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Assessment of Business Intelligence Maturity in the Selected Organizations

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Abstract—**The main purpose of this paper is to assess the level of Business Intelligence (BI) maturity in organizations. The research questions I ask in this study are: (1) what possibilities offer BI systems for different organizations, (2) how to measure and evaluate the BI maturity in organizations? The study was based on: (1) a critical analysis of literature, (2) a observation of different BI initiatives undertaken in various organizations, as well as on (3) semi-structured interviews conducted in polish organizations in 2012. Some interviews, conducted in 20 polish enterprises, were held with executives, senior members of staff, and ICT specialists. The reminder of my paper is organized as follows. Firstly, the idea of BI is described. Next, the issue of BI maturity models is recognized. Finally, Garter's Maturity Model for Business Intelligence and Performance Management is used to assess the level of BI in surveyed organizations.**

I. Introduction

ALTHOUGH Business Intelligence (BI) has been developing for over 20 years, many organizations are not able to make from it the effective tool for decision making or creating the competitive advantage [1], [2]. One of the reason of this fact is that they do not know a theoretical foundation how to diagnose (measure) BI using in organizations. So, the systematic and deliberate study on possibilities that offer BI for organizations and the ways of its assessment is crucial. The research questions I ask in this study are: (1) what possibilities offer BI systems for different organizations, (2) how to measure and evaluate the BI maturity in organizations? The study was based on: (1) a critical analysis of literature, (2) a observation of different BI initiatives undertaken in various organizations, as well as on (3) semi-structured interviews conducted in polish organizations in 2012. Some interviews, conducted in 20 polish enterprises, were held with over 80 responders: executives, senior members of staff, and ICT specialists They represented the service sector: telecommunications (T)-4, consulting (C)-4, banking (B)-4, insurance (I)-4, marketing agencies (MA)-4.

The reminder of my paper is organized as follows. Firstly, the idea of BI is described. Next, the issue of BI maturity models is recognized. Finally, Garter's Model for Business Intelligence and Performance Management is used to assess the level of BI maturity in surveyed organizations.

The paper provides valuable information on the possibilities that offer BI systems for organizations and the ways of their evaluation. It is dedicated for decision-makers, managers and ICT specialists interested in using BI systems in organizations. The study makes useful contribution to the literature and theorists on the idea of BI, BI using in organizations, and the ways of its assessment.

II. Background and Related Works On Business Intelligence

A. The issue of Business Intelligence

From a historical perspective, Business Intelligence (BI) is a popularized, umbrella term introduced by Howard Dresner of the Gartner Group in 1989 to describe a set of concepts and methods to improve business decision making by using fact-based support systems [3]. BI involves collecting, storing and presenting data, and managing knowledge by means of employing different analytic tools. Intelligent data analysis is usually obtained by OLAP (On-Line Analytical Processing), data mining and data warehouses techniques [4].

With the passing of time, the term BI has been understood much more broadly, namely, as a connecting factor of different components of decision support infrastructure [5], and providing comprehensive information for policy makers [6]. Hence, many definitions of BI focus on the capability of an enterprise to improve business efficiency and to achieve higher business goals. It is said that BI provides a means to obtain crucial information to improve strategic decisions and, therefore, plays an important role in current decision support systems [7]. The term Business Intelligence (BI) is often used as a broad category of technologies, applications, and processes for gathering, storing, accessing, and analyzing data to help users make better decisions [8]. More generally, BI can be understood as a process providing better insight in a company and its chain of actions.

According to many authors there are distinguished 3 ages in the development of BI: BI 1.0, BI 2.0, BI 3.0.

The first age of BI, called BI 1.0. falls on seventies and eighties of XX century. It is closely related with the management information systems (MIS), executive information systems (EIS), and decision support systems (DSS). Generally, the first applications from this age were dedicated on

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mainframes. They were able to process the simple tasks for operational and tactical management. They were characterized by production the simple reporting and represented simple, static applications. Individual reports were written by expert programmers. BI 1.0 was focused on "delivery to the consumer" and market leaders include: SAS, IBM [9].

