DIGITALIZATION AND INDUSTRY 4.0

Fehmi Skender, .Ilker Ali, page 47-62

ABSTRACT

The innovations brought with the use of computers and communication technologies cause various and significant changes in every aspect of our lives.Industry 4.0 offers a wide range of processing, communication and production capabilities. Along with Industry 4.0, digitalization, data classification and conversion algorithms and software, also known as digitalization, are also developing with giant steps. With the process of digitalization, digital products such as computers, printers and scanners are the most important units of the enterprises and have started to transfer the traditional accounting place to smart accounting. Days of accounting transactions as we know them, are now behind. The software, which was prepared for answering, started to use automatic answering system in communication with the customer. Today's Big Data concept is a help finding a solution instead of being scary.

Research studies were carried out with the development of a digitalization software in the field of intelligent accounting. Firstly, the developed software is scanned with the Flexi Capture SDK software and the document type is determined. Thus, digitizing and converting the data into a suitable format saves a great deal of time and effort. The performance of companies using the advantages of traditional accounting and smart accounting was measured. The results of our research proved the success and performance of the developed software in the best way.

Keywords: Industry 4.0, Big Data, Data Digitalization.

Mr.Fehmi Skender, PhD.
Faculty of Informatics, International Vision University, Gostivar, N.Macedonia

e-mail: fehmi.skender @vizyon.edu.mk

Mr.Ilker Ali, PhD.
Faculty of Informatics, International Vision University, Gostivar, N.Macedonia

e-mail: ilker@vizyon.edu.mk

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INTRODUCTION

Modern industrial development has continued for several hundred years and three major industrial revolutions have emerged to the present day. The fourth industrial revolution, now called Industry 4.0, is now underway. Industry 4.0 takes over production with robots that communicate with each other, detect the environment with sensors, and realize needs through data analysis; aims to produce a better quality, cheaper, faster and less wasted production. In addition, Industry 4.0 allows monitoring of cyber physical systems and physical processes in modular structured smart factories, allowing objects to communicate with each other and with people, resulting in decentralized collaborative decisions. In today's competitive environment, it is inevitable for businesses to apply Industry 4.0 to their organizations in order to protect and sustain their assets. Industry 4.0 is the subset of the fourth industrial revolution that concerns industry. The fourth industrial revolution encompasses areas which are not normally classified as an industry, such as smart cities, for instance. Although the terms "industry 4.0" and "fourth industrial revolution" are often used interchangeably, "industry 4.0" factories have machines which are augmented with wireless connectivity and sensors, connected to a system that can visualize the entire production line and make decisions on its own.

Digitalizationor - digitalization, is the process of converting information into a digital format, in which the information is organized into binary digits. The result is the representation of an object, image, sound, document or signal by generating a series of numbers that describe a discrete set of points or samples. The result is called digital representation or, more specifically, a digital image, for the object, and digital form, for the signal. In modern practice, the digitized data is in the form of binary numbers, which facilitate computer processing and other operations.

Our research is based on a software solution for automatically scanning and processing data from analogue to digital. Today, when accountants are over whel medby the amount of unprocessed accounts and invoices it would help a lot. So our software solution was applied in two big, similar companies in two different countries. The result was obvious, the work of accountants was limited to only scanning document sand invoices and just manually verifying the automated task.

1. INDUSTRY 4.0 AND DIGITALIZATION

The new process, called Industry 4.0, includes a structure that will completely change the relationship between production and consumption. It defines production systems that instantly adapt to the changing needs of the consumer on the one hand, and automation systems that are in constant communication and coordination with each other and encourages close cooperation between various disciplines in product development. They define Industry 4.0 as integration of complex physical machines and devices with networked sensors and software used to better predict, control, and plan commercial and social outcomes "or bringa new level of value chain organization and management throughout the life cycle of products" .

