BIG DATA APPLICATIONS IN SMES

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Abstract: *In the last several years a new technology known as Big Data has been developing. Data may now be perceived as "big", but that does not mean it is exclusively for large enterprises. It is a tool now known for being better and better accessible to small and medium-sized enterprises (SMEs) too. Enjoying easier and cheaper access to servers and data centres, delivered through cloud vendors, SMEs now face fewer constraints on upfront investment, the challenges presenting themselves as organisational and strategic by nature. Data is collected and analysed to provide new information and knowledge for useful business. Similar theoretical assumptions were the basis of business intelligence systems. Therefore, whether something new or the evolution of technology is concerned, Business Intelligence will always evolve. The issues outlined above will be analysed in this paper. It consists of a short introduction, after which the concepts and definitions of Big Data are presented. The next section presents results of analysis related to Big Data in different business areas with particular emphasis on applications dedicated to SMEs. The entire discussion ends with a brief conclusion.*

Key words: Big Data, SMEs, business analysis

JEL Classification Codes: A10, C80, C88.

1. INTRODUCTION

Micro, SMEs are the motor of the European economy, which represent 99,8% of all enterprises, and SMEs are the backbone of the service-driven economy (European Commission, 2005). According to Deloitte a typical EU enterprise is an SME which has fewer than ten employees. Almost 67% of workers are employed by SMEs, 85% of the net new jobs in the EU between 2002 and 2010 were created by SMEs.

In the report Polityka Insight (2016), the authors discuss the importance of SMEs for the Polish economy and indicate that this sector has great development potential. Moreover, they admitted that there is still space for activities for many new SMEs before the economy reaches a saturation of these types of companies. The SMEs sector can be characterised as follows:

- The Polish SME sector is smaller than in other EU countries.
- Industrial and trading type of activities dominate among the SMEs.
- SMEs use bank loans three times more than large enterprises.
- SMEs are growing on average at the same rate as large companies.
- The biggest barrier to the growth of SMEs is the high tax burden and bureaucracy.
- The development of SMEs is based mainly on increasing productivity.
- SMEs are investing more in people than machines. The share of SMEs in the total value of business investment is gradually decreasing, and the share of people working in the SME sector is growing steadily. Importantly, this group of companies provide in wages one-third more income than large companies.
- Difficult access to finance for SMEs inhibits innovation. According to entrepreneurs, the difficulty of obtaining funds is the biggest barrier to the development of innovation.

- Difficulty in finding skilled workers is growing in accordance with the size of the company. The lack of adequately trained personnel in the industrial and building sector is quite visible. The problem of gaps in education also applies to directors and owners of SMEs who often do not have management skills and basic knowledge of finance and accounting. Despite this, Polish companies least often (22 percent of entrepreneurs) throughout the EU send their employees to vocational training.
- The biggest barrier to growth is the small trap scale. This phenomenon is low growth in the scale of micro-enterprises, employing fewer than ten people. What's more, it turns out that these companies are developing more slowly than the competition, even if they have become small businesses, and will be included in the SME sector. This phenomenon results from a different development model of micro enterprises, which quite often are focused on activities only on a local scale, with high non-willingness to take business risks and deficiencies in management skills [1].

With easier and cheaper access to servers and data centres, delivered through cloud computing (CC) vendors, SMEs now face fewer constraints on upfront investment, the challenges present themselves as organisational and strategic by nature. Data is collected and analysed to provide new information and knowledge for useful business. Similar theoretical assumptions were the basis of ICT systems. Therefore, whether something new or the evolution of technology is concerned, ICT will always evolve.

