The applicability of Business Intelligence systems in the support of managerial decisions in the international enterprises.

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Abstract— The aim of the paper is to presents research results concerning application and identification of the role of Business Intelligence (BI) systems in the support of managerial decision processes at strategic, tactical and operational level of management in the international enterprises. It was presented the notion and characteristic of BI systems and benefits resulting from its application in the support of decision processes in the management of enterprises. The empirical research is followed by review of foreign research and case studies in selected subjects.

Keywords— Business Intelligence systems, business analytics, big data, data warehousing, data mining, decision support systems, managerial dashboards, corporate portals.

I. INTRODUCTION

NOWADAYS many international enterprises have implemented Business Intelligence systems of different vendors in order to achieve multiple advantages such as improvement of decision making processes at strategic, tactical and operational level of management, gaining competitive advantage on the local and international markets, improvement of communication efficiency and efficacy among different branches of particular enterprise and so on. The most important feature of BI systems in the support of decision making process is acceleration of this process at all levels of management. Faster making of decisions means e.g. the possibility of lowering the cost of enterprise's functionality.
T. Davenport underlines significance of information which is indispensable in the decision making and claims that the aim of BI and other decision support systems is "that better information would lead to better decisions and better ways of managing organizational processes" [1] and he further mentions that "if the goal of better information and better analysis is ultimately better decisions and actions taken based on them, organizations must have a strong focus on decisions and their linkage to information" [1]. R. Skyrius et. al. underline relationship between Management Decision Support

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and Business Intelligence and state that "management decision making is an information-intensive activity, where the structuredness of the problem to be solved directly translates to the complexity of the information tasks to produce a well supported decision"[2].

II. THE NOTION OF BI SYSTEMS AND BENEFITS OF ITS APPLICATION IN THE MANAGEMENT OF ENTERPRISE

There can be found many definitions of Business Intelligence in the literature of subject. Most often it is perceived as provision of the right information to the right people at the right time. The author of the term Business Intelligence is Howard Dresner from Gartner Group who introduced it in 1989. E. Turban perceives BI as "a broad category of applications and techniques for gathering, storing, analyzing and providing access to data to help enterprise user make better business and strategic decisions"[3]. S. Rouhani et. al claim that "Business Intelligence is a managerial concept which refers to a set of programs and technologies that provide capabilities of gathering, analyzing and accessing data of organization's processes. The ultimate goal of business intelligence systems' application in any organization is to help making optimal decisions as soon as possible and at all organization's levels" [4]. V. Voicu, D. Zirra and D. Ciocirlan note that "Business Intelligence technologies are most appropriate to transform data into information needed in decision-making" and "a set of methods, concepts and algorithms intended to help in achieving the aim of gathering the data from all over the organization in order to turn those data into new and relevant business information and eventually into knowledge" [5]. As far as evolutionary path of BI is concerned it is worth mentioning such stages mentioned by Z. Panian as applying "historical data mining methods and tools for strategic managerial reporting purposes, usage of On-Line Analytic Processing (OLAP) technologies and dimensional analysis of data stored in data warehouses and data marts, application of Balanced Scorecard methodology, usage of web analytics and web mining and of Business Dashboard as well as mobile and location-based Business Intelligence and finally the possibility of unstructured content utilization with the help of big data [6]. D. Airinei and D. Homocianu underline important role of visualization in BI systems and claim that

"using illustration and graphic design tools, data can be visualized using static graphical content, animated movies and 3D models, interactive visualization tools and presentations can be commissioned for web hosting or event displays" [7]. L. Kuo and H. Yang focus on the fact that "Business Intelligence (BI) represents the ability to look into the core of a business, in order to fundament the most effective and profitable decisions" [8].

The fundamental advantages related to the application of Business Intelligence systems in the management of enterprises may concern: "getting in one place reliable and coherent data and information from all areas of organization's activity which is connected with aspects of systems integration, facilitated access to data coming from different dispersed sources, shortening the time of different analyses, decision making and increasing efficiency and efficacy of management, efficient planning, simulations and prognoses in different angles, instant reaction to appearing market trends, detection of threats and chances in the area of leading activity, current analysis of financial situation and tracking budget deviations, financial optimization of undertaken activities, lowering the number of persons involved in decision making processes, influence on income growth, reduction of costs and improvement of customer's satisfaction" [9]. Business Intelligence systems allow for efficient data transformation into valuable information and as its consequence enable acquisition of knowledge indispensable for making efficient decision [9]. Business Intelligence systems can also be useful in creation, modification and improvement of enterprises' strategy as well as in the management of key business processes and its optimization with the usage of e.g. real time BI systems, semantic BI, hybrid systems and big data solutions. BI systems play a crucial role in the support of Business Strategy. Z Panian cites C. White's survey where successful BI initiatives are "those that support critical business processes, are seen by users as mission critical, and are meeting major users' needs" [10].

