BIG DATA in decision making processes of enterprises

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Abstract

The dynamically changing environment, with the convergence of IT, telecommunications and electronic media, has large impact on decision-making processes of enterprises. Decision-making is accompanied by a vast amount of data and software for their analysis. In the paper, there is indicated the significance of Big Data in decision-making processes and the essence of integrated data management in enterprises. There are presented the proposals of the stages of decision-making support based on the data, which are appropriately processed and ordered, and can be implemented in enterprises.

*Keywords:*decision-making process; Big Data; data management; decision process.

1. Introduction

For enterprises, operating in the turbulent environment, directing towards the quality of decision-making processes, is becoming an essential component of management. The information support for decision-making processes at all levels of the enterprise, and the way of organizing them, is becoming increasingly important. Big Data amounts not only to collecting data but, most of all, their processing and visualization, essential for obtaining business benefits.

The application of Big Data in modern business allows enterprises to achieve real competitive advantage, and enables research centers to increase the effectiveness of the conducted explorations. The analysis of large volumes of data is used in the following sectors: financial, telecommunications, health care, biotechnology, scientific research,

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particularly space research, IT, especially e-commerce, advertising, tourism, social networks, information websites, and also in industries and services with a global reach. The expectations concerning Big Data are enormous and it is assumed that collecting information from each source (devices, the Internet) will be common very soon almost for every enterprise, irrespective of its size. The appropriate use of the potential of deduction and analysis of a vast amount of data will allow individual enterprises to take faster and more adequate decisions leading e.g. to cost reduction, development of new products and creation of optimized tenders and emergence of market trends. An important aspect is also the automation and simplification of processes inside the enterprise. The skillful integration of systems and data coming from them will allow to support decision-making.

The aim of the paper is to indicate the usability of Big Data in decision-making processes in enterprises. In the final part of the paper, on the basis of the literature studies and the authors' own research, they formulate the proposals of the stages of supporting decision-making processes in this area, based on the appropriately ordered and processed data.

1.1. Decision-making processes and their determinants

In management, understanding the 'decision' concept is based on the Latin etymology - *decisio* (decision, settlement, resolution). The decision allows for solving many decision-making problems and situations, i.e. the ones which cannot be resolved otherwise than by selection.It is assumed that the decision is the basic activity of management staff and the information, i.e. the 'material' of the decision, is a tool for every manager.

Decision-making is correlated with both the elimination of threats and the use of occurring market opportunities[1]. Elimination of threats supports the strategic early warning systems (EWS).

Strategic early warning systems to identify six pitfalls[2]:

- scenarios that are not broad and challenging enough,
- organisational isolation of the EWS manager,
- the scenarios limit the scanning of new developments,
- no agreement on what a trend of changes is,
- too much emphasis on quantitative data rather than qualitative data,
- (organizational) acceptance that the EWS (and the EWS manager) does not provide absolute certainties about the future.

The effectiveness of these activities is conditioned by the determinants of the decision-making process. The main determinants of the decision-making process include:

- necessity to react and the resulting urgency of decision-making,
- knowledge of the decision-maker, particularly in the area of processing and using the obtained information,
- personality of the decision-maker which, among others, consists of: intelligence, sense of responsibility, tendency for taking a balanced risk, ability to cooperate with others and reach an agreement, sensitivity to problems, ambition and independence,
- conviction of the decision-maker of the feasibility of objectives,
- knowledge of the occurring problem; correctness of decisions requires different information on events, facts and phenomena, which may be used in the management process; it should be characterized by timeliness, reliability, accuracy, easy and rapid access to it, correctness in the field of processing and cost-effectiveness,
- costs of collecting and processing information, which cannot be higher than the expected results of operations,
- legal and non-legal norms,
- conditions of decision-making, among which there are: certainty (the decision-maker knows potential selection options), risk (for individual options there are known benefits and costs with certain estimated probability), uncertainty (the decision-maker does not know all choices, the risk connected with each of them or possible consequences),
- possibility of making a choice with appropriate margin of freedom.

In the subject literature, it is underlined that the quality of decision-making processes is strengthened by the fact that they are based on the rule of 4F, which consists of such elements as[3]:

- Focus, concentrating on the areas the decision-maker (enterprise) is most familiar with; thus distinctive competencies are created
- Fast, the fastest possible reaction to signals coming from both the market and the inside of the enterprise
- First, satisfying the needs manifested by clients, the best on the market
- Flexibility, innovativeness and changes both in the enterprise resources and structures, procedures etc.