2. METHODOLOGY

Definition of Big Data

The Very fast increase of data, seen as an avalanche of data, forces the need to acquire, store, to analyse as well as use it in everyday business life. Such a situation can be presented in the context of still growing the capacity of memory devoted to storing information in macro scale (see figure 1).
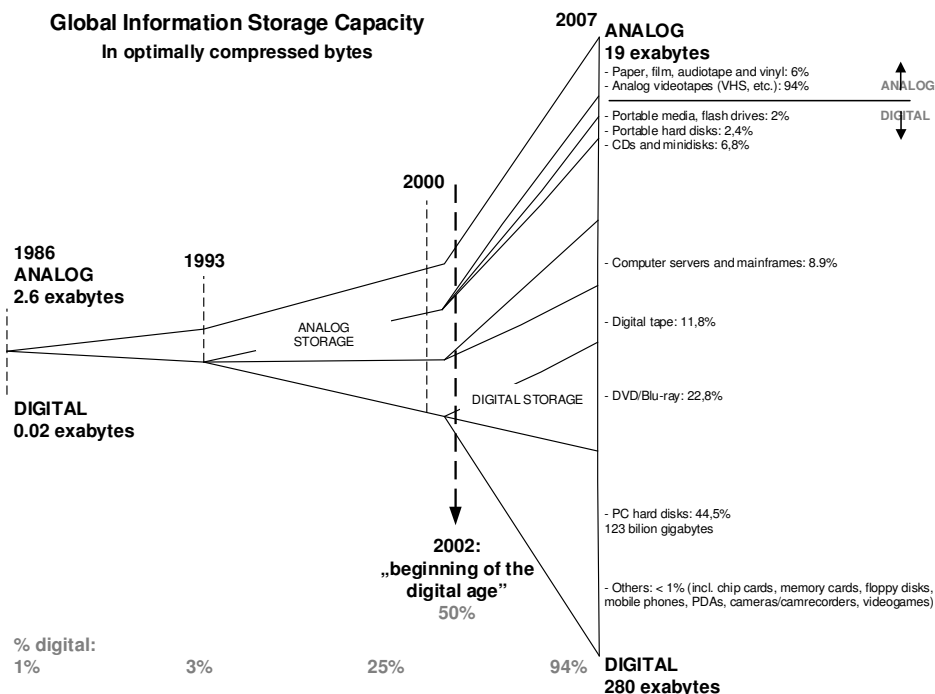

Figure 1. Growth of memory size for information storing in a global scale within the last 30 years [2]

Big Data is a term that describes the large volume of data – both structured and unstructured – that inundates a business on a day-to-day basis. But it's not the amount of data that's important. It's what organisations do with the data that matters. Big Data can be analysed for insights that lead to better decisions and strategic business moves [3]. Big Data can be described regarding data management challenges that – due to increasing volume, velocity and variety of data – cannot be solved with traditional databases. While there are plenty of definitions for Big Data, most of them include the concept of what's commonly known as the "three V's" of Big Data:

-Volume: Ranges from terabytes to petabytes of data

-Variety: Includes data from a wide range of sources and formats (e.g. web logs, social media interactions, e-commerce and online transactions, financial transactions, etc.)

-Velocity: Increasingly, businesses have stringent requirements from the time data is generated, to the time actionable insights are delivered to the users. Therefore, data needs to be collected, stored, processed, and analysed within relatively short windows – ranging from daily to real-time [4].

- Value: In 2012, Gartner extended this definition of a new component: evaluation / verification of their data (ang. Value) showing that Big Data are high-volume collections of information, indicating considerable volatility and require new types of processing to support decision-making processes to discover new phenomena or process optimisation [5].

Recently the term Big Data has appeared not only in IT societies but also in business societies and quickly became very popular. It awakes many different, both feelings, fears as well as hopes.

You can look at Big Data as on the newest trend in information analysing that enables us to carry out analyses of very large sets of data. Valuable business information is the result of these analyses.

Understanding what Big Data is, evaluates in time. Should you think only about collecting a huge number of data? About global invigilation of people? Maybe you should be afraid of the possibility to access our private data by big companies to dominate us? Maybe Big Data possibilities are connected with an e.g. better assessment of markets, achieving better knowledge about customers of banks, etc.?

Big Data applications can store, integrate and present both structured and unstructured data/semi-unstructured, providing a comprehensive view of the business environment for easier analysis and consumption [6].

The importance of Big Data doesn't revolve around how much data you have, but what you do with it. You can take data from any source and analyse it to find answers that enable:

• cost reductions,
• time reductions,
• new product development and optimised offerings, and
• smart decision making.