Business Intelligence may be perceived as a competitor differentiator. Such systems as it was mentioned can contribute to achievement of competitive advantage of a company which has implemented it. M. Muntean and G. Mircea state that "Business Intelligence is the process for increasing the competitive advantage of a company by intelligent use of available data in decision-making and that Business Intelligence (BI) represents the tools and systems that play a key role in the strategic planning process of the corporation" [11]. BI can be also defined as „the art of gaining business advantage from data and described as a value proposition that help organizations in its decision-making processes" [12]. BI drives business performance by means of business analysis, enterprises reporting and performance management where „certain aspects of business operations (at operational level) and business strategies (at strategic level) are measured and assesed by Key Performance Indicators (KPIs) [13].

E. Turban, R. Sharda, J. Aronson and D. King put emphasis on e.g. strategic imperative of BI and claim that BI have significant value to organizations and "in addition to ROI and other tangible benefits there is increasing evidence that BI are becoming a strategic imperative" [14, p.22-23]. The authors underline importance of competitor analysis which constitutes a base for strategic planning. Such solutions can help to sustain competitive advantage in different industries as well. It is worth mentioning the success factors of BI system implementation. E. Turban et al. mention that "the success of BI depends, in part, on which personnel in the organization would be the most likely to make use of it and it must be of benefit to the enterprise as a whole" [14, p.24] C. Olszak and E. Ziemba draw conclusions on the basis of research on the sample of small and medium sized enterprises that ""quick decision-making in enterprise gives a chance to overtake the competition, and it is possible when the managers have free access to business information, and it is the result of analysis of massive amounts of data; such analyses are well performed by BI systems". The other conclusions drew by the authors is that "small and medium enterprises need BI as well as large enterprises and in order to maintain a competitive advantage it became a must to implement BI system in the enterprises. To keep offer of a company competitive they must among others take decisions quickly [15, p.141]. N. Yogev, A. Even, L. Fink state that Business Intelligence systems create value for organizations of different industries. They claim that such systems "represent the natural evolution of decision support systems (DSS) and put a strong emphasis on data-driven decision making, based on the integration of multiple data resources that reflect different aspects of organizational activity" [16]. The authors further state that "BI is unique in its potential to generate both strategic and operational value through the seamless integration of organizational data to support decisions at different levels" [16].

As far as architecture and its role in the decision support is concerned it is worth outlining the exemplary architecture of such solution. In presented scheme (Fig. 1) the data from all the transactional systems operated in a company and in case of international enterprises from its branches as well undergo the process of ETL - extraction, transformation and load, then data is directed into corporate data warehouse and as a final part on the basis of stored data different analyses with the help of data mining methods and techniques are performed, reports concerning business activity are created, visualization tools, managerial dashboards improve communications within the enterprise. The whole environment is being used to make decision at strategic, tactical and operational level of management. At every stage BI systems support the process of making decision which may be presented as identification of decision problem, finding alternative solutions and finally making a choice.
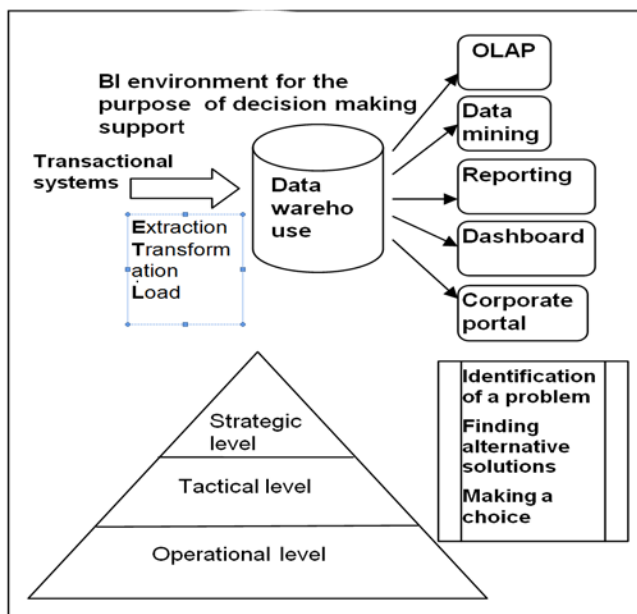
Fig. 1 Exemplary BI environment for the purpose of decision making support
Source: Author's own study

The decision making process in international enterprises embraces the headquarter of enterprises and its branches located in different countries and undergoing different law regulations. In the international companies BI systems should take into consideration different organizational structures and the types of decisions resulting from it. The crucial is the fact that the organizational structure is the main factor of strategy creation [17].

