
Organization Effectiveness and Business Intelligence Systems. Literature Review

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Abstract

Purpose: To better understand the impact of Business Intelligence systems on organizations' effectiveness.

Methodology: Critical and descriptive literature review.

Findings: On the basis of numerous case studies described in literature and pertaining to various types of enterprises, different industries and countries, the paper confirms the positive impact of the implementation of Business Intelligence systems on organizations' effectiveness.

Research implications: The paper provides insights that can fuel future in-depth research aimed at the development of objective methods for measuring the impact of the implementation of Business Intelligence systems on organizational effectiveness, as well as further quantitative research.

Practical implications: Results of the majority of studies indicate that the implementation of Business Intelligence systems brings tangible benefits to organizations. The implementation should, however, be appropriate and adequate, adjusted to each organization's resources.

Originality: The paper organizes and systematizes knowledge about the impact of BI implementation on organisation's efficiency.

Keywords: Business Intelligence, organization's effectiveness, impact of Business Intelligence systems, literature review

JEL: M000, M100, M150

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Introduction

Information technology is today one of the most dynamically developing sectors of the economy. Information systems are employed in nearly every area of organizations' operation, which, in turn, results in the need to collect and analyse substantial amounts of data. Unfortunately, traditional techniques of data processing and interpretation do not seem to suffice. Business Intelligence (BI) systems provide a response to this new challenge and are designed to meet information needs of an organization. The term „BI” has yet to be unambiguously and clearly defined in literature², but for the purposes of this paper, a BI system shall be understood as an IT system designed to enhance the quality of business intelligence and streamline the decision making process within an organization, which in turn results in the latter's increased efficiency. The effectiveness of an organization is also a broad concept that may be examined and defined with reference to at least four aspects: economic, teleological, systemic and all-embracing. For the purposes of the paper, the author has adopted the all-embracing concept of organisation effectiveness, defined as the organization's ability to achieve its operational and financial goals with the use of specific resources, measured with broadly defined indicators (Ziębicki, 2007).

This paper is an attempt to provide a general answer to an important research problem, namely the impact of the implementation of Business Intelligence systems on the effectiveness of an organization. On the basis of literature review and through an analysis of studies conducted thus far, the author attempts to determine the extent to which available research results prove the existence of this relationship. The author also endeavours to verify the hypothesis according to which the implementation of BI increases organisation efficiency.

The available literature pertaining to BI's impact on organization effectiveness has been divided into two areas: quantitative analyses of the impact of BI implementation on selected indicators reflecting the economic situation of an organization and case-study based research into the implementation's impact on the functioning of individual organizations. Literature sources are discussed in chronological order; key conclusions are presented in tables.

² Eight interpretations of the term „BI” are suggested by Olszak (2013a), 56 definitions of Business Intelligence are presented by Rouhani, Asgari and Mirhosseini (2012).

Impact of BI implementation on selected indicators reflecting the financial situation of an organization

Two basic themes pertaining to the impact of BI implementation on selected indicators of organisations' financial situation can be distinguished in the available literature. The first is represented by studies pertaining to the rate of return from investment in BI. The second is outlined in studies relating to the evaluation of changes in the overall financial situation of an organization following the implementation of BI. The bulk of research has been carried out on large samples and with the use of statistical analysis; each sample comprised between several dozen and several hundred organizations.

In 2003, S. and W. Williams were the first to address the impact of Business Intelligence systems on the functioning of organizations. According to these authors, the main measurable effect of BI implementation is the change in value added, expressed as return on investment (ROI). They also pointed out new analytical opportunities that trigger a series of changes within the organization as a result of BI implementation (Williams and Williams, 2003).

N. Raden carried out an interesting analysis of the profitability of investment in Business Intelligence systems. He suggested measuring ROI on the basis of discounted cash flow (DCF), without discounted cash flow, net present value (NPV) and profitability threshold. He distinguished between two approaches to the implementation of BI in organizations: BI merged with the architecture already in place (BI module is added to the existing CRM/ERP system), and the application of a «tailor-made» solution, i.e. the introduction of a separate system into the organization. Raden identified different types of costs borne as a consequence of adopting each approach, striving not to overlook any important item. Implementation-related expenditure includes: implementation of a BI application, constructing the necessary infrastructure, implementation of a data model, post-implementation support, costs related to the lack of access and reliability, ensuring compatibility among all systems and failure to ensure the widespread application of BI despite the implementation of the system. The author claims that several cases of spectacular benefits had been observed in the period before 2004, for instance detecting errors in billing systems; according to Raden, even though future benefits will no longer be as impressive, they will continue to increase, as they have yet to be discovered, mainly due to the fact that it is difficult to estimate information available at a specific time (Raden, 2004).