When you combine Big Data with high-powered analytics, you can accomplish business-related tasks such as:

· Determining root causes of failures, issues and defects in near-real time.
· Generating coupons at the point of sale based on the customer's buying habits.
· Recalculating entire risk portfolios in minutes.
· Detecting fraudulent behaviour before it affects your organisation [7].

Currently, Big Data, which is the analysis of large data sets, is used mainly in the largest companies in the financial sector. But that will change soon - the Big Data will also benefit SMEs. The key is to ask relevant business questions and appropriate selection of data for analysis. Collecting and analysing Big Data - large data sets - is relevant in global industry, banking and trade. The advantage of large companies lies in the fact that having a huge number of users creates an appropriate amount of comparative data [8].

Problem Statement

An analysis of the Big Data in selected SMEs in Poland shows that this kind of solution is used very seldom. This results from the fact that:

- Owners do not have any strategy for developing ICT systems.
- There is a lack of digital entrepreneurial culture in Europe.
- There is a low level of entrepreneurial skills and talent.
- There is difficult access to finance and investments.
- Owners of SMEs don't have enough knowledge on Big Data, not sufficient funds as well.
- There is a fragmented digital market [9].

It affects the level of technical problems, limits the employees in the implementing innovative changes and finally leads to gaining low profits from business activity. In Poland, only some managers are aware of the need for innovative changes. Therefore some of them whenever possible try to improve the current situation [10],[9].

The Goal of the Study

- To identify the state of the art and directions of Big Data in SMEs in Poland;
- To identify Big Data solutions which can be applied in SMEs in Poland
- To appropriate areas in which Big Data solutions can be used
- To build the business model of Big Data for SMEs
- To appropriate further development and recommendations of Big Data with particular emphasis on SMEs

Research Questions

- How do SMEs deal with the implementation of Big Data nowadays?
- Which kinds of Big Data solutions are applied in SMEs in Poland?
- In which areas can Big Data solutions be used?
- Which business model of Big Data dedicated for SMEs could be optimal?
- What further development and recommendations of Big Data with particular emphasis on SMEs may be expected?

3. RESULTS

State of the art and directions of Big Data in SMEs in Poland

The rapid growth in the quantity of information creates the necessity to acquire, store, analyse, use and disseminate data. In the last several years a new technology known as Big Data has been developing dynamically. Gathering a large variety and volume of data has mostly been possible for large corporations. It is worth mentioning that most of the large enterprises have launched initiatives to complement their analytical proficiencies, but as technologies mature and more and more companies adopt frameworks for handling data and learn how to organise within this new framework, SMEs might find it easier to gain some of the benefits.

Thus data may now be perceived as "big", but that does not mean it is only for large enterprises. It is a tool now known for being better and better accessible to small and medium-sized enterprises (SMEs) too. What is important is that it does not entail very high costs. With the proliferation of Internet-enabled technologies, such as mobile, social media, cloud computing and the Internet of Things, having less revenue and fewer people no longer means that less information is available.

To get acquainted with information on the current situation regarding the implementation and use of Big Data systems in Polish enterprises and institutions, fragments of a study conducted by Computerworld in cooperation with IBM Poland have been presented below. The essence of the analysis was to determine which companies have the solutions in the area of Big Data or plan

to achieve them and why. Another objective was to examine the problems faced, what they want to achieve, and finally - if and what correctness in this field can be identified about organisations from different sectors of the economy.

So, the report prepared by Pietruszyński (2014) shows that among the 224 companies that participated in the survey, nearly 30% use already to some extent Big Data solutions. A further 1/3 of the organisation intends to implement this type of system in the future. IT companies have been found to be the most interested in Big Data solutions. These companies have an awareness of the benefits and adaptation solutions of Big Data which means that they are going further than the rest of the surveyed organisations. This regularity is visible both at the stage of completed and planned deployments [11].

