BIG DATA – AN USEFUL TECHNOLOGY FOR ECONOMISTS

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Abstract: *This article provides an analysis of Big Data technology and its use in economics. This term is frequently associated with the notion of Artificial Intelligence so that in the text they are frequently appearing together, especially in the section for practical study. Big Data has passed the "buz word" term and it is a reality of the current period. Evolutions in the field of hardware and software also contribute to this state of affairs, which allows applications that incorporate Big Data technologies to be common in the economic field. Professional accountants need such technology because the work involved requires storing and manipulating a large volume of data, which often exceeds the table structure and is found in unstructured formats (documents, electronic correspondence) that must be analyzed in a short period of time. Big Data technology can no longer be separated from technologies for data analysis, which brings competitive advantages to economic operators who use them and an increasing knowledge for professional accountants, giving them the opportunity to diversify the services offered. The article concludes an analysis of the introduction of this technology in the curriculum of universities of economics.*

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JEL classification: *M41, M15.*

1. Presentation of BIG Data technology

In 2020 the financial industry, like all other areas, amid the health crisis made major progress in digitizing activities so that countless innovations were launched aimed at bringing the consumer closer to the services offered through applications running on mobile devices or through the Internet. It is worth noting the emergence of integrated financial services that create new industries to which consumer expectations have quickly adapted. In this context, Big Data has become the area of greatest strategic importance for all businesses. A perspective of the use of Big Data technologies can be seen from figure no. 1 where is represented the forecast of the revenues brought by this technology until 2027.

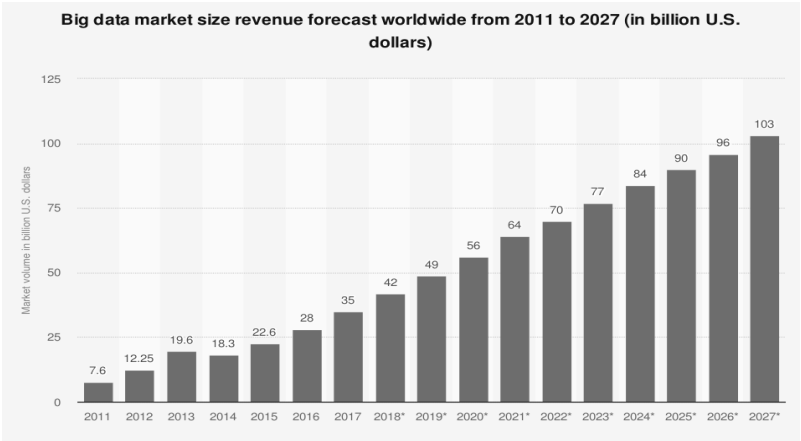

Fig. no. 1 The expansion of Big Data technologies
(sursa: https://www.statista.com/statistics/254266/global-big-data-market-forecast)

1.1 The paradigm shift

In 2018, the authors (Mayer-Schönberger and Cukier, 2018) published a popular book that changed the way we look at things. It explores new horizons, trying to understand in this way how today's avalanche of information will change our perspective on the world. With bold and well-written arguments, the book clearly explains how companies can extract value, how policymakers can use the power of detail, and how everyone's cognitive patterns need to change.

According to Mayer-Schonberger and Cukier, Big Data is the process of using advanced programs to analyze and interpret massive amounts of data. Big Data obtains information through applications, sensors or various external sources and leads to the optimization of the entire system in a short time. Large amounts of data at high speed and real-time are easily managed and after these from the past will be used to price future people's behavior and interactions between them.

Relevant statistics (Bouissou, 2019) indicate that internet traffic has exploded globally. In technical terms, the size of data circulating on the Internet exceeded one zettabyte, the equivalent of storing up to 2 billion years of music. More than 600 million people visit Google, which generates a trillion searches a day. The estimated increase for the next 5 years is 1500%. The amount of information stored is growing 4 times faster than the world economy. Aware of this avalanche of information, the question that persists in everyone's mind is whether man can capitalize on this intangible resource.

In the aforementioned paper, the authors (Mayer-Schönberger and Cukier, 2018) state that: "By changing the amount, we change essence." The essence of Big Data technology refers to obtaining predictions by applying mathematical algorithms to an important amounts of information. This change of paradigm brings as a novelty the transition from the use of samples to the use of the whole set of information and the correlation to the detriment of causality. One might think that accuracy is losing ground, but it is certainly gaining the power to understand phenomena and trends.