Another well-known study pertaining to the impact of business intelligence on the functioning of enterprises is the publication of T.H. Davenport and J.G. Harris (Davenport

and Harris, 2006). On the basis of a survey conducted among 371 large and medium-sized enterprises, the authors found that a high level of analytical competence had a positive impact on organisations' financial results.

Potential risks associated with the implementation of a BI system also deserve attention. J. Surma claims that although a project itself may prove successful in financial terms, it can generate losses in other areas, for instance the involvement of key staff in the process of BI system implementation may result in their decreased efficiency in the performance of other tasks. Professional change management is essential given that the implementation of BI (as an example of intangible assets) alone is resource-intensive and ultimately decreases the goodwill (Surma, 2009).

E.G. Tuncay and O. Belgin conducted a study in which they measured the level of satisfaction with decision support systems and BI systems among 25 Turkish companies. The authors emphasized that although the level of satisfaction with ERP systems was high, only 4% of companies declared using BI systems. As a result, it was found that the awareness of the possibilities offered by BI systems among Turkish entrepreneurs was very low (Tuncay and Belgin, 2010).

Research conducted by Barua, D. Mani and R. Mukherjee from the University of Texas, carried out on the basis of financial data pertaining to 150 companies from the Fortune 1000 Companies List³ provided evidence on improved financial indicators of enterprises – in terms of profitability, innovation and operational efficiency – which may be due improvements in the quality of information provided to organizations (Barua, Mani and Mukherjee, 2011).

In 2012, B. Wieder, M. L. Ossimitz and P. Chamoni demonstrated – on the basis of data on 33 companies listed on the Australian Stock Exchange – a correlation between company management with the use of a BI system and the quality of collected data. Research findings did not confirm the hypothesis according to which the quality of decisions had an impact on the financial performance (measured as return on assets, ROA). One of their surprising conclusions was the following paradox: user satisfaction with the implementation of a BI system is negatively correlated with the quality of decisions and with enterprise effectiveness (Wieder, Ossimitz and Chamoni, 2012).

³ Fortune 1000 List – ranking of private and public companies from the US, drawn up annually (on the basis of organisations' gross revenue) by Fortune magazine.

In the same year, a study conducted by F.N. AL-Shubiri on a sample of 50 companies listed on the Amman Stock Exchange (Jordan) and pertaining to the impact of business intelligence on company profitability (as measured by ROE) showed a positive impact of BI in three out of four surveyed areas, i.e.: finances (measured by ROI), innovation and learning ability (measured by administrative costs borne by customers) and intellectual capital (measured as the difference between a company's market value and book value). The impact of BI was not confirmed only in the area of customer satisfaction (measured by the number of complaints). The study also confirmed the impact of BI on enterprise profitability measured as return on equity (ROE) (Al-Shubirii, 2012).

An interesting publication was prepared in 2012 by Iranian researchers from the University of Tehran. On the basis of data collected in a survey (questionnaire) addressed to 66 companies listed on the Tehran Stock Exchange in 2008–2010, the authors divided the surveyed companies into three groups, according to their degree of BI use: high, medium and low. Subsequently, each group was tested with two econometric models, with ROE and ROI indicators as variables explained with basic economic values included in mandatory financial reports (e.g. revenues, expenditure). The study demonstrated a strong correlation between ROE/ROI and economic values in companies with mature Business Intelligence systems. It also showed that this correlation (between ROE and basic economic parameters) is greater in enterprises with higher levels of BI use as compared to those with medium and low level of BI use (Roodposhti, Nikoomaram and Mahmoodi, 2012).

In 2013, K. Łopaciński conducted a survey on a sample of 50 companies from the advertising industry. He found that very few companies from this sector use any business intelligence; companies collect limited amounts of data about their clients and the effects of promotional activities. As a solution to this problem, Łopaciński devised a data warehouse facilitating the analysis of the effectiveness of marketing campaigns. Answers provided by the respondents suggested that they might be interested in the solution developed by the author (Łopaciński, 2013).