Figure 2 shows the stages of implementing Big Data regarding sectors of SMEs and figure 3 shows the situation in large companies and corporations. It suggests that the SMEs which decide to implement Big Data have shorter decision-making processes, decision-makers are usually CEOs or business owners. They prefer smaller-scale implementation, which further reduces implementation time. Corporations need more time to test and implement solutions. Also, big companies have extended decision-making processes because they have to integrate the implemented system with the one already functioning within the organisation's IT architecture.
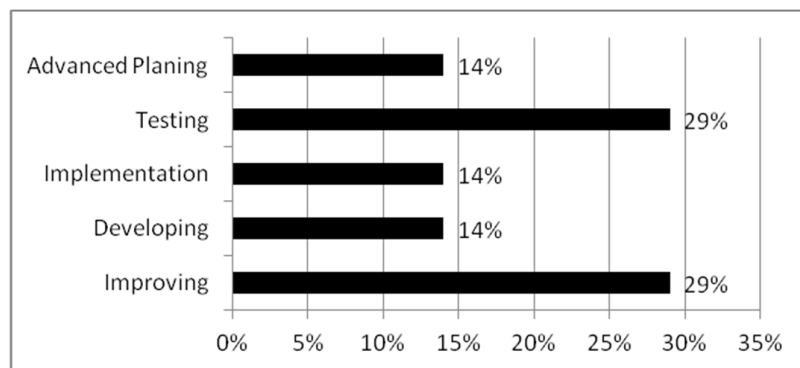

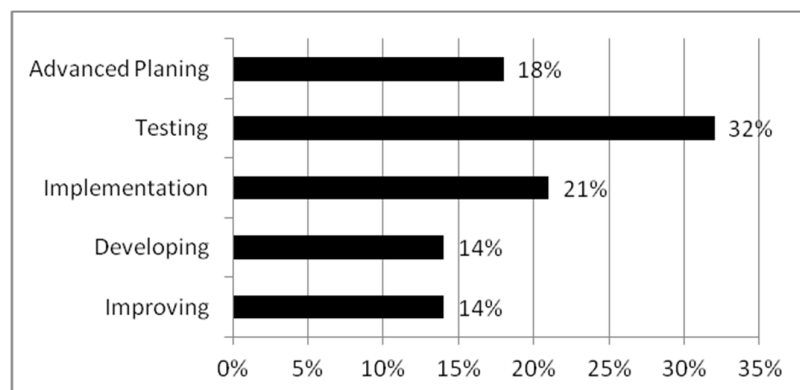**Figure 2:** Stage of implementation of Big Data in SMEs.

Figure 3: Stage of implementation of Big Data in large companies and corporations.

It is worth mentioning, as indicated above that, among the SMEs, strategic decisions about the implementation of systems analysis of large volumes of data primarily are taken by the boards. See table 1 below.

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Table 1. The departments undertaking strategic decisions about the implementation of Big Data, depending on the size of the company. Elaboration based on [11].

Policy makers/size of the company	Number of indications	Percentage indications
IT department	24	24
Large companies and corporations (over 250)	15	63
Medium-sized companies (51-250)	5	21
Small companies (below 50)	4	17
Business Departments	25	25
Large companies and corporations (over 250)	13	52
Medium-sized companies (51-250)	7	28
Small companies (below 50)	5	20
The Board	43	43
Large companies and corporations (over 250)	13	30
Medium-sized companies (51-250)	10	23
Small companies (below 50)	20	47
Other	7	7
Large companies and corporations (over 250)	5	71
Medium-sized companies (below 51-250)	2	29
A total number of responses	99	100

Big Data solutions in SMEs

Big Data technology which is mentioned above is not dedicated only to the largest companies. It is a tool becoming more accessible to SMEs as well. Of course most of the available tools are developed for large companies, however tools are increasingly appearing that can be used in the SMEs. In many cases, Big Data is suited to small business in ways that it never was for big business – even the most potent insights are valueless if your business is not agile enough to act on them in a timely fashion. Small businesses have the advantage of agility, making it perfectly suited to act on data-derived insights with speed and efficiency [12].

Lots of analytics solutions cater to larger enterprises, which makes them expensive and inaccessible to the SMEs owners. Fortunately, there are plenty of companies out there, both large and small, looking to democratise Big Data to help SMEs owners find the right tools to get their work done more efficiently [13].

Increasingly, there are more and more reports of specialists as well as valuable scientific studies about the Big Data tools. The following are selected solutions that can be used successfully in the sector of SMEs.

