the Australian Computer Society, Oracle and Teradata indicate that BI and advanced analytics have become an important area of research which reflects the importance of information in solving the problems of a modern organization. Research results reveal that BI systems can contribute to streamlining the decision-making process, improving customer relationship management, monitoring the environment as well as detecting anomalies and business fraud [18], [20], [21], [24], [25].

It is argued that a special role of BI was marked when managers faced the necessity of: (a) taking into account many data in the decision-making process, often from different sources; (b) handling historical data; (c) manipulating synthetic data; (d) predicting the future and creating long-term plans; (f) conducting continuous

control over the implementation of actions taken, both operational and strategic in nature, and (g) responding quickly to market changes and taking into account competition activities.

Although the BI issue has been developing for many years, there is still no consistency with the interpretation of this term. There are many reasons for this. The very term "*intelligence*" can be understood differently. "*Intelligence*" is sometimes associated with the intellectual abilities of a human being, skills in abstract thinking and learning, as well as perceiving the relationships between different facts and drawing various conclusions on this basis. The term "*intelligence*" can also mean the ability to adapt to new conditions and perform new tasks using the means of thinking. It is worth stressing that the ability to intelligent behaviour and action was attributed only to a human being for many years. Nowadays, this characteristics is also attributed to computers, software, various objects, products, as well as entire industries (sectors) and organizations. As a consequence, the term "*Business Intelligence*" appeared.

It is believed that the term "*Business Intelligence*" was first used in the 1980s by H. Dresner of the Gartner Group. However, some say that as early as 1958, H. P. Luhn used this term to describe data analysis tools [3]. Today, the term "*Business Intelligence*" is often identified with: (a) data analysis tools and technologies, data warehouse [15]; (b) a decision support system [22], [5], [2]; (c)  Competitive Intelligence [1]; (d) knowledge management [22]; (e)  information- and knowledge-based organizational culture [20]; (f) process focused on collecting, analyzing and sharing information [17]; (g) analytics [9]; (h) Big Data [29] as well as (and) a research field, denoting a holistic view of decision support [30], [21], [2].

While interpreting the BI term it is important to consider its two main approaches [21], [16], [23]: technical and managerial. In technical terms (and this first appeared in describing the essence of BI), BI means an integrated set of tools, technologies and software products for collecting heterogeneous data from various distributed sources, integrating, analyzing and sharing them [26]. These primarily include a data warehouse, On-line Analytical Processing (OLAP) tools and data mining techniques. The data warehouse is responsible for integrating various data from distributed sources. In turn, OLAP tools enable their multidimensional analysis, and data mining techniques are used to detect previously unknown correlations and relationships between data.

In a managerial approach, it is emphasized that information and knowledge are strategic resources of an organization, and advanced data analysis allows not only faster decision making, but also enables the discovery of new business opportunities and the identification of factors on which this development depends. In other words, BI stands for the synergy of data, information, processes, tools and technologies for data mining and multidimensional analysis [35], [20]. Such synergy, according to many researchers [32] serves to improve the decision-making process, in particular to improve the quality of expertise, forecasting event scenarios, developing good business practices as well as building a network of experts and competence centers. It is also claimed that BI enables discovering new knowledge that is important from the point of organization's competitiveness, entering new markets, acquiring new customers and introducing new sales channels. In the opinion of some authors, BI means a new work culture based on information sharing [22]. It is also highlighted that BI facilitates the development of various strategic initiatives aimed at (Fig. 1): (a) carrying out fundamental changes in an organization, establishing new relationships and introducing innovative products; (b) optimizing relationships with customers, suppliers and other stakeholders; (c) modifying and improving business strategies in order to obtain a competitive advantage, improving business processes, increasing profitability and achieving set management goals; (d) a better understanding of the functioning of organization, minimizing the risk of business operations and improving organization's performance.

Analyzing the essence of BI, it is hard not to refer to the relationship of BI with decision support systems. Many authors are of the opinion that BI represents a new generation of decision support systems aimed at transforming specific data into information and knowledge. Their goal is to increase the efficiency of decision making at all levels of management, improve business processes, relations with stakeholders, and achieve organizational success.