In 2014, A. Sieradz presented an interesting doctoral dissertation on the banking system. He confirmed the hypothesis according to which the efficiency of IT investment by universal banks representing Polish banking sector is a function of their overall efficiency. Admittedly, the author did not distinguish between different types of investments in IT and analysed them globally, and therefore his study provides no insight into the effects of applied BI systems on banks' efficiency. Nevertheless, the dissertation can serve as a starting point for further research focused specifically on the impact of BI systems on the efficiency of banks, as – given the results of research conducted

by other authors – we can assume that BI systems have a positive impact on the efficiency of organizations (Sieradz, 2014).

Table 1 presents key conclusions of the studies discussed above.

Table 1. Summary of literature review findings pertaining to the impact of Business Intelligence systems on selected economic indicators

Author	Purpose of the study	Sample size	Findings
S. and W. Williams (2003)	Impact of BI implementation on organisations		The main measurable effect of BI implementation is value added change expressed as return on investment (ROI). Authors also outlined new analytical opportunities – an equally important effect of BI implementation – that trigger a series of changes within the organization.
N. Raden (2004)	Analysis of benefits stemming from BI investment		Several cases of spectacular benefits had been observed in the period before 2004, for instance error detection in billing systems; even though future benefits will no longer be as impressive, they are likely to increase. They have yet to be discovered, mainly due to the fact that it is difficult to estimate the information available at a specific time.
T.H. Davenport and J.G. Harris (2006)	Impact of business intelligence on an organisation	371 large and medium-sized enterprises	It has been shown that a high level of analytical competence had a positive impact on financial results of organisations.
J. Surma (2009)	Threats due to BI implementation		The threat consist in the involvement of key staff in the process of BI system implementation and their decreased the efficiency in other tasks, as well as the need for professional change management during the process of implementing a BI system.
E.G. Tuncay and O. Belgin (2010)	Measurement of the level of satisfaction with decision support systems and BI systems	25 Turkish enterprises	Research on BI systems showed that only 4% of companies declared using them. As a result, it was found that the awareness of the possibilities offered by BI systems among Turkish entrepreneurs was very low.

<p>A. Barua, D. Mani and R. Mukkherjee (2011)</p>	<p>Impact of BI implementation on an organisation</p>	<p>150 companies from the Fortune 1000 Companies List</p>	<p>It was found that BI systems have a positive impact on financial indicators in the area of profitability, innovation and operational efficiency of enterprises, which may be due to the improved quality of information provided to organizations.</p>
<p>B. Wieder, M.L. Ossimitz and P. Chamoni (2012)</p>	<p>Impact of BI implementation on organisations</p>	<p>33 companies listed on the Australian Stock Exchange</p>	<p>A correlation was observed between enterprise management with the use of a BI system and the quality of the collected data. Research findings did not confirm the hypothesis according to which the quality of decisions had an impact on a company's financial performance (measured as return on assets, ROA). One of their surprising conclusions was the following paradox: user satisfaction with the implementation of a BI system is negatively correlated with the quality of decisions and with enterprise effectiveness.</p>
<p>F.N. AL-Shubiri (2012)</p>	<p>Impact of BI on the profitability of enterprises (measured by ROE)</p>	<p>50 companies listed on the Amman Stock Exchange in Jordan</p>	<p>A positive impact of BI in three out of four surveyed areas was observed, namely finances (measured by ROI), innovation and learning ability (measured by administrative costs borne by customers) and intellectual capital (measured as the difference between a company's market value and book value). The impact of BI was not confirmed only in the area of customer satisfaction (measured as the number of complaints). The study also confirmed the impact of BI on enterprise profitability measured as return on equity (ROE).</p>
<p>R.F. Roodposhti, H. Nikoomaram and M. Mahmoodi, (2012)</p>	<p>Impact of BI implementation on an organisation</p>	<p>66 companies listed on Teheran Stock Exchange in 2008-2010</p>	<p>The study demonstrated a strong correlation between ROE/ROI and economic values in companies with mature Business Intelligence systems. It also showed that this correlation (between ROE and basic economic parameters) is greater in enterprises with higher levels of BI use as compared to those with medium and low level of BI use.</p>
<p>K. Łopaciński (2013)</p>	<p>Use of business intelligence among firms from the advertising sector</p>	<p>Survey conducted on a sample of 50 firms from the Polish advertising sector</p>	<p>Very few companies from the advertising sector use any business intelligence; companies collect limited amounts of data about their clients and the effects of promotional activities.</p>
<p>A. Sieradz (2014)</p>	<p>Measurement of the effectiveness of IT investment in Polish banks</p>	<p>24 banks in 1998-2008</p>	<p>The efficiency of IT investment by universal banks representing Polish banking sector is a function of their overall efficiency. Admittedly, the author did not distinguish between different types of investments in IT and analysed them globally, and therefore his study provides no insight into the effects of applied BI systems on banks' efficiency.</p>

