

BIG DATA IN MANAGEMENT OF METAL SECTOR ENTERPRISES

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Abstract

Big Data is related to data sets which exceed the capacity of traditional data processing systems and enforces significant changes in the data analysis approach. Changes in the analysis of Big Data relate to: the ability to analyze large amounts of data, readiness to deal with unstructured data, and rising importance of correlations. Big Data Analytics (BDA) may show new relations between data, reveal unseen earlier trends and contribute to the creation of new knowledge, which can then be used to create value. The aim of this paper is to identify the areas of metal sector enterprise areas where big data analytics can be effectively used and to formulate recommendations for the effective implementation of big data analytics projects. The aim was achieved using the desk research methodology and interviews with managers of large metal sector enterprises. The results of the study justified the efficiency of the use of big data analytics (BDA) in management of metal sector enterprises in the areas of customer relationship management, creation of value, creation of innovations and production management.

Keywords: Big Data, Big Data Analytics (BDA), metal sector enterprises, Big Data Analytics in management

1. INTRODUCTION

Nowadays, in turbulent settings, each enterprise constantly seeks sources of success expressed by the achievement of competitive advantage and high profits. Under conditions of the information overload, widespread access to ICT technologies, technological challenges and increasing customer requirements, management of contemporary enterprises seems to be very difficult. The effectiveness of organization is higher in the enterprises which support their decision-making processes with the use of the data derived from analytical systems and utilize the data-driven decision-making approach (DDD) [1]. In the era of the increasing amount of data, especially the unstructured data, which cannot be effectively collected and processed by conventional information systems, the concept of big data is attracting more and more interest, with particular focus on the analytical capacity of this solution defined as big data analytics (BDA).

The aim of this paper is to identify the areas of metal sector enterprise areas where big data analytics can be effectively used and to formulate recommendations for the effective implementation of big data analytics projects.

The paper is organized according to the following design: the introduction section presents the aim of the paper, followed by the discussion of the problem of the effect of modern ICT technologies on the increasing amount of data, especially unstructured data. Using this context, the paper presents the concepts of big data and big data analytics. Another part presents the changes in the metal market with particular focus on the factors which have a negative effect on the development of this sector. The empirical part of the paper presents the results of desk research and interviews with managers in large enterprises in the metal sector. The summary contains the conclusions from the surveys and recommendations for the projects of BDA implementation in metal sector enterprises.

2. MODERN TECHNOLOGIES AND THEIR IMPACT ON NEW TYPE OF DATA

The substantial increase in the amount of information resources collected in the servers is confirmed by the introduction of the term zettabyte which means 1 trillion gigabytes. The resources of the data collected by business organization double every thirteen months [2]. The rate of changes is stimulated by numerous sensors and interconnected automated equipment that generates and saves any events connected with organizations' activities. The development of the Internet of Things and automation of collecting various data flowing from the interconnected devices is also important. It is not only people but also the devices around them that are becoming the sources of the data streams. The problem lies, however, in using these data, which seems to be inefficient and not related to the expected potential.

The current explosion of data that is being generated is due to three main reasons [3]: firstly, hundreds of applications such as mobile sensors, social media services, and other related devices are collecting information continuously; secondly, storage capacity has improved so much that collecting data is cheaper than ever, making preferable to buy more storage space rather than deciding what to delete; thirdly, machine learning and information retrieval approaches have reached a significant improvement in the last years, thus enabling the acquisition of a higher degree of knowledge from data.

Koff and Gustafson [4] demonstrated that on the one hand, the increase in the data represents an opportunity and threat for enterprises. This results from deficiencies of the experience of using both rich and unstructured resources and inability of their complex presentation so that they represent an inspiration or a source of knowledge in identification of the organizational problems. Undoubtedly, it is difficult to imagine the world of organization without big data and using them for management.

3. BIG DATA AND BIG DATA ANALYTICS

The term big data relates to the data sets with size that goes beyond the opportunities for acquisition, storage, management and analysis offered by typical tools of database software. The phenomenon called "Big Data" differs as a data source from the previously used sources such as databases or data warehouses. Davenport and others [5] emphasise that organisations which capitalise on big data stand apart from traditional data analysis environments in three key ways: they pay attention to data flows as opposed to stocks; they rely on data scientists and product and process developers rather than data analysts; they are moving analytics away from the IT function and into core business, operational and production functions.