 It is emphasized that BI systems offer access to static and dynamic knowledge (created on the basis of *ad hoc* queries and information obtained from databases and data warehouses). Thus, they encourage decision-makers to seek new knowledge; show decision-makers information in a new light. This can become an inspiration for the development of new forms of cooperation, new ways of acquiring customers as well as creating new markets and original offers for customers. It is believed that by sharing various techniques in the field of analysis, data mining and visualization, the openness, activeness, commitment and creativity of users of such systems increases.
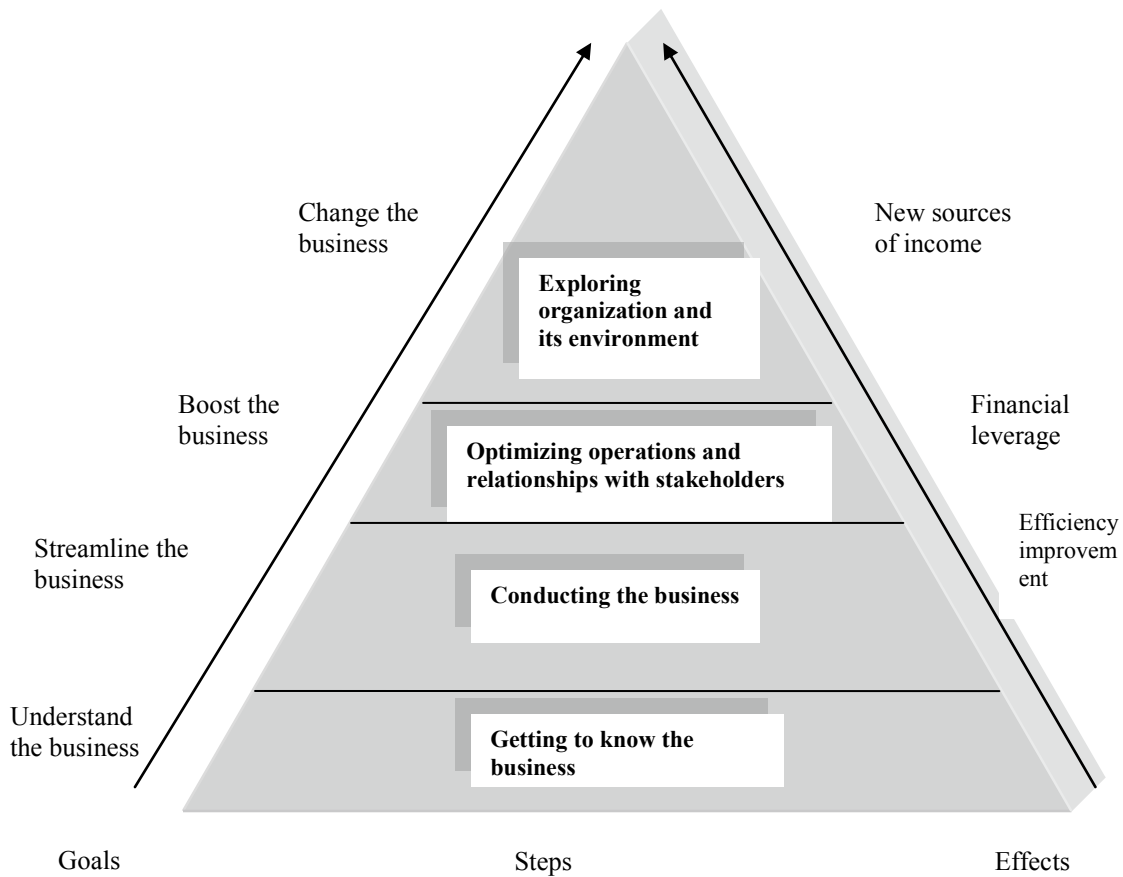
Change the
business

New sources
of income

**Exploring
organization and
its environment**

Boost the
business

Financial
leverage

**Optimizing operations and
relationships with stakeholders**

Efficiency
improvem
ent

Streamline the
business

**Conducting the business**

Understand
the business

**Getting to know the
business**

Goals

Steps

Effects

Fig.1. Business Intelligence in reinforcing organization's management
Source: Own elaboration based on [10].