The second age of BI (1990-2005) - BI 2.0 is the type of enterprise scale BI we see today. It means a concept and methodologies for improvement of business decisions using facts and information from supporting systems [33]. It is characterized by end-user friendlier client-based BI tools and centralized. Data warehouse configured to deliver preformatted information to specialists analysts and users within management. So, the role of BI 2.0 and its impact on organizations (compared to BI 1.0) has been changed. From simple, static analytical applications, BI 2.0 has evolved into solutions that can be used in strategic planning, predictive modeling, forecasting, monitoring operations, and studying the profitability of products [1],[10]. BI 2.0 is focused on "creation and delivery for consumers" and market leaders include: Business Objects, Cognos, Hyperion, Microsoft, Teradata, Oracle.

BI 3.0. presents a new era in the evolution of BI. Thanks to web and mobile technologies it appears intelligent business network for every one. There is a growing acceptance of the idea that analysis is a collaborative (not only singular) and social effort. It focuses on a collaborative workgroups (which are self-regulated) and on information outcomes within the confines of core business interaction with customers, employees, regulators etc. There is common sense that BI 3.0 should go beyond reliance on structured data available in internal sources but should use also external, mostly unstructured data in various formats (social media posts, free form web content, images, and video files) [11]. BI 3.0 is concentrated on "creation, delivery and management for consumers" [9]. According to Scott [12] there are 5 core attributes that support BI 3.0 philosophy: proactive, real-time, integrated with business processes, operational (available to line workers), and extended to reach beyond the boundaries of the organizations to improve information delivery and decision support functionality for all. It is indicated also that there is no reason to depreciate in BI 3.0 the functions (known from BI 2.0) like: reporting, OLAP, data mining. They have still their strong position. BI 3.0 philosophy is to raise the added value of BI tools' architecture by anchoring collaborative style of information search and analysis with intuitive and self-service user interface that delivers timely and highly relevant insights to anyone who is properly authorized and needs them [11].

According to Chatter [13] there are 3 prerequisites for software tools to be recognized as a BI 3.0 tools: be social, relevant (automatically delivers relevant insights that users really need according to their situation and user profile), and fully self-service (intuitiveness).

The analysis of different articles, papers and reports show that BI is mainly identified with:

- tools, technologies, and software products. BI is used to collect, integrate, analyze and make data available [14]. It includes: data warehouse, data mining and OLAP (On-line Analytical Processing). Data warehouse is a key technology, integrating heterogenic data from different information sources for analytical purposes [7]. Hence, it is assumed that the main tasks to be faced by BI include: intelligent exploration, integration, aggregation and a multidimensional analysis of data originating from various information resources [15];
- knowledge management. BI is the capability of the organization to explain, plan, predict, solve problems and learn in order to increase organizational knowledge [16]. BI is assumed to be solution that is responsible for transcription of data into information and knowledge [10];
- decision support systems. BI is considered as a new generation of decision supports systems. They differ from previous management information systems in, first of all, their wider thematic range, multivariate analysis, semi-structured data originating from different sources and multidimensional data presentation [17], [16], [6], [18];
- dashboards. Dashboards are the becoming the preferred method for delivering and displaying BI to users. They are more visual and intuitive, and typically provide linkages that enable immediate action to be taken [5];
- new working culture with information - BI constitutes an important upturn in techniques of working with information [4]. It means specific philosophy and methodology that would refer to working with information and knowledge, open communication and knowledge sharing [10]. The BI users must know more than just technology - business and soft skills are needed too;
- process. The process constitutes of activities to gather, select, aggregate, analyze, and distribute information [19]. Some of these activities are the responsibility of the BI staff, while others are the joint responsibility of the BI staff and the business units [8];
- analytics and advanced analyses. The term "analytics", introduced by Davenport and Harris[20], means "the extensive use of data, statistical and quantitative analysis, explanatory and predictive models, fact-based management to drive decisions and actions. Analytics are a subset of what has come to be called BI: a set of technologies and processes that use data to understand and analyze business performance";
- Competitive Business Intelligence (CI). Another subset of BI is CI. Its goal is to provide a balanced picture of the environment to the decision makers [15]. CI is the analytical process that transforms scattered information about competitors and customers into relevant, accurate

and usable strategic knowledge on market evolution, business opportunities and threats.