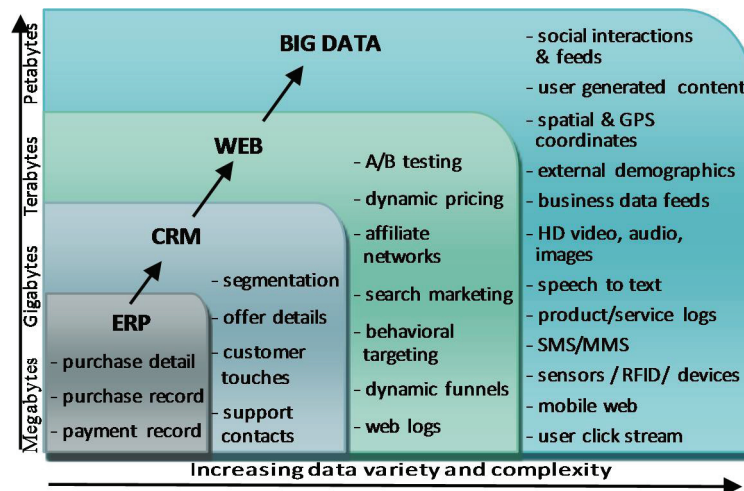


Figure 1 Big Data - variety and complexity [6]

Figure 1 shows the relations between increasing data variety and complexity and the memory size of databases from megabytes to petabytes. It is shown that ERP systems generate data which companies collect

and process in databases or data warehouses. Nevertheless CRM and Web systems have the biggest influence on the rapid increase in the amount of data. **Figure 1** also presents the main sources of data for Big Data.

Big data analytics is the process of examining large data sets to uncover hidden patterns, unknown correlations, market trends, customer preferences and other useful business information. Changes in the analysis of Big Data relate to three main areas [7]: the ability to analyse large amounts of data, while not having to use smaller data sets; readiness to deal with unstructured data, characterised by low accuracy and rising importance of correlations, which tend to look for relations between phenomena rather than their causes.

Big Data analytics may show new relations between data, reveal unseen earlier trends and contribute to the creation of new knowledge, which can then be used to increase the effectiveness and improve the profitability of the company. In the long term, these can compensate for the costs associated with the purchase of specialised software and hiring specialists [8].

4. CHANGES IN THE METAL MARKET

After years of growth, 2015 saw a decrease in crude steel output and in world steel consumption. In 2015, 1.623 billion tonnes of steel was produced globally, which means a decline by 2.8 % compared to 2014 [9]. Similar situation is observed in the European market. In 2015, EU crude steel production dropped by 2 % and apparent consumption of steel products increased by 1.6 %, primarily owing to a 3.2 % rise in third-country imports [10]. The highest declines in production were recorded in the UK (10.4 %), France (7.2 %) and Italy (7.1%). However, there are countries where steel production levels increased, such as Spain (4.4 %) and Poland.

In 2015, Poland produced 9.2 million tons of crude steel, i.e. 8 % more than in 2014, whereas the average capacity utilisation of the domestic steel industry was about 5 pp higher than the figure of the previous year, and amounted to 73 % [10]. This good result of consumption of steel products was achieved with only a 33 % share of domestic supplies. This phenomenon seems to be worrying as it forces Polish enterprises to seek new competitive advantages in the situation of unfavourable external conditions, including: the excess capacity in steel industry across the globe reaching 700 million tons of crude steel [10]; import of cheap products from non-EU countries, calling for urgent modernization of trade defense instruments; high costs of the EU climate policy; granting China the market economy status (MES); high prices of raw materials (iron ore, coal, coke and steel scrap), gaseous fuels and electricity while these prices are declining abroad; increasing cost of capital and the presence of potential risk of credit constraints; fierce competition caused by the overlapping roles of steel plants, service centres and wholesalers.

The competitiveness of European steel producers vis-à-vis cheaper imports decreased. Therefore, since the enterprises are unable to compete with prices, they should take into consideration other opportunities for gaining the competitive advantage in the market. The most popular competitive strategies include: strategy of competing by ensuring production quality [11], production flexibility [11], lean concept [12] processes improvement [13], efficient resource management [14], approach oriented towards meeting customer needs [15], focus on creation and management of relations with customers [16], approach oriented at creation of value for the customer [17, 18], orientation towards innovativeness [19], including the enterprises in the network structure [20], using ICT and integrated information systems (e.g. MRP, MRP II, ERP), and many others. The effectiveness of the selected and implemented competitive strategy depends on a number of internal and external settings, recognition of strengths and weaknesses of the enterprise, identification of opportunities and threats of the environment and, first and foremost, understanding of the specific nature of the enterprises in the metal industry. Big Data can also be the source of competitive advantage in metal sector enterprises, especially if the solution implemented substantially supports the decision-making processes in various areas of the enterprise.