In the industrial sense, the First Industrial Revolution (Industry 1.0), which first started with steam engines in the 18th century and aimed at increasing production, was followed by the Second Industrial Revolution (Industry 2.0), which emerged as a transition to mass production at the beginning of the 20th century and paved the way for the utilization of electrical energy. Then came the Third Industrial Revolution (Industry 3.0), where production systems ceased to be analog and digital systems took place in the industry. Thus, the first three industrial revolutions brought mechanization, electricity and information technology (IT) into human production. These three industrial revolutions aimed at increasing productivity in production. However, the manufacturing companies in the world have faced serious difficulties due to the environmental, social, economic and technological developments experienced at that time and only increasing productivity has not brought companies to the forefront in global competition. To overcome these challenges, companies needed virtual and physical structures that allowed close collaboration and rapid adaptation throughout the entire lifecycle, from innovation to production and distribution, and were constantly on a quest. After the Cold War, trade borders between the countries disappeared and exchanges between these countries began to increase. In the 1960s, the change in the demands and expectations of the customer who bought only the existing product in the 2000s caused the production processes of the companies to be more complex. Thus, firms now have the need for interdisciplinary work and the Fourth Industrial Revolution (Industry 4.0) has emerged where all objects communicate and interact over the Internet.

Since the first industrial revolution, subsequent revolutions have led to radical changes in production, from water and steam electric machines to electrical and digital automated production. Production processes have become increasingly complex, automated and sustainable. This has led to the need for simple, efficient and stable operation of the machines. On the other hand, the continuous development of information and communication technologies has continued to offer manufacturing companies great potential to meet their needs. Accordingly, during the Hannover 2011 Hannover Fair event, a new concept was introduced by the Germans, Industry 4.0, which symbolized the beginning of the 4th industrial revolution. It also became a strategic initiative of the German government in the same year and was included in the High Technology Strategy 2020 Action Plan.

This, the concept of Industry 4.0,was considered as a strategy to compete in the future. Similar strategies have been proposed in similar industrial countries. For example; At the European level, the corresponding concept is a ”Factories of the Future“, Industrial Internet ’in the US and“ Internet + ’in China. Since then, the term Industry 4.0, also known as “intelligent manufacturing internet“ industrial internet, or ”Industry” integrated industry, industry has become one of the most popular manufacturing issues among industries and academics in the world and has the potential to affect all sectors at the moment. is a default issue. 4. The Industrial Revolution has arisen in industry when machines in general have started to manage themselves and their production processes without the need for manpower. While Industry 4.0 was initially considered a technology trial, it has now become a requirement to maintain competitiveness in an ever-changing industry environment. Because of industry 4.0, it is expected that more computerization and more software decision making processes and intelligent systems will be involved in production.

Digitalization is of crucial importance to data processing, storage and transmission, because it “allows information of all kinds in all formats to be carried with the same efficiency and also intermingled”. Though analog data is typically more stable, digital data can more easily be shared and accessed and can, in theory, be propagated indefinitely, provided it is migrated to stable formats as needed. That is why it is a favored way of preserving information for many organizations around the world.

1.1.Cyber-Physical Systems

Cyber Physical Systems (CPS) are the structures that involve communication and coordination between the physical world and the cyber world. The main role of CPS is to meet the agile and dynamic requirements of production and to increase the efficiency and efficiency of the entire industry. Industry 4.0 is characterized by an unprecedented connection of the Internet and CPS, which can be regarded as systems that bring the physical and virtual world together.

1.2. Internet of Things (IoT)

The structures that enable objects to communicate with each other are called the Internet of Things (IoT). The Internet of Things is expected to open numerous economic opportunities and is considered one of the most promising technologies with great destructive potential. Internet of Things concept of a British entrepreneur created by Kevin Ashton. The idea was formulated in 1999 to describe a system in which the material world communicates with computers (data exchange) with sensors everywhere. In this approach, not only objects, but also processes, data, people and even animals or atmospheric phenomena - a system of all things has been formed as a variable.