3. Elements contributing to the success of Business Intelligence systems

The theory of CSFs gives good basis for stating what criteria should be followed during usage of BI systems in order to gain innovative development of organizations [24]. Several authors identify CSFs for BI in the dimensions of organization, environment, and project planning. They find especially strong support for organizational factors [14]. Several authors reviled the importance of various issues: technical as well as personal, educational and business [36]. Ariyachandra and Watson [4] analyzing an issue of BI implementation, consider two key dimensions: process performance (e.g., how well the process of a BI system implementation was conducted), and infrastructure performance (e.g., the quality of the system and the standard of output). According to [37], elements that result in success from BI usage can be generally classified into three dimensions: organization, process, technology. The organizational dimension includes such elements as: committed management support and sponsorship, clear vision, well-established business case. In turn, the process dimension includes: business-centric support and balanced team composition, business-driven and interactive development approach, and user-oriented change management. Technological dimension regards such elements as: business-driven, scalable and flexible technical framework as well as sustainable data quality, and integrity.

Davenport and Harris [9] report that the most important elements contributing to the success of BI systems in organizations include: quality of data and used technologies, skills, sponsorship, alignment between BI and business, and BI utilization. Other elements concern: organizational culture, information requirements, politics.

According to Olszak and Ziemba [23], the biggest barriers that organizations encounter during the implementation of BI systems have a business and organizational nature. Among the business barriers, the most frequently mentioned are: the lack of well defined business problem, not determining the expectations towards BI, and the lack of connection between the business and the vision of BI system. Whereas as the key organizational barriers the enterprises enumerate: lack of management support, lack of knowledge about the BI system and its capabilities, exceeded BI implementation budget, ineffective BI project management and complexity of BI project, lack of user training and support [25].

## 3. Research method

The study investigates an issue of BI and elements shaping BI-based innovative development of organizations. 150 direct interviews in small and medium enterprises among owners, top executives, and managers were conducted. The survey was carried out in September 2019. The questions referred to the following main topics:
1. What ICT are being used in your organization?
2. What benefits / values the organization receives using ICT/BI?
3. Does your organization have a digital (BI) strategy?
4. How do you grade the management's commitment to supporting the digital (BI) strategy in your organization?
5. What information sources does your organization use and how would you describe information assets in your organization?
6. What competences and skills are given importance in your organization?
7. How would you describe the culture of your organization?

The study generally focused on examining dependencies between answers to the questions of the questionnaire. The most of the answers were represented by nominal variables, therefore the logit models were applied. The models were used to examine a relationship between two items from the questionnaire, given the set of $k$ controls is represented by the characteristics of the companies in the sample. They took the following form:

$$P(y_j = 1) = \frac{\exp(\beta_0 + \beta_1 x_j + \sum_{i=1}^{k} \gamma_i c_{ij} + \xi_j)}{1 + \exp(\beta_0 + \beta_1 x_j + \sum_{i=1}^{k} \gamma_i c_{ij} + \xi_j)}, \tag{1}$$

where:
$P(y_j = 1)$ – probability that respondent $j$ gives a positive answer to outcome item $y$,
$x_j$ – an answer to independent item $x$ given by respondent $j$,
$c_{ij}$ – an $i$-th characteristics of a company represented by respondent $j$, $i = 1, 2, ..., k$,
$\beta_0, \beta_1, \gamma_i$ – estimated coefficients,
$\xi_j$ – error term.

## 4. Findings

The survey has shown that the most used ICT in organizations include: data warehousing (53.6%), Big Data (BD) (52.1%), Business Intelligence (51.0%) and mobile technologies 46.9%. Technologies such as Internet of Things (24.7%), Cloud Computing (21.8%), Artificial Intelligence (12.4%), blockchain (6.7%) are applied less frequently.