The presented rule allows for the development of effective procedures of operation, by means of which it will be easier and faster to take internal decisions in the future and to limit the scope of decision errors[4].

1.2. The idea of Big Data

The concept of Big Data has evolved over the last several decades; in the subject literature the most frequently adopted definition is the one by Douglas Laney who, in 2001, claimed that it is a vast amount of data generated very quickly and containing a large amount of content. The characteristics of Big Data is based on the rule of 4V: volume (a large amount of data), variety (any type of data), velocity (high changeability, dynamicof data), value (assessment expressed by verification)[5,6].

Big Data reflects a vast amount of disordered data, collected by different types of business and State organizations; these data belong to different categories, they are disordered, uncategorized, thus it is difficult to apply them and, simultaneously, use in decision-making processes. Big Data consists of a vast amount of clients' records, audio data, photos, graphics, text messages, comments in social networking websites, digital papers and books, information coming from blogs and technical information. As far as, in 1993, 3% of the world information was stored on digital devices (hard or optical disc drives) already in 2007, 94% of the world information capacity were DVDs, CDs, memory cards and other digital devices. In 2014, 93% of all data were unstructured data, such as digital videos, audio files, photos and graphics.

The research conducted among enterprises shows that the amount of data in circulation of enterprises is growing by 200 % a year; moreover, it is predicted that the data of enterprises will increase by 800% within five years, out of which 80% amounts to unstructured data. The latest Cove research indicated that 85% of the investigated managers think that the management of disordered data will determine the effectiveness and efficiency of customer service in the future. According to the IBM research, including the group of 1500 presidents, there was indicated the increasing frustration of CEOs, brought about by the lack of possibility of transforming and using the available data to implement the established operation plans. Managers are aware of great significance of the integrated data coming from all departments: product, customer service and sales, and they indicate the necessity to share them in real time[7].

A big challenge for managers is searching for information from different sources and formats: intranets, e-mails, shared files, Wiki and systems accumulating knowledge of the enterprise, such as: Customer Relationship Management (CRM), Enterprise Resource Planning (ERP)or other applications. One of the proposals in the field of integrated data management is the concept by Diane Berry[8] (see Table 1).

The presented proposals of integrated data management in the enterprise refer to three departments: customer service, technology and product development and sales and marketing. For each of the listed departments there takes place the operation consisting in:

- searching for and navigating to find information from any sources,
- consolidation of important sources of information from many sources,
- correlation and looking for ties between different data from various systems,
- data analysis and discovering information relationships.

The above concept of data processing is very logical and well thought; however, the way of its development is open and difficult in the practice of the operation of enterprises.

Internet companies began pioneering work in the area of administration of Big Data. They avoided the models of relational databases and created their own framework for cooperation with Big Data; they consisted of NoSQL databases, distributed processing systems, specialized data structures and other elements. Subsequently, this framework was consolidated and much of this is available until now in the option of parallel processing. Google was the first company to apply the effective use of Big Data. By means of gathering and analyzing huge collections of websites and relationships between them (links), it was possible to make the first real search engines, capable of queries and indexing billions of pages without human interference. In the place of the traditional technology – a relational database, Google engineers created their own unique service system - Big Data.

Table 1.The proposal of integrated data management in the enterprise.

	Column A	Column B	Column C	Column D
Section/task	Search & navigate find information within any system of source	Consolidate combine relevant information from multiple sources	Correlate identify information relationships within disparate types of data from different systems	Analyze draw conclusions and uncover themes within data as well as information relationships
Customer/Service Agents	Find product info and knowledge to respond to customer inquires	Consolidate all information around and particular customer or set of customers their history products, past issues, etc.	Correlate similar complex customer issues with most likely resolution paths	Uncover emerging customer issues following a product launch, before they become endemic
Engineering/Product	Find and navigate through Documents internal and external experts schematics and more	Compile all information related to specific project including experts and customer feedback	Identify root-causes of product defect and how they may be impacting customer and sales	Understand which concepts have been applied most often and which are most successful
Development	Find prospect and customer information	See all information about customers-from initial lead, to all interactions (including, social media to service history – in one)	Identify best prospects and get an early warning on customer defections better target audiences	Understand the major themes and sub-characteristics of wins and losses: relate customer loyalty to engineering and service

Source: Diane Berry, Unstructured data: Challenge or asset? Diane Berry, April 9, 2012. http://www.zdenet.com/news/unstructured-data-challenge-or-asset/6356691

The use of Big Data created the possibility due to which enterprises of any size have access to computing power, essential for the processing of more and more data. This, in turn, generates positive feedback: if the final users believe that they can process more data, simultaneously, they will be collecting more data, which, in turn, leads to an increased demand for data processing, and so on and so forth.