1.3. Cloud-based manufacturing (CBM)

Cloud-based manufacturing (CBM) is another emerging paradigm that will make a significant contribution to the success of Industry 4.0. CBM uses on-demand access to a sharing set of shared diversified and distributed production resources to create temporary, reconfigurable cyber-physical production lines that increase productivity, reduce product life costs, and allow optimal resource allocation to respond to customer-generated variable demand depending on the production model.

1.4. 3D Printers

This technology was first applied in 1984, but with Reprap, which emerged in 2006, there was little interest until it was re-introduced. 3D printers take raw material directly into production, unlike cutting, cutting and then reassembling the raw material. Thus, there is no material waste and the products are produced at a much lower cost at one time. Another

advantage of 3D printers, is that it allows for a wide range of production. It is believed that this technology, which enables production in every field from information technologies to genetics, medicine, food and jewelry to city planning, will start a new era for humanity.

1.5Artificial intelligence

Algorithms with cognitive functions such as perception, learning, linking, plotting, thinking, inference, and reasoning, which are unique to human beings, are called artificial intelligence. Through self-learning, artificial intelligence applications can mimic human behavior and develop itself at a later time to reach a more advanced level of consciousness than humans. This situation can evolve to humanity in medicine, astronomy, agriculture, energy management and production, as well as technologies that can bring an end to humanity. So many scientists, such as Stephan Hawking, have warned or continue to warn of the dangers of artificial intelligence. However, the evolution of artificial intelligence, regardless of its end, will open the door to a completely different era in human history that we have never seen before.

1.6.Autonomous Systems

Thanks to the internet of objects, developing sensors and robots with increased mobility, the problems that may occur in the production line can be detected instantly and remedied by remote and mobile communication tools. Autonomous robots that communicate with each other will be able to act together to solve the problem without interrupting the current production and transfer information to the operators through the server they are connected to in case of negative situations that occur at some point of the production line. In this way, the productivity of the production will increase while the costs resulting from the production error can be reset.

1.7. Robotic and smart factories

Most of the world's leading industrialized countries have invested in national initiatives to promote advanced production, innovation and design in a globalized world. Much of this investment has been to reach a future where rational factories such as Industry 4.0 and intelligent manufacturing are the norm. Industry 4.0; It is called smart

manufacturing, where all objects can interact with the internet through advances in fields such as artificial intelligence, 3D printers and "space technology". In Industry 4.0, one of the important places where objects communicate with each other is "smart factories", which are equipped with"smart"technologies and also called dark factories because no people work.

1.8. Big Data

Data from any source connected to the Internet (social media, blog, vlog, blogs, etc.) is transformed into a meaningful and processable format called big data. However, it is quite difficult to do so; because the amount of stored data increases day by day, making it very difficult to make sense of these data stacks. However, "big data" result that is processed makes it easier to understand human nature. At this point, which entered into force and previously, in the May 2018 issue of the Machine Bulletin, we can determine the estimations on the values, expectations and behaviors of people with an accuracy of up to 90%. There is only one way to increase the accuracy of predictions; replicate the number of data you have as much as possible and make it workable with a good algorithm.

1.8.1. Data Size

Companies use huge amounts of data in their decision-making processes. The size of the data continues to increase exponentially. While some experts consider peta bytes as the starting point of big data, many companies consider data sets between one terabyte and one peta byte as big data.

1.8.2.Diversity

The large data structure accommodates a wide range of data types such as photos, click throughs, emails, sounds, videos, HTLM, PDF and ecg data. This data is structured (edited), semi-structured and unstructured data. Most of the large data consists of unstructured data that is not placed in rows and columns in classical format.

1.8.3. Speed

The rate at which data is produced, processed and analyzed is constantly increasing. Higher speed is due to the need to combine the generated data with natural real-time and flowing data with business

processes. Today, data is being produced at an ever-increasing rate. However, it is not possible to capture, store and analyze this data using traditional methods. Particularly for time-sensitive processes such as multichannel instant marketing, it is crucial to analyze data simultaneously for business value.