Over 71% of the surveyed organizations stated that used ICT are the strategic tools for them in management and achieving a competitive advantage. All organizations that implement BI (included data warehousing) and BD technologies recognized them as key tools in their search for competitive advantage. They are used in such areas like: logistics and supply chain (59.88%), marketing (53.1%), finance and banking (50.5%), advanced services (40.2%), trade (31.4%), research and development (29.4%), HR (25.3%) and production. When asked about the link between the technologies used and the company's success, the respondents emphasized that it is strong or very strong (over 75% of the surveyed organizations). About 24% of the organizations indicated that it is weak or rather

weak. The respondents emphasized, however, that this strong correlation is in close correlation with motivating employees (82.4%) to use ICT, support from the management (77.9%), skills in building strong and cooperative teams using ICT(73.3%), role of team leader (64%), knowledge of ICT, and analytical skills (60.3%).

The most frequently mentioned benefits of using BI analytics   included: improved customer relationship management (52.6%), improved supply chain management (45.4%), improved communication (42.3%), internal optimization of business processes (40.7%).

Among the surveyed organizations, 62.3% definitely confirmed having a digital strategy focused on BI analytics. Only 5.7% of the surveyed respondents stated that they did not have such a strategy. When asked how they assessed the involvement of management in supporting the digital strategy, they emphasized that management is involved in the development and implementation of the digital strategy in the organization (46.9%) and encourages employees to develop and implement tasks related to the digital strategy (50.5%). However, 11.9% of the surveyed responders believed that the management is not involved in the development of the digital strategy and does not encourage employees to implement it (7.2%). 14.4% of respondents expressed doubts as to the sense of having a digital strategy, considering it as a myth and something vague.

On the other hand, the surveyed organizations indicated that the most frequently used information resources include: internal reports (85.6%), specialized databases (65%), data warehouses (38.7%), public databases and open repositories (29.9%) as well as digital platforms, social media, and  blogs (24.2%)

According to the opinion of respondents,  for the development of the organization, information was assigned the significant role. The greatest importance was attached to reliable and valuable information (81.5%) and information that is a result of complex processing and analyzing (66.6%).  Then, the importance was attached to information that is rare (44.3%) and inimitable (difficult to copy) (40.2%). The respondents highlighted that for a innovative development of an organization such elements are important like: in-depth knowledge of the specifics of the industry (78.4%), team building and teamwork skills (54.1%), analytical skills (49.0%) and creative thinking (42.3%). 24.7% of the surveyed respondents emphasized the importance of knowing ICT and having technical knowledge. 21.1% of respondents   stressed the importance of knowledge and skills in the field of change management.

Responses to questions about organizational culture showed that half of the surveyed organizations are open to new and sincere ideas of employees (50%), as well as ideas of clients (35.1%) and ideas of stakeholders (32%). 47.4% of respondents emphasized that their organizations motivate employees to learn and improve their competences. About 13.9% of the surveyed respondents indicated that their organizations attach great importance to professional data analysis, analytical skills  as well as the use of various ICT tools.

5.  Business Intelligence-based innovative development framework

The obtained results from the survey  as well as from the analysis of the subject literature allow us to propose a framework to provide an innovative development of organizations based on BI. The framework contains four components:  (a) digital strategy and support from top management; (b) BI infrastructure and tools;  (c) information and knowledge repositories; and (d) organizational culture focused on analytics  and change management (Fig. 2).

The research showed that one of the measures that guarantees success in BI-based innovative development  is a clear and well-developed digital strategy. It is the basis for enabling firms to develop their capabilities and resources in line with their objectives. It was emphasized that this strategy should correspond strictly with the business strategy and be understood by all employees.