The Business Intelligence sector report by Redwood Capital company states that "over the last few years Business Intelligence has become the top ranked IT priority among enterprise business leaders" [15]. The reports announce that "the global business intelligence market is projected to reach $20.81 billion in 2018, up from $13.98 billion in 2013, representing a Compound Annual Growth Rate (CAGR) of 8.28%2. Among all regions, North America is the largest, capturing 49% of the global BI market. It presents the fact that the BI market is segmented into traditional, mobile, cloud and social Business Intelligence, based on product architecture and user interface" [18].

III. REVIEW OF FOREIGN RESEARCH AND CASE STUDIES

On the basis of selected foreign case studies involving the application of BI it is worth mentioning the solution presented by Enterprise Iron company and concerning the application of BI for large international chemical company. The vendor claims that "for a large chemical company based internationally, a solution for data warehousing and business intelligence was needed to standardize across the enterprise. It was decided that they needed an enterprise solution for these capabilities to provide the competitive advantage gaining benefits of effective business intelligence. (...) EI's Business

Intelligence Solutions practice helped the client write an RFP and evaluate potential vendors, ultimately selecting SAP Business Warehouse as the COTS solution. EI's Data Warehousing practices helped establish the plans for migrating data to SAP BW, and were involved in the specification of solutions to cleanse the data and improve customer data quality. EI's Program Management practice provided steering and program oversight to the project through its implementation. (...) As a result of engaging EI, the client consolidated its disparate business intelligence offerings into a standardized industry leading platform, and was able to provide business intelligence on a level not previously possible, exposing insights that promised to enable greater competitive advantage in their market place, while enabling them to diagnose and understand their own operations and customer relationship management for opportunities to improve and modernize sales and operations"[19].

G. Miller et al. presented the results of the survey conducted by BetterManagement subscribers who completed a survey concerning application of BI in their organization. The authors of state that "the online survey was completed by 220 companies across various industries, sizes, geographic locations, and job levels and 84% companies have implemented BI system" [20]. They further claim that "among those companies that conduct a formal BI needs analysis, three quarters (73%) perform an ongoing review of BI needs to ensure that new opportunities or requirements are identified and added to BI processes. (...) The primary components of a BI needs analysis are reports (73%) and strategic analytics (68%). Somewhat less frequently used in the analysis are compliance/corporate governance issues (46%) and early warning systems (44%). Fewer than one in three companies (29%) incorporate legal/ regulatory reporting. The survey also showed that "BI usage still seems to be restricted to management level in most companies" [20].

The other research conducted by W. Eckerson and entitled Business-Driven BI "examines best practices for implementing self-service BI and the technologies and tools that let users create their own reports and dashboards and conduct their own analyses. The survey was taken by 249 people. Survey results are based on 234 respondents who indicated their positions as "BI or IT professional," "BI sponsor or user" or "BI consultant." Responses from those who selected "BI vendor" or "Other" were excluded from the results [21]. (...) The industry with the highest percentage of respondents was manufacturing with 13%. Next were consulting with 11%, retail with 9% and banking, health care and software, all at 8%. Self-Service BI allows users to create own reports and dashboards so they get the information they want, when they want it and how they want it displayed. Self-service BI removes IT professionals as intermediaries between business users and the data. This gives business users direct access to the raw material" [21]. (...) "There are two types of self-service BI, one for report users and another for report authors. The number one challenge cited by almost three-

quarters, or 73%, of BI professionals is counterintuitive: Self-service BI "requires more training than expected. Survey respondents also said self-service BI "creates report chaos" (61%), "makes it harder to find the right report" (36%) and the "tools confuse users" (42%). The research showed that there is a correlation between success with self-service BI and BI adoption rates" [14]. The author drew the conclusion that "self-service BI can empower users and increase BI adoption, but it is difficult to implement properly because there are many types of users with different information requirements. There is no single tool or approach to self-service BI that works in all situations" [21].

Another example of BI application in the organizations is an example of healthcare industry. P. Dindigal presents BI application in saving people's lives and claims that "time is perhaps the most important factor when people are stricken with heart attacks" [22]. He says that "thanks to computer systems that enable clinicians to analyze treatment procedures for suspected coronary victims, Florida's BayCare Hospital has reduced the time it takes to diagnose and process a heart patient by 20 minutes [22]". He further states that "reducing medication errors is another priority for healthcare providers. In Cincinnati, the Children's Hospital Medical Center cut medication errors in half by analyzing orders and feeding the results back to a medication-administration system [22]". "In Tulsa, OK, the St. John Medical Center recently reduced the number of transfusions leading to negative reactions by 18 percent. That saves $1.4 million annually, and eliminates the opportunity for numerous errors" [22]. The author indicates benefits of BI systems in healthcare such as "faster data gathering and meaningful analytical report production helps in decision support and operational management, while seamless integration and pre-data integration efforts cleanse data and remove duplicate data from various sources. They also provide high-quality data for enterprise decision making. Further, performance and quality improve by segregating main subject areas into key performance indicators (KPIs)" [22]. It should be remembered that „Information Systems of hospital must possess appropriate degree of technological advancement which allows for gathering and delivery of useful data which may be used by BI systems" [23].