Source: own study.

The majority of authors have identified an improvement in economic indicators of companies representing various sectors. It should be noted, however, that implementation may prove unsuccessful if organisations fail to introduce BI systems properly; it is of utmost importance to ensure adequate and professional change management throughout the process. The organisation's executives must be aware of the fact that the implementation of a Business Intelligence system is only the beginning of a complex process of change.

It should also be noted that there are areas in which the use of BI remains limited. In the study conducted among Polish companies from the advertising sector, it was impossible to verify the effect of BI on economic indicators due to the very low level of BI maturity of these entities; a similar situation was observed in the survey carried out among 25 Turkish companies. However, in the first case, the researcher reports considerable interest in BI systems as a solution to be employed in the future.

Case-study based research on the impact of BI implementation on the functioning of organizations

The list of major case studies undertaken in the area in question include research carried out with respect to a large Finnish telecommunications company (research by A. Lönnqvist, V. Pirttimäki and A. Karjaluoto) and to a Slovenian manufacturing company Melamin (B. Hocevar and J. Jaklic). Both studies demonstrate that the majority of benefits and advantages brought by BI are very difficult to measure. Researchers point out that the process of implementing a Business Intelligence system triggers a series of changes within the organization. Management is provided with information and knowledge which – due to their very nature – are not easily measurable, yet bring long-term effects. In view of the above, it is difficult to specify whether the advantages observed are due to the implementation of a Business Intelligence system or to other factors. At present, according to the authors, no universal methodology is in place allowing us to evaluate investment in BI, and it is therefore necessary to assess the impact of BI implementation individually, taking into account the characteristics of each enterprise and reasons behind its decision to implement BI (Hocevar and Jaklic, 2010; Pirttimäki; Lönnqvist and Karjaluoto, 2006).

L. Ziora refers to three case studies pertaining to the implementation of BI in the financial sector and the energy sector. The first was conducted in the second largest financial institution in Germany – ComertzBank, where IBM technology, along with Cognos 8 software, was put in place. Cognos 8 platform has generated a 60% reduction

of reporting costs and time devoted to this task. Data quality has improved, an early warning mechanism has been implemented and transparent managerial dashboards have been created, allowing managers to control all aspects of business within the organization (Ziora, 2012). The second study was conducted with respect to one of the largest companies in the European financial sector, which had implemented Oracle Business Intelligence Enterprise Edition. Until the implementation of the BI system, each department would execute its own reporting tasks using Excel spread sheets. At present, the main and only central source of data is the data warehouse that integrates the contract system and the accounting system; this solution has accelerated the decision-making process; greatest changes in this respect have been observed in the risk management department. Although the scope of data collection has not changed, the BI system has positively contributed to the efficiency of data quality control processes. In addition, the BI system has also enabled customer profiling, helping the company to prepare and deliver appropriate promotional offers to individual clients in a timely manner. The third case study was conducted with respect to Epicor, an energy company. Its central source of data is a data warehouse, which is supplied from transactional systems and external sources. Among the observed advantages, the author mentioned the acceleration of the decision making process (by over a dozen per cent), greater efficiency and accuracy of decisions, improved communication and access to information. BI implementation has also resulted in revenue increase and cost reduction. Upon BI implementation, employees gained access to more accurate data. The majority of users declare being satisfied with the BI system (Ziora, 2011).