The conducted research allowed us to state that the top management plays a key role in innovative development of organizations based on BI. The management is responsible for the dissemination of knowledge sharing, learning and search for new ideas. It significantly affects the behavior of other employees. Other competencies of the management, important from the point of BI usage and innovative development are: the ability to manage change in the firm and trust as well as creating a climate for the development of creative and innovative work.
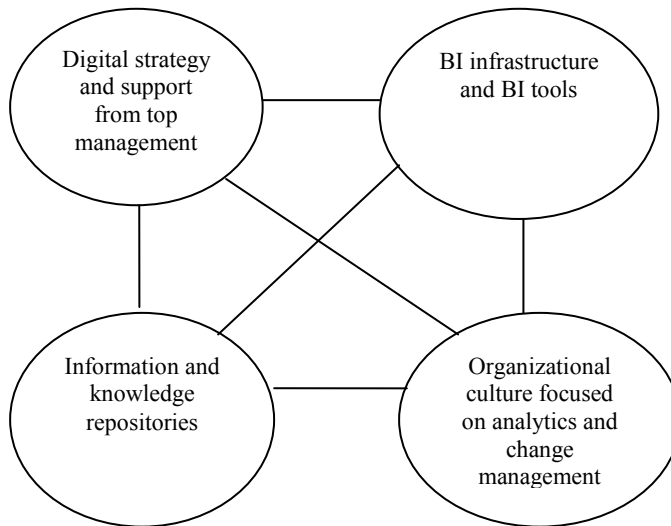
Fig. 2. Components shaping an innovative development of organizations based on BI

The surveys reviled the significant role of intangible resources (especially information and knowledge) and analytical skills and competences for innovative development of organizations. Acquisition, configuration, reconfiguration, and development of available information resources  are critical factors in  gaining a competitive advantage. It was confirmed that to lead a competitive advantage, resources should be VRIN:  Valuable (enable an organization to carry out a value-creating strategy), Rare (are in short supply), Inimitable (cannot be perfectly replicated by competitors), and Non-substitutable (cannot be countered by a rival with a substitute). The organizations need people who create individual and collective knowledge trough learning, sharing knowledge, solving problems, integrating it with the culture of organization with the ultimate aim to market, e.g., better products and services. The organizations with good leadership and open to new products; change  and innovation had real interest in competing on the basis of information and intellectual resources. It was stated that transforming information into knowledge, and especially into deep knowledge, requires appropriate infrastructure and up to date BI  tools.

Research findings have highlighted the important role of organizational culture and its direct impact on BI usage and innovative development of organizations. Culture should be understood as key beliefs, values, norms and social behaviors that imply the way employees work in the organization.  BI-oriented culture encourages the creation of knowledge, development of various forms of cooperation, and knowledge sharing and its use. In the light of conducted research, it was confirmed that organization's success is largely influenced by its employees, their competences and their ability to think and act creatively. Transforming information into knowledge, and especially into deep knowledge, requires individual employees, but also the entire organization, to think and act creatively.

6. Conclusion

There is a lot of evidence in the research literature that ICT  can play a crucial role in achieving advantage, improving decision-making as well as innovative development of organizations. Unfortunately, there is still too little research focused on exploring an issue of using BI systems in organizations. A theory and a practice clearly confirm that organizations insufficiently utilize the potential of the opportunities offered by BI systems. The reasons for this are extremely complex and not sufficiently analyzed.  That is why there is an absolute need to intensify research on the effective use of BI, mainly on its usage to provide an innovative development of organizations.

The discussion on the BI issue  in this study was presented in light of components that shaping and contributing an innovative development of organizations based on BI. A framework to provide BI-based innovative development of organizations was proposed. This framework includes four components: (a) digital strategy and support from top

management; (b) BI infrastructure and tools; (c) information and knowledge repositories; and (d) organizational culture. The research showed that organizations that were successful in BI utilization had clearly defined digital strategy and goals. The leaders of such organizations perfectly understood the mechanisms of market functioning and support their employees. The study showed a strong correlation between having a BI strategy and an organizational culture. The organizations with good leadership and open to new products, change and innovation had a real interest in competing on the basis of information and knowledge.

The developed framework has been subject to initial verification. The conclusions from the conducted research may prove to be helpful for all organizations that intend to use BI in their activities as well as in their innovative development. The conducted research confirms our conviction that we need to conduct further work on learning about the components that contributing innovative development of organizations based on BI.

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