For instance, you can use the information on the volume and location of purchases provided by, among others Factual. Factual focuses on location data — data about where places are and how to better understand people based on their geographic behaviour. Factual has APIs, mobile drivers, and on-premise implementations to make the data easy to use and integrate. The companies, across some categories including local search, mapping/navigation, social/messaging, mobile advertising, and payments, use Factual data to improve their products - products that are used daily by people [14].

According to the authors, also services such as Kaggle may be helpful, which cooperate with experts from around the world specialising in solving analytical problems. Kaggle was founded as a platform for predictive modelling and analytics competitions on which companies and researchers post their data and statisticians and data miners from all over the world compete to produce the best models. This crowdsourcing approach relies on the fact that there are countless

strategies that can be applied to any predictive modelling task and it is impossible to know at the outset which technique or analyst will be most effective. Kaggle also hosts recruiting competitions in which data scientists compete for a chance to interview at leading data science companies like Facebook, Winton Capital, and Walmart [15], [16].

Another solution in the field of BI and analysis of Big Data is Apache Hadoop. Hadoop enables the cost-effective platform to manage and analyse vast amounts of text, graphics and movies; both ordered and devoid of structure form. For example, typical business applications can be used as monitoring systems, customer service, text analysis and forecasting. It is worth mentioning that some companies are trying to prepare the IT infrastructure for future Hadoop projects. Planned investments apart from the necessary equipment also include training for specialists, the introduction of new specialised jobs and increasing budgets to finance future resources.
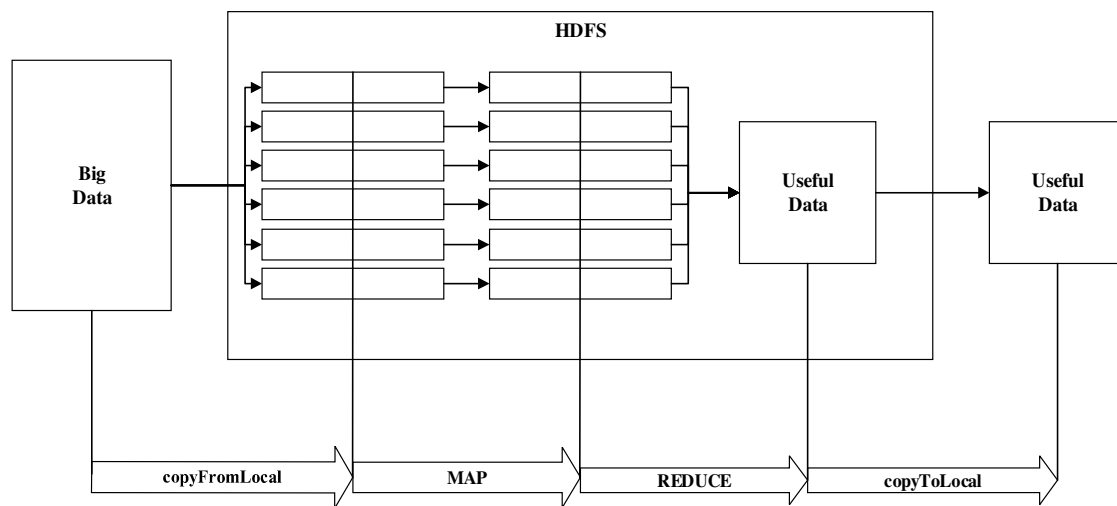

Figure 4: Map-Reduce Jobs [17]

The aim is to prepare to use Big Data technology in many areas such as study data aggregation and processing of diverse data sets. As an important area of the use of the platform, Hadoop is the expansion of the existing data warehouse. The most frequently cited barriers to the use of solutions of this type are the lack of technical knowledge, implausible scenarios of applications, the lack of a solid business case and depreciation doubts about the new technology concepts [18].

Dariusz Flisiak (2015) believes that you have to remember that Big Data is not a means to solve all the problems. First of all, you should define your business needs, and with the first attempt to carry out carefully and rather on a small scale. We often have to deal with the situation that companies are trying to gain too much detailed data from different sources, while most of them will never be used. Big money spent on analytical tools and technologies needed to perform the analyses are not a guarantee of success. Very few owners of companies understand that the strength and quality of Big Data have little in common with the purchased IT tools. Instead of costly investments in infrastructure and the accumulation of huge amounts of data from the beginning, you should learn how to properly use the data they already have, and come back later to complement the analysis, e.g., Data from social networks. Above all, remember that a vision of the business should define what data and technology we need, and not vice versa." [19].