Business Intelligence can also be used for the purposes of data set segmentation. The advantage of BI technology over the classical segmentation method consists in the fact that data assignment can be performed automatically and simultaneously with the process of supplying the central data source, for instance daily. On the basis of data from smart electricity meters (readings from 215 customers, performed in 15-minute cycles), German researchers conducted segmentation using SAP BI system (NetWeaver BI), in which k-means algorithm was implemented. They identified the following profiles: weekday, weekend and weekly, separately for summer, winter and transitional seasons. On the basis of daily profiles for weekdays, 14 clusters were identified, with consumers classified as follows: enterprises, users of heat pumps, farms and mass users. Researchers pointed out that the combination of reading data with data from other systems could significantly improve the segmentation process. Among the potential benefits, they listed tailor-made energy rate plans, energy management services and improved adjustment of supply and demand on the electricity market (Flath, Nicolay, Conte Dinther and Filipova-Neumann, 2012).

Another example of interesting research in the banking sector is the study carried out by A. Munteanau and O. Raduta. They compared the existing bank platforms to Baroque castles characterized with insufficient quality, yet generating high costs and ill-adapted to contemporary standards requiring quick access to information. The authors proposed their own model, «Banking Intelligence Accelerator – Decision Support», which is designed for banking and customer-oriented. The results of case studies carried out by A. Munteanau and O. Raduta demonstrate that the model may prove useful in five areas: strategic planning, improving customer relations, product and service profitability analysis, analysis of internal processes aimed at improving performance, control and accounting. Authors also noted that many banks – following in the footsteps of ING – have data warehouses and can use it to streamline the process of implementing business intelligence within their structures (Munteanau and Raduta, 2012).

In their research, G. Głód and J. Jasłowski, as well as C.M. Olszak and K. Batko examined the implementation of BI systems in health care centres. The authors found that, for these entities, data quality, users' knowledge about information systems and widespread computerization are foreign concepts. The use of information systems is – in most cases – limited to mandatory accounting systems, HR systems and systems used for the settlement of contracts with the National Health Fund. Potential advantages stemming from the implementation of the BI system include data consolidation, greater efficiency, reduced costs, increased revenue, improved customer satisfaction, reduced frequency of medical errors, improved treatment and medical care services delivered to patients, streamlined decision-making process, enhanced monitoring of inventories, greater transparency of the organization (Głód and Jasłowski, 2013; Olszak and Batko, 2012).

In 2012, L. Serbanescu pointed out that given the current global economic situation, BI was needed more than ever, as a prerequisite for the creation of a new corporate culture in which management is based on measurable targets. L. Serbanescu also described examples of four reports (pertaining to customer analysis, product structure, sales over time and warehouse inventory), drawn up using one of the most common BI tools – QlikView. He presented the ease of use of this class of tools, which do not require specialist IT knowledge. It was stressed that one of the key advantages of BI tools, as compared to traditional tools, consists in the fact that they allow users to dynamically analyse a given report in relation to several other parameters, based on up-to-date and reliable data sources (Serbanescu, 2012).

Another area of application of BI technology is text analysis. J. Ministr and P. Rozenhal refer to a case study in which opinions expressed on the forum of a financial website were classified as negative and positive. In this approach, in addition to applying

a suitable methodology, it is important to build an appropriate knowledge base, i.e. a dictionary of keywords (Ministr and Rozenhal, 2012).

J. Olejniczak and B. Kubiak, in turn, formulated a proposal of budget-based organisation diagnosis using BI tools (including dashboards). The proposed approach allows one to measure performance in relation to budget implementation. External and internal factors affecting the budget were defined and minimum system and budget requirements (compared to the classic budget) were formulated; these minimum requirements must be met to enable users to monitor the implementation and the plan. Moreover, the authors explained – using the example of „what if” scenarios, which also form part of Business Intelligence systems – that revenue could be increased through improving product quality (Olejniczak and Kubiak, 2012).

Extensive studies in the area of Business Intelligence were also conducted by C.M. Olszak. In one of her publications, she outlines examples of BI system implementation processes in four organizations: Monster.com, Harrah’s Entertainment Inc., Continental Airlines and Norfolk Southern. According to the author, these are examples of organizations whose operations are based on Business Intelligence; each of them has developed its own BI system, yet all have been successful, i.e. have introduced new business services, improved customer service and developed new forms of cooperation, which has resulted in greater competitiveness. The success factor was a significant change in each organization’s operation, which was streamlined in all key areas, namely the strategy of devising long-term plans, information and business process management, customer service and the methodology of introducing innovative services for customers (Olszak, 2012). In a study whose results were published subsequently, C.M. Olszak surveyed 20 organizations (representing five sectors: telecommunications, banking, insurance, consulting and marketing) with a view to determining their level of BI use. It turned out that all organizations surveyed were using BI 2.0 systems, developed in 1990–2005 and that they were focused on internal processes rather than on competition. They also rarely had recourse to social media elements in their solutions, which are among the features of modern BI 3.0 systems (Olszak, 2013b).