Table 2.Convergence of data processing.

Convergence of data processing	
'Today'	'Tomorrow'
Cloud Computing	Cloud Computing
Mobile devices	Big Data
Social Media	Social Media and Mobile devices
Big Data	

Source: Krishnan Subramanian, Principal Analyst, Rishidot Research Editor, CloudAve.com.

Generally speaking, Big Data amounts to big challenges and searching for appropriate algorithms for data processing.

An interesting analysis of Big Data processing, connected with mobile technologies and Cloud Computing was presented by Krishnan Subramanian[9] (seeTable 2).

In the future, as shown in Table 2, the data from Social Media and mobile data must be treated as one source; Big Data is not the last element of the chain of data processing , but its center. Moving Big Data to the central place of the chain of data processing is connected with such tendencies on the market as: a growing number of users possessing mobile devices, a larger amount of data generated by these devices and mobile applications. It should be underlined that the amount of mobile applications and, at the same time, their connection with Cloud Computing.(CC)[10] influences the change in the application consumption model Section heading[11]. The data aggregated by applications are processed due to CC as Big Data and, subsequently, used for dealing with the application users and further development of application[12]. The necessity of handling a vast amount of data leads to semantic network, semantic search and the beginnings of artificial intelligence.

2. The stages of supporting decision-making processes based on the data set

When managers dispose large and small data sets, there occurs the question how to use them cheaply and efficiently in decision-making processes[13,14.]
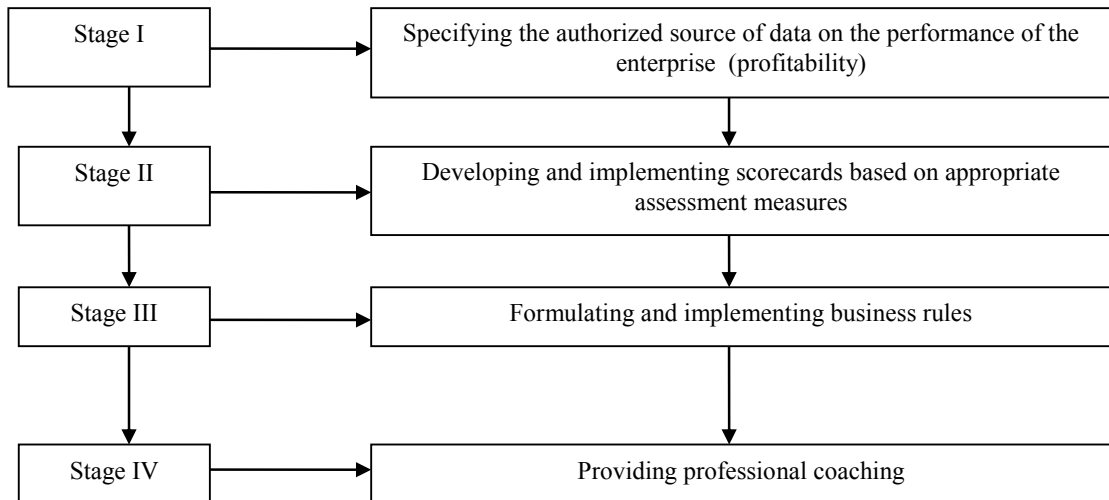

Fig. 1. Stages of supporting the decision-making process based on the market data set
Source: Own study

In the light of the conducted research and interviews among Polish managers of large and small enterprises, there was made an attempt to indicate the activities supporting decision-making in the enterprise, on the basis of the market data; they are based on four stages (see Fig. 1).

The first stage of supporting the decision-making process consists in determining the authorized source of data referring to the performance of the company; there is no need for the existence of only one data repository but all the internal units should use the common source of data on the performance of the enterprise[15]. A good indicator quantifying performance is profitability. The assessment of the enterprise activity requires the review of business processes and detection of these areas of the activity and places where errors get into systems. In such a situation, employees will be interested in both supervisory procedures for explaining the way of defining data and knowledge of information flow in the enterprise.

