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## BI AND BIG DATA SOLUTIONS IN PROJECT MANAGEMENT

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## WYKORZYSTANIE NARZĘDZI KLASY BI I SYSTEMÓW BIG DATA DO ZARZĄDZANIA PROJEKTAMI

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**Summary:** The success of projects in enterprises and the success of an entire organization's business largely depend on the possession and efficient use of the relevant information. In a broader context, success depends on having the adequate knowledge at the right time and place. Business processes generate large amount of data that are collected and processed in a way enabling transforming data into a measurable and useful value, which is information. Its efficient usage streamlines business processes, and allows to respond quickly to changes and proper decision-making. The aim of the paper is to present and define the project management challenges and ideas of Business Intelligence and Big Data systems. The types of analysis available in both platforms are also discussed. In the paper, the authors try to identify the areas of project management that can benefit from Business Intelligence and Big Data analysis.

**Keywords:** Business Intelligence, Big Data, analysis, project management, project execution, IT tools.

**Streszczenie:** Powodzenie projektów w przedsiębiorstwach i sukces działalności całej organizacji w dużej mierze zależą od posiadania i efektywnego wykorzystania odpowiednich informacji. W szerszym kontekście sukces zależy od posiadania odpowiedniej wiedzy, zgromadzonej i wykorzystanej we właściwym czasie i miejscu. Procesy biznesowe generują dużą liczbę danych, które są gromadzone i przetwarzane w sposób umożliwiający ich przekształcanie do wartościowych, użytecznych informacji, wykorzystywanych w dalszym procesie decyzyjnym. Efektywne użycie właściwych informacji usprawnia procesy biznesowe, umożliwia szybką reakcję na zmiany i podejmowanie trafnych decyzji. Celem niniejszego artykułu było wskazanie wymagań dotyczących zarządzania projektami, znaczenia narzędzi *Business Intelligence* (BI), a także systemów *Big Data*. Zgodnie z założeniem autorzy zidentyfikowali i opisali obszary zarządzania projektami, w których mogą być wykorzystane narzędzia *Business Intelligence* i analizy dużej ilości danych (*Big Data*).

**Słowa kluczowe:** *Business Intelligence*, *Big Data*, analiza, zarządzanie projektem, prowadzenie projektu, narzędzia IT.

## 1. Introduction

Organisations working in today's world are facing various challenges. The crucial fact is that they possess a huge amount of data created during their operational activity. The data is stored in various IT systems in miscellaneous locations and formats. Data describing the current business can be compared to those that have been acquired during a longer period of enterprise activity (the analysis of historical data affect current decisions).

The continuous development of Computer Sciences and Information Technologies and the increasing level of knowledge regarding methods of designing and creating databases and processing the data give us new possibilities and opportunities in acquiring information and knowledge accelerating the business performance.

The effectiveness of the decision-making does not result only from the amount of data collected and the information systems used, but also the ability of the proper choice of sources of information and the speed of extracting the information that will enable the most pertinent decision taken at a certain time, and decisions will be less adventurous.

The use of advanced tools of artificial intelligence seems essential to run a business, particularly in terms of project management.

## 2. The division of activities within the organization

We can divide the activities undertaken by enterprises in terms of complexity and recurrence (Figure 1).

			Tasks' complexity
		Little and very little	Medium
	Little or none	Improved action	High and very high
Actions' recurrence	Medium	Routine activities	Projects
	High and very high		Functions (Repeatable processes)

**Figure 1.** Typology of organisation activities

Source: own study based on [Trocki, Gruzca Ogonek 2003].

Improved actions are based on the fact that the repeatability of the activities is low, whereas the undertaken tasks' complexity is slight. An example of such a task would be an unusual event that will be quickly resolved.

Routine activities are simple activities of moderate complexity (e.g. to issue an invoice). These operations are simple to make and happen quite frequently and therefore are usually executed quickly, without taking extra steps to implement.

Repeatable processes in a company (implemented functions) are actions with a higher degree of repeatability and complexity. Typically to implement them we use fixed procedures and plans. The results of these activities are the foundation for various analyses and are the basis for creating or improving procedures. An example of such a process would be the customer complaints management process.