An interesting process of BI implementation combined with the implementation of a new ERP system by Poland’s largest manufacturer of rolling stock, PESA from Bydgoszcz, was described in 2013 by L. Drelichowski and R. Lewandowski. In a survey conducted once the implementation process was completed, users referred to an insufficient number of training sessions and dissatisfaction with the extent of modernization, yet claimed that both ERP and BI had positively affected their work and interaction among employees. In their opinion, the most important success was the fact that – as

the following step in the process – managers planned to implement knowledge management solutions. This proves that the implementation of BI and ERP systems triggered the process of change within the organization (Drelichowski and Lewandowski, 2013).

In another study L. Drelichowski described the process of BI system implementation in POZKAL – company operating in the printing industry and established in Inowrocław. Using this example, he has proven that an important success factor is an appropriate design of the process of data supply to the data warehouse. According to the author, widespread use of BI systems is contingent on user confidence in the quality of information stored in the data warehouse. Therefore, in the process of data supply, data verification and feedback from source systems users are necessary (Drelichowski, 2013).

In 2014, T. Sitek and M. Litka measured the implementation of BI systems using the example of Avena, a company based in Gdansk and providing IT services to approximately 30 clients. Researchers focused on the measurement of performance in the sector of IT services. A number of indicators were taken into account, e.g. the number of requests from clients, employee productivity, difference between the reference time and real time devoted to the execution of a request etc. They were subsequently measured in two periods: a period of several months following the implementation of BI and the same period of the subsequent year; the results were compared. Consequently, an original method for measuring the impact of BI implementation was developed, based on the measurement of eight indicators typical of the sector of IT services. With this method, it is possible to determine whether the implementation of BI has had a positive impact on the organization. In the case of Avena, 72% efficiency increase was observed (Sitek and Litka, 2014).

An example of BI implementation in the banking sector is ING Bank Śląski. In the first stage, which began in 2008, the bank provided access to the system to approximately 250 users; later, development was extended to other areas and, ultimately, 2,800 users had access to the system, including 300 direct recipients drawing up reports and conducting *ad hoc* analyses and 2,500 intermediate users, primarily recipients of reports and analyses; a total of 170 analysts were involved (Kuczera, 2008). The analysis of the impact of BI implementation on ING Bank's financial situation was carried out and published separately by R. Tunowski and J. Jaworski. They demonstrated that – with a high degree of probability – the implementation of the BI system had positively affected the financial situation of an organisation, as in four out of five areas (profitability, quality of assets and liabilities, debt and position on the capital market) the financial situation measured with the WBI index⁴ had improved. The opposite was observed

⁴ WBI – indicator used for assessing the impact of the implementation of a BI system on the financial condition of an enterprise.

only in terms of liquidity. This confirmed the research hypothesis, according to which the implementation of Business Intelligence management systems has a positive effect on the financial situation of a bank (Tunowski and Jaworski, 2015).

Table 2 provides a summary of research findings presented above.

Table 2. Summary of results of literature review pertaining to cases of Business Intelligence implementation in an organization

Author	Purpose of the study	Sample size	Findings
A. Lönnqvista, V. Pirttimäki and A. Karjuluoto (2006)	Impact of BI implementation analysed on the basis of a case study	Telecommunications company (Finland)	Both studies demonstrate that the majority of benefits and advantages brought by BI are very difficult to measure. Researchers point out that the process of implementing a Business Intelligence system triggers a series of changes within organizations. At present, according to authors, no universal methodology is in place allowing us to evaluate investment in BI, and it is therefore necessary to assess the impact of BI implementation individually, taking into account the characteristics of each enterprise and reasons behind its decision to implement BI.
B. Hocevar and J. Jaklic (2010)	Impact of BI implementation analysed on the basis of a case study	Manufacturing company Melamim (Slovenia)	
L. Ziora (2011)	Impact of BI implementation analysed on the basis of a case study	ComertzBank (Germany)	Cognos 8 platform has generated a 60% reduction of reporting costs and time devoted to this task. Data quality has improved, an early warning mechanism has been implemented and transparent managerial dashboards were created, allowing managers to control all aspects of activity within the organization.
L. Ziora (2011)	Impact of BI implementation analysed on the basis of a case study	Large enterprise from the financial sector	At present, the main and only central source of data is the data warehouse that integrates the contract system and the accounting system; this solution has accelerated the decision-making process; greatest changes in this respect have been observed in the risk management department. Although the scope of data collection has not changed, the BI system has positively contributed to the efficiency of data quality control processes. In addition, the BI system has also enabled customer profiling, helping the company to prepare and deliver appropriate promotional offers to individual clients in a timely manner.