The traces that internet users leave out of browsing activity prove to be extremely valuable to any company and huge amounts are spent to capture and store important information in data warehouses. The analysis of search activities in the Internet (e.g. sales and traffic, search for information about epidemics, election results) through the sophisticated algorithm leads to the discovery of behavioral patterns. Unlike any other collection system it has previously used and which required a considerable amount of time for a synthesis to interpret, Google uses Big Data technologies to provide real-time information.

Estimating the potential offered by this technology, other companies try to exploit the mass of data that accumulates every day in various data warehouses. Top companies that use Big Data technologies include: Accenture, Oracle, IBM, SAP, Microsoft, Hewlett Packard Enterprise, EMC, Cisco, Amazon.

1.2 The advantages of the Big Data model

Big Data (Stanescu Mihaela, 2013) is not only an extremely vast collection of information that becomes useless after use but acquires a vital economic importance leading to a new economic vision, a source of innovation and new services. In addition, the same data will be able to be used for various studies only needing to design an algorithm appropriate to the purpose.

Big Data constantly communicates information which determines a triple change of mentality:

1. the unilateral perspective is replaced by a rapid analysis of a vast amount of information;

2. the heterogeneous mixture of information is favored over accuracy;
3. the correlation of information gains weight while causality is abandoned as illusory.

The benefits of using Big Data technologies in current activities of information exploitation from various sources are (Juvyns, 2017): operational optimization, actionable intelligence, identification of new markets, correct predictions, detection of losses and fraud, very detailed records, decisional process improvement.

Going further, a multidisciplinary approach reveals the development of complex social systems in this digital age.The acceleration of processes changes the reality that becomes measurable, thereby, scientific. For example, tags become a way of organizing reality no matter how large the quantity being evaluated. The acceleration of processes changes the rules of the game, in particular of the economic game.

2. Big Data technology for economists

The Internet is the place where we look for the most information in all fields and also here we keep in touch with people, hold courses, make transactions, appointments, develop business. There are businesses that are born 100% online and grow in the same way.

The granularity and multidimensionality of big data offer economists the advantage of identifying economic trends as they arise ("now casting"). You can also create a set of tools to manipulate and analyze this data.

In the past, new entrants to the financial services industry had difficulty to set foot in, disadvantaged by the lack of a time-consuming customer database. Now, FinTech companies, often start-ups, have found ways to enter markets based on innovative technology or the processing of all data, from mobile payments to insurance, investment, savings, etc., the trend being to create an ecosystem that has the effect of mutually beneficial cooperation between stakeholders, reducing costs with financial services, increasing speed and improving quality for consumers.

At the same time, financial market supervisors and Fin-Tech companies have been set up to work so that both the authority and the regulated entities and / or other interested companies have a good understanding of the opportunities and risks generated by the implementation of advanced technologies (big data, artificial intelligence) in the economic sphere.

Another direction, accelerated by the social conditions created by the pandemic, is the development of Blockchain technology, which is a database that is consensually distributed and synchronized across multiple sites, institutions or locations. The European Parliament adopted a resolution entitled "European Parliament resolution on distributed register technologies and blockchain technologies: building confidence by eliminating intermediation". Blockchain technology can be applied in all sectors of the economy and the importance of research and investment in these technologies that provide a high degree of security to financial transactions is emphasized. The European Commission's position on new technologies is reflected in two draft regulations, one on crypto-asset markets, together with the draft regulation on a pilot regime for blockchain-based market infrastructures.

2.1. The characteristics of Big Data technology in economic perspective

In 2013, the QuantCube application was created to quantify the growth of businesses around the world using "alternative data" extracted from social media, search engine queries, GPS coordinates or satellite imagery. In just a few minutes, the application developed by a fintech startup predicted the failure of the new version of the BlackBerry

smartphone, right on the day of its launch, a failure that was confirmed a few weeks later by a decline in smartphone sales (Bouissou, 2019).

This new world of data stretches from infinitely small to infinitely large. The particularities (Bodislav, 2018) that make Big Data such a tender source are:

1. **Volume** - the amount of data created in 2018 is 40 zettabytes of data, marking an increase of 300% compared to 2017;
2. **Velocity** - increases exponentially based on the number of connections to the mobile network;
3. **Variety** - the sources, formats, file structures can be different, either for basic information or for real-time communications or transfers;
4. **Veracity** - attempts are being made to improve the percentage of truthful information given that 1 in 3 respondents "do not trust the information" that big data provides. Inaccurate data costs the US economy about $ 3.1 trillion each year.