1.8.4. Value

After 3V (volume, velocity and variety) definitions are made to describe the big data, these analyzes need to produce a value to obtain useful results after the data is collected and processed. Therefore, it can be said that this V is the junction point of the other 3V (volume, velocity and variety).

1.8.5. Accuracy

Accuracy refers to the level of reliability associated with certain data types. High data quality for big data is an important requirement and the quest for struggle. But even with the most important data clearing methods, the inherent unpredictability of some data (such as weather, economy or a customer's purchasing decisions) cannot be removed.Today, many different definitions of big data are worshiped. The main reason why these definitions are different stems from the area in which they are used.

1.8.6.BIG DATA analytics

Each project starts to achieve a specific objective and sub-objectives are set for this purpose. In order to achieve the project objectives and objectives, organizations have to access the appropriate data as raw material from large and complex data sets that the existing information systems cannot process. Once appropriate data is reached, data analytics will be needed to relate, process, and access information at the stage of making strategic decisions in projects. With technological developments, semi-structural and non-structural data types have been used in addition to structural data. Big data analytics is the use of analytical and parallel techniques developed to handle very large and diverse records that contain different types of content. At this point, the big data analytics tools aim to obtain valuable information from the data by analyzing a large amount of structural, semi-structural and non-structural “data as a whole”, which is difficult to process using traditional database techniques.

- **Data Collection Processes and Methods**

Data is defined as any measurement, value, fact and information that can serve to solve a problem. These can be verbal and written expressions, as well as figures, pictures, articles, models, numbers and symbols. The concept of information emerges when we investigate the definition of data. Knowledge is a concept that can be obtained at the end of a process. In other words, it is the processed version of the data. Therefore, the most basic concept in accessing information is "Data"

- **Data Types**

1. Factual data: Data that cannot be interpreted by the researcher and can be evaluated by everyone in the same way. More precisely, it is the kind of facts that everyone can agree on, independent of personal judgment. (Age, gender, etc.)

2. Judicial data: Data that can be defined by subjective judgments, which acquire the quality of data by the researcher's interpretation. Lazy, harmonious, emotional and so on. personality traits such as. Evaluations of social behaviors in social research may also be an example of this data type.In order to make the data collected by the researcher meaningful and to reveal the meanings that are hidden in the data, various methods and statistical methods should be used. These ways are verbally explaining the data, grouping them in tables, showing them in graphs, specifying and describing them in statistical values by performing various calculations.

In order to make the data meaningful, the first thing to do is to classify them and formulate the tables. It is easier to see what type of data is available from these tables, their amounts, distribution shapes and properties.

- ***Quantitative Data:*** Data that give a countable, measurable characteristic of an experiment. There are two types: continuous quantitative data and discrete quantitative data.Continuous quantitative data: Quantitative data that can take decimal values. Length, weight, etc.Discrete quantitative data: These are the integer values obtained by

counting. Population, number of students, number of households etc.

- ***Qualitative Data:*** Data indicating the characteristics of a subject. Educational status, whether to host, etc.… Qualitative data are divided into two groups.Classifiable Qualitative Data: Data that can be classified by class, which can be represented by codeand number. Qualifiable Data: Data obtained by a sequence or grade that do not specify a specific quantity.

- ***Criteria in Data Acquisition Tools.***

The measurement is significantly influenced by the measuring instrument used. Gold that requires a sensitive measurement requires a sensitive balance. No matter how good the measuring instrument and the data acquisition technique are, the capabilities of the user also have a large impact on the measurement.

Validity; the undesirable things to be measured, in other words, what the instrument is intended to measure is explained by the fact that other factors and features do not affect the measurement result. This is the feature of an instrument measuring only what it is intended to be.