Table 2 (Continued)

Author	Purpose of the study	Sample size	Findings
L. Ziora (2011)	Impact of BI implementation analysed on the basis of a case study	Epicor – company from the energy sector	Among the observed advantages, the author mentions the acceleration of the decision making process (by over a dozen per cent), greater efficiency and accuracy of decisions, improved communication and access to information. BI implementation has also resulted in revenue increase and cost reduction.
C. Flath, D. Nicolay, T. Conte, C. Dinther and L. Filipova-Neumann. (2012)	Impact of BI implementation analysed on the basis of a case study	German company from the energy sector	On the basis of data from smart electricity meters (readings from 215 customers, performed in 15-minute cycles), German researchers conducted segmentation using SAP BI system (NetWeaver BI), in which k-means algorithm is implemented. They identified the following profiles: weekday, weekend and weekly, separately for summer, winter and transitional seasons. On the basis of daily profiles for weekdays, 14 clusters were identified, with consumers classified as follows: enterprises, users of heat pumps, farms, mass users.
A. Munteanau and O. Raduta (2012)	Model aimed at banking, supporting decision-making processes		The authors proposed their own model, “Banking Intelligence Accelerator – Decision Support”, designed for banking and customer-oriented. The results of case studies carried out by A. Munteanau and O. Raduta indicate that the model may prove useful in five areas: strategic planning, improving customer relations, product and service profitability analysis, analysis of internal processes aimed at improving performance, control and accounting.
G. Głod and J. Jasłowski (2013)	Impact of BI implementation analysed on the basis of a case study	Polish health care centres	The authors found that, in general, the concept of data quality, users’ knowledge about information systems and widespread computerization are foreign to Polish health care centres. The use of information systems is – in the majority of cases – limited to mandatory accounting systems, HR systems and systems used for the settlement of contracts with the National Health Fund.
C.M. Olszak and K. Batko (2012)	Impact of BI implementation analysed on the basis of a case study		

<p>L. Serbanescu (2012)</p>	<p>Analysis of functionality of BI tools – QlickView</p>	<p>Example of reports drawn up with the use of a popular BI tool – QlickView.</p>	<p>The author presented the ease of use of this class of tools, which do not require specialist IT knowledge. It was stressed that one of the key advantages of BI tools, as compared to traditional tools, consists in the fact that they allow users to dynamically analyse a given report in relation to several other parameters, based on up-to-date and reliable data sources. Examples of reports from the following areas were outlined: customer analysis, product structure, sales over time and warehouse inventory.</p>
<p>J. Ministr and P. Rozenhal (2012)</p>	<p>Text analysis as an area of BI implementation</p>	<p>Financial website</p>	<p>In the case study, opinions expressed on the forum of a financial website were classified as negative and positive. According to this approach, in addition to applying a suitable methodology, it is important to build an appropriate knowledge base, i.e. a dictionary of keywords.</p>
<p>J. Olejniczak and B. Kubiak (2012)</p>	<p>Diagnosis of an enterprise on the basis of its budget, with the use of BI tools</p>		<p>The proposed approach allows one to measure performance in relation to budget implementation. External and internal factors affecting the budget were defined and minimum system and budget requirements (compared to the classic budget) were formulated; these minimum requirements must be met to enable users to monitor the implementation and the plan. Moreover, the authors explained – using the example of „what if” scenarios, which also form part of Business Intelligence systems – that revenue could be increased through improving product quality.</p>
<p>C.M. Olszak (2012)</p>	<p>Impact of BI implementation analysed on the basis of a case study</p>	<p>Monster.com, Harrah’s Entertainment Inc., Continental Airlines and Norfolk Southern</p>	<p>These are examples of organizations whose operation is based on Business Intelligence; each of them has developed its own BI system and all have been successful, i.e. have introduced new business services, improved customer service and developed new forms of cooperation, which has resulted in greater competitiveness. The success factor was a significant change in each organization’s operation, which was streamlined in all key areas, namely the strategy of devising long-term plans, information and business process management, customer service and the methodology of introducing innovative services for customers</p>
<p>C.M. Olszak (2013)</p>	<p>Analysis of the degree of BI maturity</p>	<p>20 organisations from 5 sectors: communications, banking, insurance, consulting and marketing</p>	<p>All organizations surveyed were using BI 2.0 systems, developed in 1990-2005. It was found that companies were focused on internal processes rather than on competition. They also rarely had recourse to social media elements in their solutions, which are among the features of modern BI 3.0 systems.</p>