The definition of any technology as belonging to the Big Data domain implicitly refers to the 4 characteristic elements (fig. No. 2)

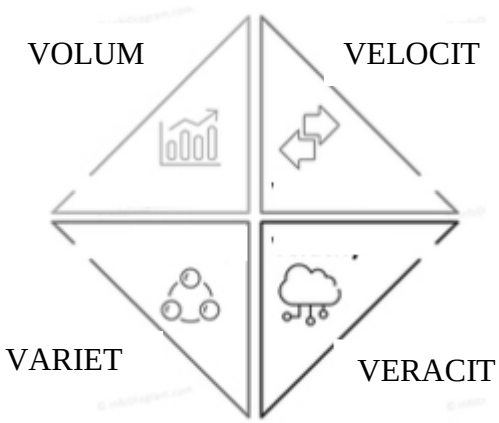

Fig. no. 2 Big Data particularities

Because this information helps to better understand the target audience and their preferences, the business will be able to anticipate their needs. Big Data information can help innovation and be a decisive support in overcoming competition. Companies like Google and Alibaba use Big Data to discover flaws in their services and products, as well as consumer intentions and preferences (Tenenbaum, 2017)

To get more benefits from Big Data, it is important for any company to properly approach the management of a Big Data project by training its employees. The result will be a more productive and efficient business. The use of the collected data gives a potential to grow the business. How to obtain relevant information is provided by Big Data Analytics.

Big Data Analysis is the process of extracting useful information when analyzing different types of big data sets. The data approach is based on a specific data lifecycle analysis that organizes and manages the tasks and activities associated with data analysis. According to the authors (Janvrin and Weidenmier Watson, 2017) this sequence contains the following stages:

1. Business case evaluation - The business case must be identified, created, evaluated and approved. The business case helps to determine the evaluation criteria and guidelines for evaluating the analytical results.
2. Data identification

3. Data filtering - The data identified in the previous step is collected and filtered to eliminate corrupted data due to the fact that not all data collected contains significant information.

4. Data extraction - Some of the significant data identified in the third step may be incompatible with the analysis tools. For this reason, data that is not compatible with the instrument is extracted and transformed into a form compatible with the analysis tools to be used.

5. Data aggregation - In this step, data with the same fields in different datasets are integrated together to achieve a unified view.

6. Data analysis - Data analysis is the process of evaluating data using analytical and statistical tools to discover patterns or correlations. It is an iterative step, which means that the analysis process can be repeated until the desired results are discovered.

7. Data visualization - The results of the data analysis stage are then communicated graphically using tools such as Tableau, PowerBI and QlikView

8. Use of analysis results - The analytical results obtained are made available to the various stakeholders of the company to support the business decision-making process.

If before the advent of the Internet, data collection was often limited to daily sales - after the best product, you can now track the full course and behavior of the buyer, from the purchase history to his requests by his exposure to advertising.

The level of finesse of Big Data type analyzes (Sfetcu, 2019) can be exemplified by the following examples from the economic sphere: checking stock traceability, monitoring online transactions in the field of public utility services (taxes, social benefits programs, etc.), data analysis on employment (positions held, candidates' skills, online comments of employers on the professional level). These types of information that can be collected and analyzed through Big Data are considered by the World Economic Forum as a "new asset class".

The benefits of Big Data technology for economic research are (Tenenbaum, 2017):

1. improving the monitoring and forecasting of economic activity in areas such as tax collection, social programs, education or demography.

2. the use of new data to monitor the economic activity of the private sector, sometimes even in real time.

3. online searches can be economic indicators that can identify economic trends as they unfold.

4. the gradual availability of administrative and private data leads to better ways of measuring economic effects, especially with regard to the behavior of individual agents ('nanodata').

5. the correct perception of the effects of different policies and economic shocks.

6. switching from weekly data to data at a much higher frequency (minute), or to data on consumers or individual products, so that it is possible to detect details or variations at the micro level that would be more difficult to isolate and exploit with more aggregated data.

Statistical and machine learning techniques can help build more robust predictive models, especially in the field of empirical microeconomics (Maxime Hanssen, 2015).

In the insurance industry, the development of the ability to establish the profile of policyholders and to analyze risks pave the way for a new generation of "smart policies". They could be completely customized and adaptable to changing needs. At the same time, technological advances could make market access easier and lower for new entrants.

By correlation, personal scores are obtained. Lifestyle data determine the risk to be taken into account by insurers.

Examples of the use of technology that confirms the efficient and positive use of information provided by Big Data (Stanescu Mihaela, 2013):

1. The American courier company UPS used Big Data methods to optimize the races of its trucks and the optimization solutions implemented led to substantial savings because the trucks traveled 48 million km less per year and consumed 11 million liters of less gasoline. The number of road accidents has also fallen.