Projects are company activities that have little (usually none) repeatability but a very high degree of complexity. Typically, those undertaken actions are related to new (unique) activities that bring solution for a new business situation or a problem. To achieve the effect, we must specify, among others, its duration and costs. We usually assign an author/owner/manager for those actions, who is responsible for achieving the final result of the project.

The international organization consisting of companies and individuals interested in managing projects the Project Management Institute – defines a project as a temporary activity that is undertaken to provide a unique product service or achieve unique results [Kerzner 2013]. Z. Szyjewski believes that a project is a unique, non-routine process meeting specific targets in a given time by means of specific measures [Szyjewski 2004] (c.f. [Pondel, Pondel 2011]).

A project can also be defined by indicating its individual characteristics. Various authors claim that a project is non-repetitive and time-limited, it has defined objectives, it includes various management methods and techniques, it solves new and previously unknown problems and it is associated with certain risks. The project must have a corresponding budget and during the performance of work, the project participants are under pressure [Kellner 2001].

The basic attributes of a project include:

- location in time,
- uniqueness,
- complexity,
- purposefulness.

Project management can be defined as a set of managerial activities related to the implementation of projects and a set of principles used in these operations, methods and tools [Guide 2001]. Project management involves the application of knowledge, experience, tools, methods and techniques during the project activities to achieve or even surpass the needs and expectations of the stakeholders. The implementation of the project requires squaring many aspects, such as:

- scope, time and quality,
- various needs and expectations of stakeholders,
- identified and anticipated requirements,
- risks and their neutralisation plans.

Efficient project management requires specific planning and good cooperation. Therefore for the successful implementation of the activities relating to the project it is necessary to properly organize the work and to constantly coordinate the whole project and its specific actions.

Modern organizations, to streamline their operations and project management, use the access to various electronic information resources. The multitude of available information and the diversity of sources make the decision-making more complex. We should take into account such factors as the reduction/extension/asymmetry of time and information, and the responsibility of many people for making decisions (various locations of the company). At each stage of the projects in companies we can identify many of the key elements that influence the success of the whole project realization. All this encourages companies to investigate and use different types of IT tools that allow to facilitate an efficient decision-making process.

Information systems play a more and more significant role in project management, including knowledge management and innovation management. Their proper use can increase the effectiveness of businesses and thus increase market competitiveness.

### 3. Components of Business Intelligence systems

According to the reports of global research and IT enterprises such as the Gartner Group, the Australian Computer Society, Oracle and Teradata, Business Intelligence (BI) Technology is among the highest priorities of investment in the field of IT in modern enterprises. Companies base the processes of decision making on BI technology. They benefit from BI in the fields of optimisation of business processes, the appropriate and rapid response to emerging changes and all the signals coming from the market.

Business Intelligence systems consist of two functional parts. We can distinguish the following modules:

- Data Warehouse – storing business data.
- Presentation Layer – allowing analysis making based on the data located in Data Warehouse. It also provides users with presentation of analysis results.

In both Data Warehouse and Presentation Layer we can distinguish more detailed components. There are in Data Warehouse:

- ETL – Extract–Transform–Load.
- DM – Data Marts – a subset of the data warehouse that is oriented to store data describing a specific business line.

The presentation system includes functional subsystems that are responsible for budgeting, deviation analysis, optimization, reporting, etc. [Bardzki 2015]

Source data generated in various IT systems, called facts, are delivered into Data Warehouse by data convey procedures called EFT. During the process the following activities are undertaken:

- extraction of data from their sources,
- data cleansing that is detecting and correcting erroneous values, indicating those missing and conflicting,
- integration of data from different sources (merging data describing the same object),

- transformation of data structures (to the correct form of model data in the data warehouse),
- loading data into the warehouse.

The essence of Business Intelligence is a comprehensive way to integrate and process information in the data warehouse. BI mechanisms collect and associate information following the specific procedures to answer the specified user queries. In this way the information is converted into knowledge, which is then made available to the user through the presentation layer. Thanks to such an approach, systems provide visualization tools (e.g. charts, tables of results, geographical maps) to efficiently support managers, allowing them, for example, to build what-if analyses, budgets or controlling systems.