Big Data business model (Maturity Index) dedicated for SMEs

To effectively deal with the implementation and use of Big Data technology it is worth mentioning that knowledge of business processes in the company can significantly facilitate all activities concerning the implementation of Big Data. The vast majority of SMEs which you can encounter are stuck in the business monitoring phase. See figure 5 below:
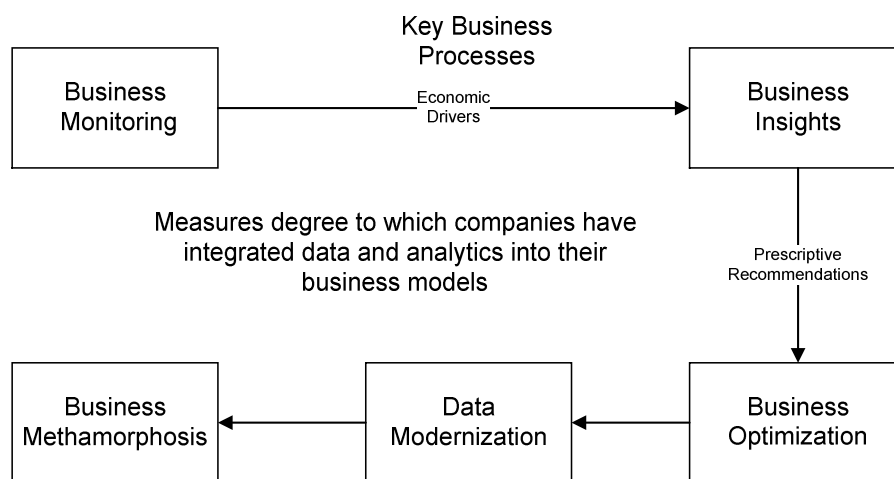
Key Business Processes

Business Monitoring

Economic Drivers

Business Insights

Measures degree to which companies have integrated data and analytics into their business models

Prescriptive Recommendations

Business Methamorphosis

Data Modernization

Business Optimization

Figure 5: Big Data Business Model Maturity Index [20]

In this phase, companies are using BI and Data Warehousing (DW) tools to monitor the business; providing a retrospective, batch view of what the business has accomplished. And while this is a critical foundation upon which to build Big Data capabilities, organisations have learned that they cannot become a real-time, predictive and prescriptive data-driven organisation using these BI and data warehouse tools. Organisations need something more, which is where the Big Data Business Model Maturity Index comes into play [20].

Thus it is worth finding answers to the questions:
1. So what are the steps that a company needs to accomplish to advance itself through the Big Data Business Model Maturity Index?
2. What actions do organisations need to take to become a more real-time, more predictive and prescriptive organisation that is capable of monetizing opportunities with Big Data and developing entirely new business models around these new insights?

Companies need a prescriptive guide to progress through the Big Data Business Model Maturity Index; to become more effective at leveraging data and analytics to power their business models [20].

Further development and recommendations of Big Data with particular emphasis on SMEs

Big Data is a big problem for the owners of SMEs. For this reason, the authors present a list of recommendations for the owners of SMEs, which can be a stage of the initial implementation of this technology.

Knowledge of corporate e-mails. The source of the data which you can use to improve your business are e-mails. During a thorough analysis of the company's employees' correspondence with customers and partners a lot of gaps and oversights can be found, which can be eliminated in the further operation of the company.

Website analysis. Representatives of SMEs should analyse as much data on the use of the website, its suitability for business, user experience, etc. as possible. It provides a basis for conclusions which most customers are interested in and what type of content or product must be offered to them.