2. In 2009, Google managed to apply the Big Data system to Internet search terms to find out how the H1N1 virus, which causes the swine flu epidemic, is spreading in real time in human communities.

3. The use of satellite images and data provided by various sensors allows the identification of risk areas for fires, for the occurrence of infrastructure problems and others.

Economists face three challenges in trying to master this technology: accessing this data, the ability to reproduce it, and developing the technical skills to manipulate it. The solutions to overcome these impediments are strengthening training in advanced computing and statistics and closer collaboration between big data companies and researchers working on Big Data.

2.2. Research on the adaptation of economic university education to modern technologies (big data, artificial intelligence, data analysis technologies)

The accounting profession is currently in a period of substantial changes. The classic way of carrying out the activity, the manual registration of operations, is obsolete. Under the sign of modern technologies, the professional accountant must adapt in order to be able to meet the demands of young entrepreneurs. This generation of entrepreneurs, raised with the phone in hand, no longer plans to walk the documents to the accountant for registration.

The modernization of the offer of accounting services is also observed from the economic management software applications, which from version to version improve the management of the activity of a financial-accounting department. In order to be able to use the tools of the 21st century, professional accountants need a solid knowledge base in understanding and using information and communication technologies. We live in a time when the digital economy is the main engine of growth. The vectors of this economy (fig. No. 3) are represented by emerging technologies (big data, artificial intelligence, etc.) that provide support for market anticipation and decision making.

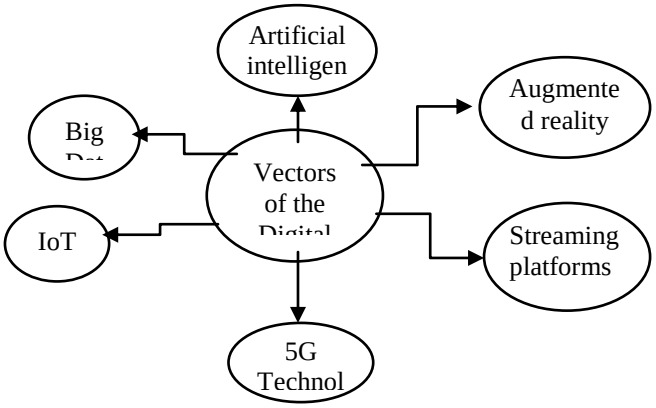

Fig. no. 3 The digital economy ecosystem

According to a study conducted by the authors (Groșanu et al., 2020) it was found that professional accountants use basic IT programs, without resorting to complex applications. Thus, 90% of respondents use simple accounting applications (SAGA) and at the same time 70% rely on Microsoft Excel as a suitable application in any situation that requires the manipulation and processing of data in the form of a table.

The use of new information technologies in accounting is expected to benefit from facilities such as: text recognition from physical documents, automation of operations, support in decision making. The 3 technologies that are common elements in any government strategy, Big Data, Artificial Intelligence and process automation could be integrated into the work of professional accountants as follows:

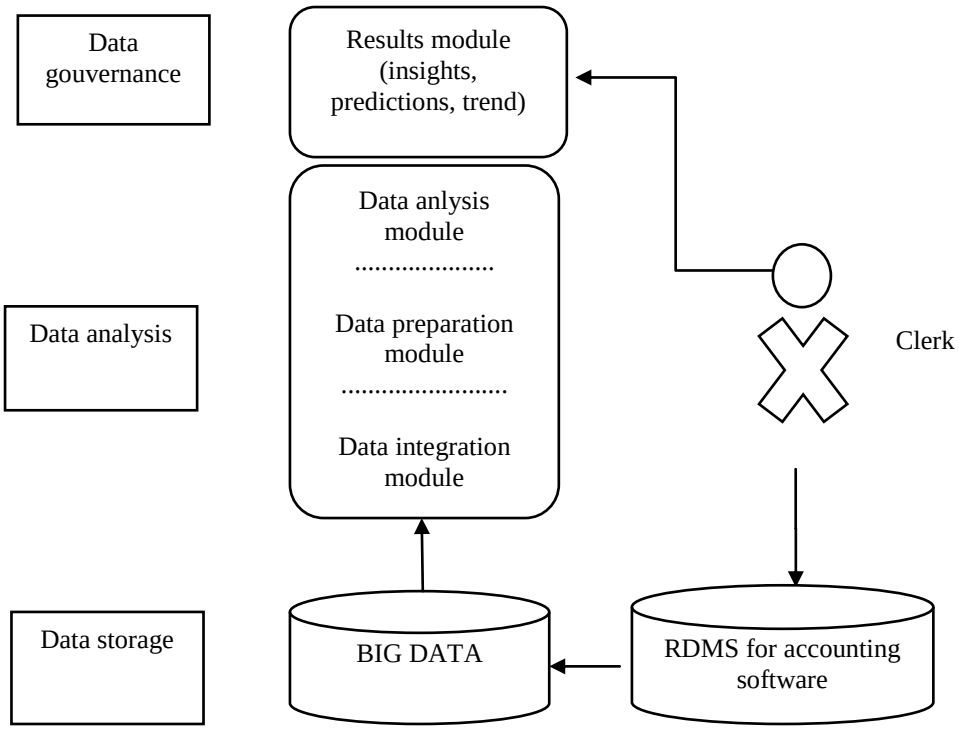

Fig. no. 4 Integration of Big Data, Artificial Intelligence and process automation in the activity of the professional accountant

Mastery of technologies related to methods and technologies specific to efficient processing of large volumes of data (big data), algorithms specific to machine learning and data extraction (machine learning, data mining) begins by assimilating the related notions in academic studies. Our research on this topic begins with a laborious documentation on the analytical program of the main faculties of economics in Romania (Academy of Economic Studies in Bucharest, Faculty of Economics and Business Administration at the West University from Timisoara and the Faculty of Economics and Business Administration Alexandru Ioan Cuza University from Iași). These strong university centers are doubled by a strong community of IT companies.

The analysis aimed to verify the content of curricula in order to validate the hypothesis that the top university centers have adapted their analytical curriculum to the technologies promoted by the IT industry. The practical part of the research focused on the study of discipline files from undergraduate and master's degree programs in accounting to prove the existence of curricular content that also specifies the existence of notions in the field of Big data, Artificial intelligence, business process automation.

The results of the study reveal that:

1. The Faculty of Economics and Business Administration within the West University from Timisoara has implemented two courses at the level of undergraduate studies (Information Systems Analysis, Accounting Information Systems) containing specific notions of Big Data and AI

2. The Faculty of Economics and Business Administration Alexandru Ioan Cuza University from Iasi has a master's program called Data Mining which contains a portfolio of disciplines that address the issue

3. The Academy of Economic Studies has several master's degree programs (e.g. Master's in Applied Statistics and Data Science) where it deals with the two topics considered.

The results of the study show the concern of economic education institutions for updating curricula by introducing disciplines containing notions of BIG DATA and / or AI, thus managing to comply with the requirements formulated by employers regarding the competencies of graduates. The subject is vast and we failed to research the curricula of several faculties of economics in Romania in an attempt to correlate the demand for specialists in the field of data analysis with the supply of graduates with economic profile.

In addition to research conducted in the three faculties of economics in traditional university centers, we found that the Employers' Association of the Software and Services Industry organizes ANIS scholarships for teachers who want to introduce / update courses in the portfolio (Big data, Cyber Security , Artificial Intelligence, Machine Learning, FinTech, HealthTech, Tech for All). The radiography of the awards (table no. 1) won by teachers during the 3 editions (2018-2020) with reference to courses in the field of artificial intelligence and Big Data proves that academics did not remain indifferent to the new trend in the world.

Table 1. Big Data courses introduced in the study programs of universities

Educational institution	2018 edition of ANIS scholarships	2019 edition of ANIS scholarships	2020 edition of ANIS scholarships
Babeș-Bolyai University	Award-winning Big Data course		Award-winning AI course (Computer Vision and Deep Learning)
Gheorghe Asachi Technical University		Award-winning Machine Learning course	
Timișoara Polytechnic University		Award-winning course of Machine Learning in the field of Bioinformatics	
București Polytechnic University	Award-winning AI course (Machine Learning)	Award-winning ML course	Award-winning Big Data Visualization course
Timișoara West University	Award-winning course in Artificial Intelligence and Machine Learning		

3. Conclusions

In the current period characterized by an openness to the adoption of technologies that simplify professional activity, Big Data has found a niche for acceptance and implementation in the activity of professional accountants. The main advantages that recommend this technology as the new "wizard" are: the use of the entire population of data in analysis, the emergence of cloud technologies, the orientation towards analysis, control and monitoring.

Big Data technology has reached maturity and its implementation in economic activities is favored by a combination of factors (accessible hardware and software resources, well-structured working methodologies) which leads us to say that the accounting profession will know in a reasonable horizon time a change in the framework for carrying out specific activities of registration of economic operations, analysis of results, risk management. At the same time, this technology, due to its interdisciplinary character, will determine a unification of the specializations that exist in the economic sphere, thus managing to create a professional capable of working with data regardless of their source.

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