B. Business Intelligence in organizations

According to Goodhue, Wixom and Watson [8] there are three targets that organizations can aim for when implementing BI:

- single or a few applications. They are used in selected departments (marketing, sale, controlling etc.) to support effective marketing campaigns, to analyze profitability different products and to monitor the behaviors of customers;
- BI infrastructure. "The organizations create an infrastructure for BI by clearing up and defining their data, establishing efficient process to move data from source systems to a highly extensible data warehouse, implementing a variety of BI tools and applications, and investing in BI user training";
- organizational transformation. BI systems are used in order to introduce new business model oriented on change management, knowledge management and customer relationship management. BI aims to run company differently. In this case, some investments in huge corporate data warehouse are needed.

Many case studies confirm that BI may be utilized in an organization for [11], [21], [22];

- increasing the effectiveness of strategic, tactic and operational planning including first of all: (a) modelling different variants in the development of an organization; (b) informing about the realization of enterprise's strategy, mission, goals and tasks; (c) providing information on trends, results of introduced changes and realization of plans; (d) identifying problems and 'bottlenecks' to be tackled; (e) providing analyses of "the best" and "the worst" products, employees, regions; (f) providing analyses of deviations from the realization of plans for particular organizational units or individuals; (g) and providing information on the enterprise's environment;
- creating or improving relations with customers, mainly: (a) providing sales representatives with adequate knowledge about customers so that they could promptly meet their customers' needs; (b) following the level of customers' satisfaction together with efficiency of business practices; (c) and identifying market trends;
- analysing and improving business processes and operational efficiency of an organization particularly by means of: (a) providing knowledge and experience emerged while developing and launching new products onto the market; (b) providing knowledge on particular business processes; (c) exchanging of knowledge among research teams and corporate departments.

The most spectacular results, from using BI, have been observed while running promotional campaigns, anticipating sales and customer behaviors, creating loyalty policies and investigating anomalies and frauds [23]. The studies show that BI may also generates a wide variety of organizational benefits [8]. Some BI benefits are tangible and easy to measure (e.g., the reduction of software and hardware licenses and fees). Other benefits, such as improved quality and timeliness of information or improvement of business process and the enabling of new ways of doing business, are much more difficult to quantify, but they may generate a competitive advantage or open up new markets for the company. According to Howson [24], who examined 513 organizations, to the most significant measures of success of BI projects belong: improved business performance, better access to data, support of key stakeholders, user perception that it is mission critical, return on investment, percentage of active users, costs savings, defined users.

C. Business Intelligence maturity models

The effective development of BI in the organization should be based on scientific theories. It seems that theory of maturity models gives the good foundation [25]. The term of maturity describes a "state of being complete, perfect or ready. To reach this a desired state of maturity, an evolutionary transformation path from an initial to a target stage needs to be progressed" [26]. Maturity models are used to guide this transformation process. They help define and categorize the state of an organizational capability [27]. Maturity model for BI helps organization to answer for these questions: where in the organization is most of the reporting and business analysis done today?, who is using business reports, analysis and success indicators?, what drives BI in the organization?, which strategies for developing BI are in use today?, and what business value does BI bring? [28].

A high number of maturity models for BI has been proposed [26], [29], [27], [30].

One of the most popular is Gartner's Maturity Model for Business Intelligence and Performance Management. It describes a roadmap for organizations to find out where they are in their usage of BI. It provides a path for progress by which they can benefit from BI initiatives. The model recognizes five levels of maturity: unaware, tactical, focused, strategic, and pervasive. The assessment includes three key areas: people, processes, metrics and technology [28], [29], [30]. The first level is often described as "information anarchy". It means that data are incomplete, incorrect, inconsistent and organization does not have defined metrics. The uses of reporting tools are limited. The second level of BI maturity means that the organization starts to invest into BI. Metrics are usually used on the department level only. Most of the data, tools, and applications are in "silos". Users are often not skilled enough in order to take advantage of the BI system. At the third BI maturity level the organization achieves its first success and obtains some business benefits from BI, but it still applies to a limited part of the organization. Management dashboards are often requested at this level. At the strategic level, organizations have a clear business strategy for BI development. The application of BI is