Another stage (the second one) of supporting decisions results for stage one and it consists in developing and using individual scorecards among employees; scorecards are currently updated and they show who is assessed and what scope of activities this evaluation refers to. Moreover, employees obtain feedback from managers and, therefore, they currently deal with professional duties. The advantage of the scoreboard is the fact that it focuses on the work results of a group of employees, out of whom each one can control it; it allows to notice the shortcomings of individual employees with reference to others before they affect the performance of the enterprise. However, an important issue is the selection of the appropriate measure in the scorecard, the level of which can be influenced by an employee.

The third stage of conduct in the analyzed decision-making process consists in explicit management of business rules. Business rules specify how to operate in certain circumstances. An example of a general rule of a furniture company is the following activity: if the payment is not made within 30 days from the specified date of payment the client's account is cancelled. An important issue is to make business rules provide the alignment of operational and strategic decision-makers. Enterprises characterized by the culture of decision-making based on evidence should care about continuous assessment and improvement of business rules, while formulating them clearly, and their observance throughout the organization. Business rules can be built in the systems of enterprises. Automation of business rules allows for easier data analysis and brings about more opportunities for conducting tests and drawing conclusions. However, an essential issue is to specify responsibility for specific rules and who can change them. With lack of responsibility for the operating rules there is reduction in their implementation in enterprises. What is more, enterprises should create rules engines separating rules from applications they are built in. Consequently, rules management and their modification will not require information expertise, by means of which it will be cheaper.

The use of coaching to improve the effects of the enterprise activity (stage four) constitutes the supplement of the data on the performance, measures and scorecards and business rules. In the processes of supporting decisions, there is a need for constant coaching, directed towards an increase in the efficiency of each employee; employees must be helped in switching to decision-making based on data. The function of a coach is frequently performed by e.g. presidents for senior managers; they explain them the meaning of e.g. rate of return on sales and show what can be done to achieve its improvement at the end of the month.

It should be underlined that the presented stages of supporting decision-making processes of enterprises should be introduced gradually in enterprises; first, the changes may affect e.g. the quality control department. While implementing performance measures and business rules, essential for decision-making, employees should be assigned coaches; their role could be performed by appropriate managers of appropriate management levels[16]. These initial attempts may lead to the detection of inappropriate rules, unreliable data and defective measures. The process of rational decision-making may be complex and it does not have to be linear (the order of stages is not always the same). In some aspects of the activity of enterprises the process of decision-making may be developed by the repeated return to the previous stages and starting the procedure from the beginning. The following, among others, are responsible for these retroactive operations: complexity of the problem, lack of accurate information and time and financial limits[17,18].

The decisions taken to improve the investigated area of the enterprise activity should gradually include further aspects of enterprise activity to develop the holistic and integrated model of enterprise management.

4. Conclusions

In the era of the Internet, each day, there are collected and processed all petabytes (millions of gigabytes) of data. It is estimated that, every hour, 100 hours of films get into You Tube, and 85 thousand films, which amount to 2400 gigabytes, are uploaded daily. Taking into consideration the fact that the object can be anything, from a photo to multi-structure database and assuming that the average file size is 1 megabyte, this may amount to even exabyte (a billion of gigabytes). According to the research conducted in 2011 by the scientists from the University of Southern California, the amount of data collected globally on the Internet and on devices outside the Network exceeds 295 exabytes. It should be noted that the data storage in present technical conditions is currently not a big challenge. The way of using data is extremely important nowadays and the quality but not the amount of data is vital.

The quality of decisions taken in the contemporary operations of enterprises is affected by efficient and effective use of available large and small data sets. It is not an easy task since modern information and communication technologies are a rather complex set of hardware, software and organizational solutions processed with data and the offered contents. They exert an influence on the way of enterprise management[19]. Supporting decision-making processes based on a data set should be used to respond to such challenges. In the paper, the authors have made an attempt to present the stages of decision support since only the organizations which formulate and implement new solutions in the field of decision-making processes can satisfy clients' expectations and establish business rivalry with competitors; the solutions in this field indicate the scope of challenges managers are to face in the area of the improvement of decision-making processes based on data sets.   The suggested mode of conduct referring to decision-making is of a utilitarian nature and requires further development; the selection of the important contents from the whole available information noise involves the integration with the overall strategy of the enterprise.

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