Customers on Facebook. SMEs can take advantage of the large amounts of data which are provided by social media. Keeping a Facebook profile also provides accurate information about customers, their preferences and how to effectively reach them. Tracking specific entries can measure the popularity of the brand or website and, if necessary, the study of which is the weakest and the strongest point. Even with a single entry on Twitter you can get information such as the place from which it was sent, the user's name, its operating system, the browser. With built-in GPS transmitters in increasingly popular smartphones, you know the whereabouts and residence of their owners. Based on the analysis of the behaviour of an Internet user gender and age are requested. Knowing these parameters, it is much easier to plan a marketing campaign, even realised offline.

The analysis of accounting documents. Corporate balance sheets contain a lot of tips about potential savings or poorly developed measures. It optimises fixed expenses and sees if the use of other, more expensive technology does not return quickly enough the investment and was worth it. Even small prompt savings and scale can significantly improve the functioning of the business.

The most important is not the collection, but the use of information and drawing conclusions from them leads to business benefits. Properly prepared and interpreted information can bring profit on every possible level - from improving the relationship with the customer, to savings associated with the business [21].

Possible areas to use Big Data solutions in SMEs.

Quite interesting examples of Big Data technologies are presented by Piotr Płoszajski (2013) in the article " Big Data: nowe źródło przewag i wzrostu firm". The analysis mainly concerns large companies, but some of the solutions presented below can be successfully applied in the field of SMEs. Examples of the use of Big Data:

- The Bank implements methods of the segmentation of millions of credit card owners to customise products to individual risk profiles.
- Hypermarkets perform daily analysis of data on transactions using their loyalty card - for better promotion of specific client segments.
- Sales networks of fruits and vegetables can take every day (sometimes even more) to make an automatic adjustment of prices and launch new promotions by data on online transactions, customer visits to the website and customer service departments.
- Companies producing cars or airlines follow posts on Facebook and Twitter to react immediately to changes in customer attitudes towards companies and products.
- Supermarket chains predict how the weather affects customer purchases and adjust delivery.
- Travel Agents use data analysis to determine pricing policy and marketing strategies for vacation packages.
- Real estate companies test the mathematical models to understand the trends in demand for office space.
- Farecast, the tool associated with the Microsoft search engine Bing, advises clients about the best time to buy an aeroplane ticket, analysing for each question up to 225 billion data about flights and prices. The same method is used to book hotel rooms and cars.
- Analysis of large data sets led to the discovery of the practice of match-fixing and fraud agents totalizator.
- Insurance companies are beginning to test the sensors placed in cars to monitor driving customers and enable the calculation of appropriate rates. Specialised sensors can indeed

be replaced by much simpler ones to use the data from the client smartphones, whose advanced models have a GPS, accelerometers and position sensors [22].

4. RESEARCH LIMITATIONS AND SCOPE FOR FUTURE STUDY

Big Data is rapidly evolving into an analysis allowing for the acquisition of valuable information and knowledge. For this reason, attempts are being made to establish areas for future study. As a suggestion for future research on Big Data, the study creates an opportunity towards the new business model for SMEs, which could be implemented in companies regardless of their type and activity. Since the study focuses on Polish enterprises, the resulting contents reflect the situation in Poland and probably in some SMEs of the EU as well. Thus it may be a starting point for analysing other regions all over the world.