TABLE I.
OVERVIEW OF BI MATURITY MODELS

Name of the model	Description
TDWI's Business Intelligence Model –Eckerson's Model Eckerson [30]	This model focuses mainly on the technical aspect for maturity assessment. It constitutes of 6 maturity levels and uses a metaphor of human evolution: prenatal, infant, child, teenager, adult and sage
Gartner's Maturity Model for BI and PM [31]	The model is a mean to assess the maturity of an organization's efforts in BI and PM and how mature these need to become to reach the business goals. The model recognizes 5 maturity levels: unaware, tactical, focused, strategic, pervasive
AMR Research's Business Intelligence/ Performance Management [29]	The model is described by 4 maturity levels: reacting (where have we been?), anticipating (where are we now?), collaborating (where are we going?), and orchestrating (are we all on the same page?). It is used to assess the organization in the area BI and PM
Business Information Maturity Model [28]	The model is characterized by 3 maturity levels. The first level answers the question „ what business users want to access", the second "why the information is needed", the third "how information put into business use"
Model of Analytical Competition [1]	The model describes the path that an organization can follow from having virtually no analytical capabilities to being a serious analytical competitor. It includes 5 stages of analytical competition: analytically impaired, localized analytics, analytical aspirations, analytical companies, and analytical competitors
Information Evolution Model, SAS [32]	The model supports organization in assessing how they use information to drive business, e.g., to outline how information is managed and utilizes as a corporate asset. It is characterized by 5 maturity levels: operate, consolidate, integrate, optimize, innovate
Model Business Intelligence Maturity Hierarchy [33]	The model was developed in knowledge management and constitutes of 4 maturity levels: data, information, knowledge and wisdom
Infrastructure Optimization Maturity Model [28]	The model enables a move from reactive to proactive service management. It aids in assessing different areas comprising the company infrastructure. The model is described by 4 maturity levels: basic, standardized, rationalized (advanced), and dynamic
Lauder of Business Intelligence (LOBI) [28]	The model describes levels of maturity in effectiveness and efficiency of decision making. IT, processes and people are assessed from the perspective of 6 levels: facts, data, information, knowledge, understanding, enabled intuition
Hawlett Package Business Maturity Model	The model aims at describing the path forward as companies work toward closer alignment of business an IT organizations. It includes 5 maturity levels: operation, improvement, alignment, empowerment, and transformation
Watson's Model [27]	The model is based on the stages of growth concept, a theory describing the observation that many things change over time in sequential, predictable ways. The maturity levels include: initiation, growth, and maturity
Teradata's BI and DW MM [26]	Maturity concept is process-centric, stressing the impact of BI on the business processes The model has 5 maturity levels: reporting (what happened?), analyzing (why did it happen?), predicting (what will happen?), operationalizing (what is happing?), and activating (make it happen).

often extended to customers and suppliers. It supports the tactical and strategic decision making. Sponsors come from the highest management. At the last BI maturity level, BI pays pervasive role for all areas of the business and corporate culture. BI provides flexibility for adapting to the fast business changes and information demand. The users have access to information and analysis needed for creating a business value and influence business performance. The usage of BI is available to customers, suppliers, and other business partners.

Moving from one maturity level to another requires changes in all of the characteristics that make up these stages (e.g., changes in management vision, founding, data management) [8].

III. RESEARCH METHODOLOGY

The aim of the survey was to assess the BI using in 20 purposefully selected organizations, and to determine the factors that allow the firms to achieve high competences in BI, and consequently various business benefits [2]. The research was of qualitative nature and used as a research tech-