BI systems enable an interactive way of communicating with the user and also the creation and distribution of static reports (e.g. in the form of PDF files). BI tools, apart from the presentation of historical reports, allow forecasting based on data describing the past. Certain time trends can be presented using different statistical methods, e.g. the moving average, the method of approximation (interpolation, extrapolation) function.

The main risks in project realisation do not come from the past events that we are aware of. The risks results from the events happening during the project performance. The unawareness of their possibility and influence on the project is the most important danger of project failure. By analysis of data describing previous projects we can become more aware of possible project risks and prepare better plans for their neutralisation. This is the way of increasing the probability of the projects' success.

The project management is in most aspects based on estimations. To properly estimate the workload or time necessary to complete specific actions, we need the experience from performing similar actions in the past. If such experience can be complemented with the knowledge acquired from the data warehouse we can expect that the current estimations and plans will be more precise.

The purpose of Business Intelligence systems for project management is therefore the collection, processing, storage, data sharing and management of available knowledge using a variety of analytical tools, in such a way that it is possible to reduce the risk of future operations and the preparation of more applicable project plans.

#### **4. Types of analysis in Business Intelligence systems**

The purpose of the company is to conduct business in order to maximize profits whilst minimizing losses and risks. To achieve this, they collect and organize available data, converting them into information. However, to understand cause-and-effect relationships that occur in the company and its surroundings they have to invest in data analytics.

Methodology and the ability to perform research (analysis) data is defined as data analytics. There are many approaches to analytics, but they can all be conventionally divided into simple analytics (business), advanced and difficult (Big Data) [Chen, Chiang, Storey 2012; Kohavi, Rothleder, Simoudis 2002].

Reports created by traditional BI systems containing tables and charts may be conventionally called simple analytics as they can be created and delivered in a fully automatic way.

The need for advanced analytics occurs when we expect to extract knowledge from the databases. The most common methods are:

- classification,
- association rules,
- prediction,
- anomaly identification.

We call these methods advanced analytics.

The techniques used to implement these methods are called data mining (data exploration, data extraction). They involve statistical and mathematical models to discover patterns, correlations, dependencies (due to the amount of data and the complexity of relationships they are difficult to discover by people). The difficulty of applying advanced analytics is the correctness of the model. Insufficient data quality and the lack of representativeness of the data lead to failure to detect the correlation, the detection of false correlations or the discovery of the results without practical significance.

The growth dynamics of the raw data available widely on the Internet means that it cannot be ignored as a potential source of information for analysis (especially in terms of project management). These are mainly data available on web portals or in social networks, blogs, web sites, etc. The data must be treated mainly as unstructured.

The aim of the Big Data analysis, as an advanced analysis, is to detect correlation and trends with the difference that the data need not be structured. It is believed that Big Data analytics can bring the company some very valuable findings because of the amount of unstructured information available on the Internet.

In project management it is essential to explore the solutions which in an integrated way help both run the processes associated with the acquisition, management and distribution of information and knowledge belonging to the organization and also provide the ability to create new networks of relationships. The usage of Business Intelligence tools also aims to turn on the knowledge of workers and knowledge of cooperating enterprises to allow the creation of corporate knowledge, which is sometimes called enterprise intelligence.

The main assumption of the usage of Business Intelligence in project management is to streamline the knowledge management process in an organization on the indicated levels of management (Table 1), where there is a lot of unstructured and heterogeneous data.

**Table 1.** Example of BI tasks

Level of management	BI tasks
Operational	<i>Ad hoc</i> analysis, current operations information, finances, sales, collaboration with suppliers, customers, clients, etc.
Tactical	Making fundamental decisions in marketing, sales, finance, capital management project. Optimizing operations and modifying factors affecting the implementation of projects influencing the strategic goals of the company.
Strategic	Precise goals setting and tracking their achievement, performance of various comparative summaries, conducting simulations of success, growth, risk identification, forecasting future results based on specific project assumptions.

Source: own study based on [Olszak, Ziemia (eds.) 2012].

BI technologies endeavour to make the most efficient presentation of the multitude of possibilities for decision-making to the user who most readily understands the two-dimensional flat reports presented on paper or screen.