5. USING BIG DATA ANALYTICS IN SELECTED AREAS OF FUNCTIONING OF METAL SECTOR ENTERPRISES

According to Davenport and Harris [21], more and more enterprises build their strategies effectively using big data analytics. The examples are the UPS express courier services provider which uses big data to improve their performance, Kayak tourist portal that uses big data analytics to predict prices of airline tickets or Netflix and the sector of video rental that created a unique system of offer personalization. In light of the above example, the question arises: If so, how the metal sector enterprises use (or can use) big data analytics? The author attempted to find the answer by using the desk research and interview methodologies. The basis for the desk research analysis was publications from the two areas: big data analytics and management in metal sector enterprises. The analyses resulted in identification of the areas of using big data analytics (BDA) in management of metal sector enterprises. These include: changes in the decision-making process: rejecting the hypotheses and attempts to collect information in order to verify them to wait for the results of BDA and analysis of the presented, previously unknown relationships; the use of BDA in customer relationship management; the use of BDA in value creation; the use of BDA in the process of creating innovations; the use of BDA in production management, especially in planning and improving production quality.

The aim of the interviews with the managers of 6 large metal sector companies (3 steelworks, cast iron foundry, alloy foundry, metal processing company) was to verify and supplement the above list with potential applications of BDA in management of metal sector enterprises. The interviews were made in person in the enterprises' headquarters in April 2017. When talking about big data phenomenon, all the managers agreed that they did not see a substantial increase in the amount of unstructured data in the resources of their enterprises. They do not experience problems with acquisition of information from the information systems. The interviewees were familiar with the concept of big data, its potential for advanced analyses and detection of the relationships. Without going into detail, this solution was compared to business intelligence, data mining and knowledge discovery systems. One of the respondents concluded that there is lack of experts and analysts who are familiar with the metal industry and can properly interpret the obtained results of the analyses. Several years ago the enterprise implemented an integrated ERP system with the module of manager dashboard, which is not fully used since users do not have sufficient competencies in terms of the analytics and interpretation of the data and construction of prediction models.

During the conversation about customer relationship management and value creation, it was demonstrated that the most numerous group of recipients includes corporate customers and it should be recognized what is the value for such customer since the reception of the value by individual groups of recipients of steelwork products is observed: public procurement market, industrial processing market and foreign trade market. Three enterprises have a formal system of customer relationship management and these companies confirmed the importance of the unique relationships obtained based on BDA.

Full consistency in managers' opinions was found for the use of BDA in innovative activities. Two respondents referred to the INNOSTAL programme whose aim is to increase competitiveness and innovativeness of the Polish steel industry in the perspective of 2026. In the INNOSTAL contest for innovative projects in the metal sector in 2016, 132 million zlotys were allocated to the contest's budget, whereas this value for 2017 was over 95 million zlotys (decision in the third quarter). Both enterprises will apply for the contest and their managers appreciate the use of advanced analyses and detected relationships which would identify the directions of innovations.

The concepts of *Internet of Things (IoT)*, *Industrial IoT* and *Industry 4.0* were mentioned during the discussions and it was agreed that the effect of automation of production lines is supplying huge amount of data from smart sensors to information resources, control devices, monitoring systems etc. Integration of these data with the resources of ERP, CRM and SCM systems offers a perfect environment for the use of BDA and supporting planning, evaluation of the costs of production processes and using information from recipients to implement real-time changes in production lines and process parameters.

When asked about the future of BDA in metal enterprises, all the managers agree that it is a promising solution, which, facing the increasingly competitive environment, may turn out to be a substantial support in decision-making and the source of inspiration in seeking competitive advantage in the metal market.

6. CONCLUSION

The theoretical investigations, analysis of the results of desk research and interviews with managers of large enterprises from the metal sector led to the following conclusions:

- 1) Enterprises of the metal sector do not see a substantial increase in the amount of data, including the unstructured data in information resources.
- 2) Managers are familiar with the concept of big data, but big data analytics projects are not considered as priority
- 3) Big data analytics are not viewed as an important source of value creation and competitive advantage in the metal market.
- 4) In the enterprises of the metal sector, the potential areas of using big data analytics are indicated by strategic management, including the support for the managers, predictive analytics and simulations "what will happen".
- 5) Big data analytics may be an important support in customer relationship management, innovation management and production management.

For metal sector enterprises which intend to implement BDA solutions, the following recommendations were formulated:

- 1) Implementation of big data project in the metal sector enterprise is a complex project and requires the use of reliable methods of project management at each stage, i.e. preparation, implementation, use and improvement of big data analytics.
- 2) The stage of preparation should represent a sequence of actions: identification of the areas of enterprise's activities where big data can yield measurable benefits, build future-state capability scenarios and define benefits and road map
- 3) The process of value creation in big data solution should be focused on the development of a new analytical model which allows a user to retrieve information from the available database. Interpretation of the data obtained in this manner may represent a significant economic value.
- 4) It seems legitimate to improve competencies of managers in the areas of data science and big data analytics so that they are able to fully utilize available information in the processes of decision-making.
- 5) With increasing opportunities for using big data solutions, it seems critical to constantly improve the functioning solution to keep up with the changes in the IT market and ensure real-time responding to changes in the metal sector.

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