TABLE II.
TYPES OF ASKED QUESTIONS AND ANSWERS

No	Asked questions during interviews	Answers (number of organizations)
1	How do you define BI?	Tools to manage information (9), data warehouse (5), analytical applications (4), new way of doing business (2)
2	What do you use BI for (reporting, ad-hoc reporting, analyzing, alerting, predictive modeling, operationalizing, optimization, activating, etc.) ?	Reporting (15), ad-hoc reporting (9), analyzing (12), alerting (2), predictive modeling (2), optimization (3), activating (2)
3	Does your organization have a defined BI strategy?	Comprehensive BI strategy (5), partly defined BI strategy (12), none (3)
4	Does your organization have defined business processes?	Defined basic processes (9), defined core business processes (6), not defined (5)
5	Does your organization/department have defined metrics?	Metrics for selected departments (13), metrics for the whole organization (4), none metrics (3)
6	Assess the quality of data used in your organization (complete, correct, consistent; high/medium/poor quality data, etc.)	High quality data (6), medium quality data (11), rather poor quality data (3)
7	Are you skilled enough in order to take advantage of BI systems?	Skilled enough (7), not skilled enough (8), poor skilled (5)
8	Do you use management dashboards?	Used management dashboards in limited scope (14), used management dashboards in whole organization (4), not used (2)
9	Is your BI (un)limited to the part/department of organization?	BI limited to the part of organization (15), unlimited (5)
10	Are you motivated to use BI (how)?	Users motivated by training (8), motivated by bonuses (6), not motivated (6)
11	Do you use BI for analyzing customers, suppliers, competitors and other business partners?	BI for analyzing customers (17), suppliers (14), competitors (5), other stakeholders (4)
12	Who is the sponsorship of BI in your organization?	CIO (3), senior management (6), business analyst (4), ICT specialists (7)
13	What kind of BI software do you use?	Regional data warehouse (9), centralized data warehouse (5), operational data bases (6)
14	Describe some successes/failures from using BI	Success: acquiring new customers (14), acquiring new suppliers (11), increase of sale (8), fraud detection (6), launching new channels of sale (3), launching new products (3). Failures: not trust in BI (4), gap between BI/ business (12), users do not recognize their own data after it is processed (7), decision-making skills absent (6), BI is expensive (5)
15	Indicate some benefits from using BI	Better access to data (13), better decisions (12), improvement of business process (9), improved business performance (8), costs saving (7), transparency of information (5), new way of doing business (2)

nique of an in-depth interview. Types of core interviews questions relevant to this paper are reflected in table 1.

The survey was conducted in 2012 among purposefully selected firms (in Poland) that are considered to be advanced in BI. They represented the service sector: telecommunications (T)-4, consulting (C)-4, banking (B)-4, insurance (I)-4, marketing agencies (MA)-4. Interviews were held with executives, senior members of staff and ICT specialists. Interviewees were selected on their involvement in BI or on their ability to offer an insight based on experience in BI and related decision support systems. Gartner's Maturity Model for Business Intelligence and Performance Management (described in the previous section), for the assessment of the BI-maturity level in selected organizations, was used.

IV. FINDINGS

My research confirmed that BI identified in the literature was also experienced in selected organizations. Table 2 presents the answers for asked questions. The BI maturity in surveyed organizations (mapping onto Gartner's Maturity Model for Business Intelligence and Performance Management) and factors that allow them to achieve the various business benefits with BI, are indicated in table 3.

V. DISCUSSION

The collected and processed data were mapped onto Gartner's Maturity Model for Business Intelligence and Performance Management. The obtained results allow to state that among 20 surveyed organizations two organizations fall into the category of "pervasive" level. These were telecommunication company and marketing agency. Their analytical and BI competences are aimed at business benefits, like: acquiring new customers, launching new products and new channels of sale.

BI competences are treated by these organizations as their core competences that help them to compete on the market. Organizations achieve significant economic benefits and use BI for marketing analyses (sales profitability, profit margins, meeting sales targets, time of orders), customer analyses (time of maintaining contacts with customers, customer

TABLE III.
OVERVIEW OF BI- MATURITY LEVELS IN SURVEYED ORGANIZATIONS

Level	People	Process	Metrics and technology	Scope of benefits
Unaware	Users do not know their own data requirements or how to use them	Users do not know business processes; data are poor quality	Lack of appropriate hardware and software; the metrics are not defined; the use of reporting is limited	Almost none
Tactical 2I, 2C, 1MA	The users take the first BI initiatives; low support from senior executives	Identification of basic business processes	Regional data warehouses are built; analyzing trends and past data; first interactive reporting tools; metrics are usually used on the department level only	Low benefits limited to small group of users; better access to data and static reporting
Success factors: support from senior management, appropriate BI tools, quality of data, defined business processes and metrics				
Focused 2T, 1MA, 2C, 2I, 2B	Users try to optimize the efficiency of individual departments by BI	Standardization of business processes and building best practices in BI	Management dashboards are used; a centralized data warehouse is built; ad-hoc reporting, query drilldown	Benefits limited to departments and business units; improvement of internal business processes and decision making on operational level
Success factors: developing corporate culture based on facts, stating clearly BI strategy, implementing training system on BI				
Strategic 1MA, 1T, 2B	Users have high BI capabilities, but often not aligned with right role	Business process management based on facts	High-quality data; have BI strategy; using more complex prediction and modeling tools; data mining	Benefits for the whole organization; integrated analysis for finance, logistics, production; improvement of decision making on all levels of management
Success factors: support from CEO, motivation of users for collecting, analyzing and using information				
Pervasive 1T, 1MA	Users have capabilities and time to use BI; skill training in BI; users are encouraged to collect, process analyze and share information; CEO passion and broad-based management commitment	Broadly supported, process-oriented culture based on facts, learning and sharing of knowledge	Enterprise-wide BI architecture largely implemented; customized reports; business and BI are aligned and cooperative	Benefits for the whole environment; competing in BI; new ways of doing business
Success factors: strong support of CEO, effective HRM and all user's trust in BI				