IV. EMPIRICAL RESEARCH

In order to prove that Business Intelligence systems have a significant influence on acceleration of decision making process at strategic, tactical and operational level of management there was conducted a survey research on the sample of 34 international enterprises which embraced different industries such as e.g. energetics, electronics, building and construction, retail sale, banking, clothing, IT, logistics, metallurgy, chemical etc. The research was conducted for the purpose of PhD thesis realization of the author. Most of surveyed enterprises belonged to the group of large enterprises. The results showed that thanks to the implementation of Business Intelligence system in a particular

international enterprise the decision making process at all level of management was accelerated. The average values for 3 levels of management is presented in figure 2.
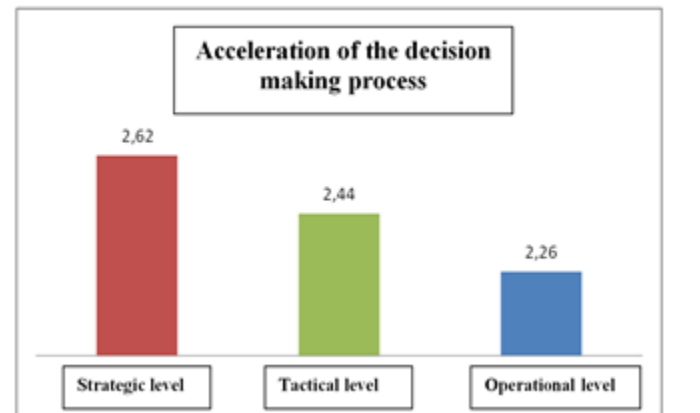

Fig. 2 The average level of decision making support by BI systems with the division into three levels of management
Source: Author's own study

As far as the methodology is concerned the respondents had to select in the research questionnaire whether the decision making process in a given enterprise was greatly, moderately not significantly, was not at all accelerated or it was slowed down after implementation of BI system. Besides mentioned acceleration of decision making processes BI systems bring such advantages in surveyed enterprises as an increase of decisions' efficacy at all levels of management and it can be also stated on the basis of the research that BI systems have significant impact on such areas of decision making as consumer relationship management, marketing, sales, distribution, human resources management, controlling and logistics. The other selected advantages were improvement of communication among employees, increase of information which was indispensable for making a decision and improvement of reporting and different analyses realization. According to the research at the strategic level of management Business Intelligence systems have an impact on acceleration of managerial information reception; acceleration of information-decision analysis performance in the scope of competitors analysis; acceleration of an access to information by application of managerial dashboard and visualization tools; improvement of communication between employees of particular company thanks to the usage of corporate portal. Implementation of BI system caused an increase of the amount of information needed for decision making at all three levels of management. Utilization of information from BI system allowed for making decisions in the conditions of lower risk. The latency reduction occurred after implementation of BI increased the value of business decision. BI allowed for monitoring of KPIs and allowed for conduct of planning and modelling of different scenarios of company's development. What is more, implementation of BI system increased revenue of a particular company and had an effect on reduction of

business activity costs. The quality of decisions increased as well as the market share (competitive advantage) of a given enterprise. At the tactical level of management similarly to strategic level the implementation of BI had an influence on acceleration of managerial information reception and the quality and speed of customer service were increased. Its implementation allowed for collecting more detailed data for the purpose of vendor and customer analysis and the customer churn analysis and life time value analysis could be performed. The application of OLAP tools and data mining allowed for faster creation of forecasts and for presentation of sales trends. At operational level of management the benefits resulting from implementation of BI were similar to tactical and strategic level and additionally BI had an effect on reduction of operational costs of enterprise. After implementation of BI users receive more detailed and clear data comparing to usage of only transactional systems. BI systems allowed for monitoring of current business activity and disturbances detection. BI allowed for performance of comparative and ad hoc analyses. At all levels of management information was useful for undertaken decisions.

V. CONCLUSIONS

As a conclusion it is worth mentioning that Business Intelligence systems have many advantages for the companies which implemented it, from the acceleration of decision making process at all levels of management to the facilitation of different types of analyses. Such solutions help to conduct campaign analyses, loyalty, sales, profitability analyses as well as customer profiling. As it was also mentioned BI system are a key feature for achievement of competitive advantage. All the modern technologies applied in contemporary enterprises such as BI systems, business analytics tools, data mining methods and techniques, cloud computing and big data solutions contribute to better communication within a particular enterprise, optimization and improvement of management processes.

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