## 5. Big Data analytics

Big Data analytics is the most advanced method of data analysis that allows the extraction of knowledge from huge sets of data, which have many dimensions, heterogeneous structures and they are disordered. Systems with Big Data analytics require advanced transformation processes, including data cleansing, to bring unstructured data into a usable form. The transformation process in the Big Data may be a natural language analysis, data extraction from video content, graphs analysis or sequences of behaviour analysis. Difficulty in data analysis is also the presence of noise information (Signal to Noise Ratio) in the external data [Gridwise 2015].

Due to the high cost of solutions used and the frequent difficulties with data analysis, the cost of implementing Big Data solutions for enterprises is higher than in the case of advanced analytics. However, the possibility of obtaining very valuable findings (if only because of the amount of available unstructured data and information appearing on the Internet) as bigger companies, especially those focused on information processing, massively invest in Big Data analytics.

Project management in companies is associated with a high degree of risk of their success. Therefore the analysis of all the available data and the information collected during the previous projects performance plays a significant role in both the planning and implementation of the next project.

The usage of IT tools to perform detailed analysis leads to more effective decisions, resulting in greater operational efficiency, reduced costs and reduced risks.

Companies making project decisions not only use the data and information, stored in their information systems, they also need to integrate data and information



available on the Internet, generated in various forms as newsgroups, social media platforms and other places where practitioners and researchers exchange and publish information regarding specific topics. Contrary to the data and information contained in enterprise systems, the data and information available on the Internet are usually disorganized and they have a variety of forms, however, they are a rich source of information (e.g. customer reviews, information about the functioning of other entities). Using Big Data tools, information can be properly converted and combined together with those corporate tools, resulting in discovering more valuable findings that significantly affect the effectiveness of the company.

## 6. BI and Big Data analytics in Project Management

There are many project management methodologies, but one of the most common was prepared by the Project Management Institute (PMI) and called PMBOK (Project Management Body of Knowledge). It distinguishes five groups of project processes. They are [Guide 2001]:

1. Initiating – definition of a new project or a new phase of an existing project by obtaining authorization to start the project or phase.
2. Planning – establishing the scope of the project, refine the objectives, and define the course of action required to attain the objectives that the project was undertaken to achieve.
3. Executing – completing the work defined in the project management plan to satisfy the project specifications.

**Table 2.** Data analysis during project management processes

Project management processes	BI simple analytics	BI advanced analytics	Big Data analytics
Initiating			May be useful in requirements discovery.
Planning	Estimations (time, costs) may be improved by previous projects history analysis.	Risks identification using data mining methods.	Risks identification using information from Internet (e.g. social media).
Executing	Quality management by checking KPIs. Project decision-making.	Anomaly detection by analysing project data. Risks' identification.	Anomaly detection by analysing project data/information.
Monitoring and Controlling	Schedule, scope, budget monitoring. Progress reporting, risks.	Anomaly detection by analysing project data. Risks' identification.	Anomaly detection by analysing project data/information. Risks' identification.
Closing	Reports can help in a phase of concluding project objectives.	Analysis of project anomalies during conclusions preparing.	Analysis of events occurring during the project.

Source: own study.



4. Monitoring and controlling – tracking, reviewing and regulating the progress and performance of the project; identifying any areas in which changes to the plan are required; and initiate the corresponding changes.

5. Closing – finalizing all activities across all process groups to formally close the project or phase.

All of them should be supported by analytics. Some require simpler techniques and some could benefit from the most advanced analytics. Table 2 presents the processes and ideas of usage of all the methods mentioned in this paper.

## 7. Conclusions and further research

During project management processes it is essential to possess proper experience especially to be able to properly identify risks and avoid mistakes during project planning and execution. There is a huge amount of data that is created during project execution that should be correctly processed and analysed to generate adequate information important in project decision making processes. The knowledge gathered during project execution is also helpful for streamlining of succeeding projects. That is why the Business Intelligence tools and Big Data analysis can provide project managers and stakeholder with very valuable information and knowledge. This paper proposed areas of usage of various methods and tools in project management and execution. The authors of this paper are aiming to prepare a model of IT tools supporting project management and execution processes with the identification of data sources, models and specific tasks that can be supported by basic and advanced analysis.

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