profitability, modeling customers' behavior and reactions, customer satisfaction), monitoring of competitors and current trends in the marketplace. The common analytical approach is used by the whole organization where broadly supported fact-based and learning culture is cultivated. The interviewees confirmed that the factors that help those organizations to stay at that high maturity level in BI, include strong support of CEO and all user's trust in BI.

An interesting group was made up of organizations classified at the fourth BI maturity level. Four organizations (1MA, 1T, 2B) in my study fit into the strategic level. They do not compete through BI, but they have high competences in using different BI analyses, like: financial analyses (reviewing of costs and revenues, calculation and comparative analyses of corporate income statements, analyses of corporate balance sheet and profitability), customer profitability, customer segmentation, improving marketing effectiveness. It seems that there is a very little to be done in order to use BI for making significant changes in running a business. Therefore, shifting these organizations from "strategic" to "pervasive" level requires more support from CEO and his/her real passion. The interviewees indicated the greater need for motivation of users for collecting, analyzing and using information.

The survey has shown that up to 9 organizations (2T, 1MA, 2C, 2I, 2B) use BI on the department level. Although they would be much more common in a random sample, and perhaps the largest group. BI in these organizations has not been playing a strategic role and benefits from it are limited. BI is used to perform ad hoc reporting and to answer questions related to departments' ongoing operations, up-to-date financial standing, sales and co-operation with suppliers and customers. BI and management are often not aligned. The observation and interviews with senior executives allow to state that the lack of appropriate knowledge about possibilities of BI among staff results in a relatively low use of it. Therefore, the main tasks for organizations include first of all: developing corporate culture based on facts and learning,

stating clearly BI strategy and implementing training system on BI.

I found in my study that 5 organizations (2I, 2C, 1MA) are at the position of "tactical" maturity level. They use a traditional approach to management, focused more on the performing the basic tasks of departments than on business processes. The knowledge about BI in these organizations is rather low and identified mainly with regional data warehouses or databases. Only basic business processes are recognized and basic metrics are used. The interviewees indicated that many users have some problems with recognizing their own data after processing. The users have rather low experience with other types of management information systems. Their intellectual resources are not adequate in order to develop complex BI infrastructure and to use it for improvement of business processes and decision-making.

To conclude the discussion on the use of BI in surveyed organizations, I wonder why organizations in a similar segment, with similar financial resources and comparable BI infrastructure, derive from BI such diverse benefits (e.g. in the studied case, telecommunications companies and advertising agencies). Seeking the answer to this question it should be noted that the organizations, that have been classified into the category of BI "pervasive" level, were highly determined to collect, process, analyze, and share information. Corporate culture based on facts and learning helped them to use chances offered by BI. The most important factors that decided on the success of BI initiatives refer not to the technology, but to the strong believe of all users in BI.

VI. Conclusions

The main conclusion of this study is that BI systems may be a trigger for making more effective decisions, improving business processes and business performance, as well as doing new business. Observation and conducted discussions with interviews let to state, that the factors that allow organizations to achieve business benefits with BI, include first of all: management leadership and support, corporate culture, expressed by effective information resources management, clearly stated strategy and objectives, and use of appropriate BI technologies. Additionally, the important factors were: clearly defined business processes, business performance measurement, incentive system to encourage collecting, analyzing information and knowledge sharing, appropriate resources (financial, intellectual), training and education on BI and knowledge management.

The research has made a theoretical contribution to our understanding of BI issue. The outcomes extend current theory on BI and provide useful information, which hopefully will help the organizations to understand the consequences of the different ways of BI using, as well as, to determine the factors on which they should give particular attention while building different BI applications.

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