Table 2 (Continued)

Author	Purpose of the study	Sample size	Findings
L. Drelichowski and R. Lewandowski (2013)	Impact of BI implementation analysed on the basis of a case study	Manufacturing company PESA (Poland)	According to the authors, users referred to an insufficient number of training sessions and dissatisfaction with the extent of modernization, yet claimed that both ERP and BI had positively affected their work and interaction among employees. In their opinion, the most important success was the fact that – as the following step in the process – managers planned to implement knowledge management solutions. This proves that the implementation of BI and ERP systems triggered the process of change within the organization.
L. Drelichowski (2013)	Impact of BI implementation analysed on the basis of a case study	Printing industry company POZKAL (Poland)	An important success factor is an appropriate design of the process of data supply to the data warehouse. According to the author, a widespread use of BI systems is contingent on user confidence in the quality of information stored in the data warehouse. Therefore, in the process of data supply, data verification and feedback from source systems users is necessary.
T. Sitek and M. Litka (2014)	Impact of BI implementation on an IT company, analysed on the basis of a case study	IT service provider Avena (Poland)	An original method for measuring the impact of BI implementation was developed, based on the measurement of eight indicators typical of the sector of IT services. The method allows determining whether the implementation of BI has had a positive impact on the organization. In the case of Avena, 72% efficiency increase was observed.
R. Tunowski and J. Jaworski (2015)	Impact of BI implementation on the basis of a case study	ING Bank Śląski (Poland)	There is a high degree of probability that the implementation of a BI system has positively affected the financial situation of an organisation, as in four out of five areas (profitability, quality of assets and liabilities, debt and position on the capital market) the financial situation measured with the WBI index has improved. The opposite has been observed only in terms of liquidity.

Source: own study.

Studies discussed above provide evidence confirming that numerous benefits stem from the implementation of BI in organizations operating in various sectors: energy, financial services, IT, banking, telecommunications, insurance, consulting, marketing, manufacturing, railway and printing. It proves the versatility of BI systems in broadly defined area of business intelligence, regardless of the type of business activity.

Business Intelligence systems can be used wherever traditional IT solutions fail to process large amounts of data. They provide – in a transparent manner – information to decisions makers at various levels of an organization. In addition, text analysis – which is relatively complex and has thus far been rarely used by Polish companies – can be successfully implemented thanks to BI systems.

Conclusions

It is undeniable that significant developments have taken place in the field of business intelligence. One of the main and highly useful solutions available to organizations is the implementation of Business Intelligence systems, which triggers a series of changes that involve the entire company – from strategic to tactical structures – and penetrate into operational work, improving and increasing the efficiency and effectiveness of the organization.

The review of recent literature relating to the subject matter allows us to conclude that the implementation of BI systems has a positive impact on organisation efficiency. Authors have identified numerous cases of successful implementation in various sectors and many countries. Diverse cases of BI system use have been described, along with potential barriers and threats. Research findings confirm the hypothesis presented in the introduction. However, apart from numerous advantages of this solution, it should be emphasized that professional management of change triggered by the implementation of Business Intelligence solutions is essential with respect to the majority of processes taking place within an organization, as the implementation of intangible assets (of which a BI system is an example) results in a decrease of goodwill (Surma, 2009).

Despite many attempts at measuring the impact of BI implementation, a universal method of estimating the benefits of implementing a Business Intelligence system within an organization has yet to be developed. The author shall endeavour to fill the knowledge gap in this area with in-depth research conducted in the future.

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