Figure 6 below shows the forecast of Big Data on the supply chain issue. However, you can expect similar forecasts of Big Data in SMEs. A rational approach would be to determine the possibility of using the applications characterised in this article to perform the tasks associated with Big Data in the sector of SMEs.
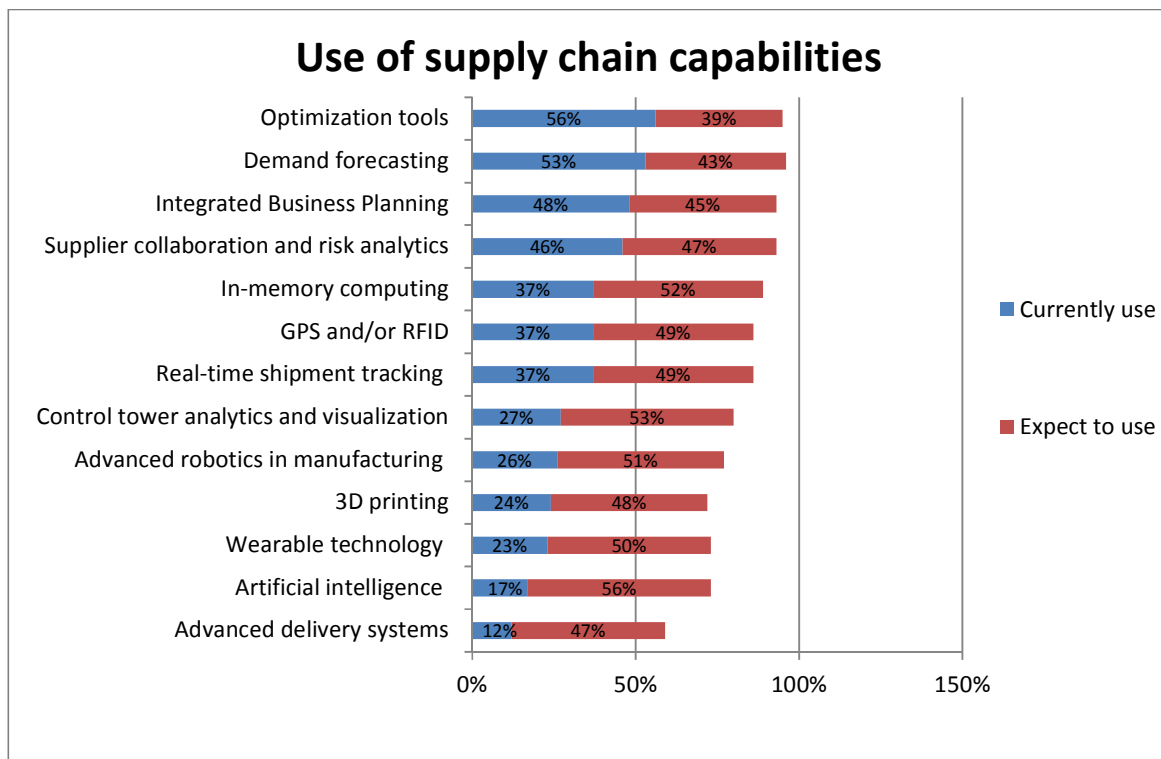

Figure 6: Use of supply chain capabilities [23]

Big Data and advanced analytics are being integrated into optimisation tools, demand forecasting, integrated business planning and supplier collaboration & risk analytics at a quickening pace. These are the top four supply chain capabilities that Deloitte found are currently in use from their recent study, Supply Chain Talent of the Future Findings from the 3rd Annual Supply Chain Survey [23].

5. CONCLUSION

The role of Big Data in SMEs is still increasing. SMEs need to take decisions with synthesised information about the company and the market in which they operate. With the help of these analyses and forecasts, the company can make better decisions, which in effect will be fruitful in increasing competitiveness. Despite the fact that Big Data presents many opportunities for SMEs, the utilisation of Big Data in SMEs is very seldom. Mobile, social media and the Internet of Things will have more and more influence for Big Data solutions in SMEs.

Unfortunately, we still have to deal with many restrictions. Someone still has to manage the processes and read the answers hidden in the data. So we need specialists in Big Data analytics. Data science, data scientists, data experts, and even the ruler of the data - these various professions will be on the lists of the most popular and most desired professions of the future.

Most SMEs can't afford to employ a dedicated analyst or order sophisticated market analyses. One solution may be to use outsourcing companies as well as the purchase of ready-made solutions at an affordable price with implementation. Providers are increasingly identifying the need to work with the SME segment. Innovative solutions are currently available on the market (e.g., Data Platform Beat - analysis of BI in the formula SaaS for small and medium-sized enterprises). These tools allow the integration of multiple types of data from different sources, providing some work modules.

In conclusion, it should be noted that companies that invest in Big Data solutions will open in front of themselves a chance to not only improve the performance of their existing lines and business processes but also to start the next, based on new information on consumer trends, obtained from the Big Data tools. It is a solution that can support decision-making in business, allowing quick collection, storage, analysis and sharing of relevant data for running and developing the business. Access to such information and, in a broader context, knowledge, will enable SMBs quickly and efficiently to adapt to necessary changes and identify new opportunities for business tasks.

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