Reliability, the second important feature of a measuring instrument is reliability. This is the ability of the instrument to measure the same degree each time it measures. That is, if there has not been any change in the subjects, test and test area in relation to the subjects and information in the test, the measurement is expected to give the same result.

2. METHODS AND FINDINGS

Prior to the survey, an application for digitalization of accounts and invoices data was developed. While the research itself contains: documents scanning, the experimental method, observation and descriptive method.

The software solution has the following modules:

- ABBYY Form Capture form templates of more then 30 different types of invoices and various types of documents, for automatic classification and recognition, which results in XML documents with description of all important fields.
- Separate software application for fixing the common errors, but also processing the generated XML document, by mapping the predefined codes and inserting the actual records into the database of the existing accounting software.

The end-result was the same as with manual retyping of the same documents, which saves many hours, or even days of human labor.

A good quality high volume double page scanner was also required and with the right settings and adjustments, quite high accuracy rate was achieved.

After the initial period of this software approach with different types of real documents, the conclusion was that the software was fully automated and with minimal human intervention: only maintenance of the code mappings and quick verification of the output. Its usefulness was proven buy it's use of many months afterwards and on a large volume of documents.

The similar software solution was also applied in a company in neighboring country, with accounting legislative compatible to the one in EU.

The performance and the accuracy rates in the both companies were quite similar. For example, in a quite large accounting sector with more then 10 accountants, the productivity was increased by factor of 10.

Here are the approximate results of the usage period of one month:

Company	Number of different types of documents	Number of processed pages	Accuracy
Company A (MKD)	12	750	90%
Company B (SRB)	2	150	95%

Table1. The approximate results of the usage period of one month

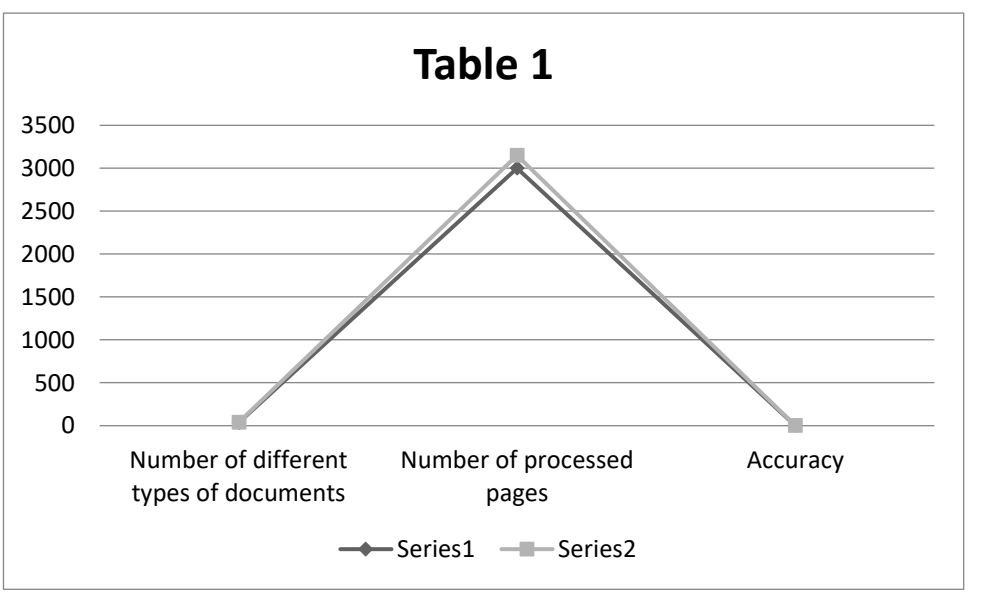

Chart.1. The approximate results of the usage period of one month

After several recognition accuracy and other improvements, as well as support more document types, we got the following approximate results:

Company	Number of different types of documents	Number of processed pages	Accuracy
Company A (MKD)	35	3000	97%
Company B (SRB)	4	150	98%

Table2. The following approximate results

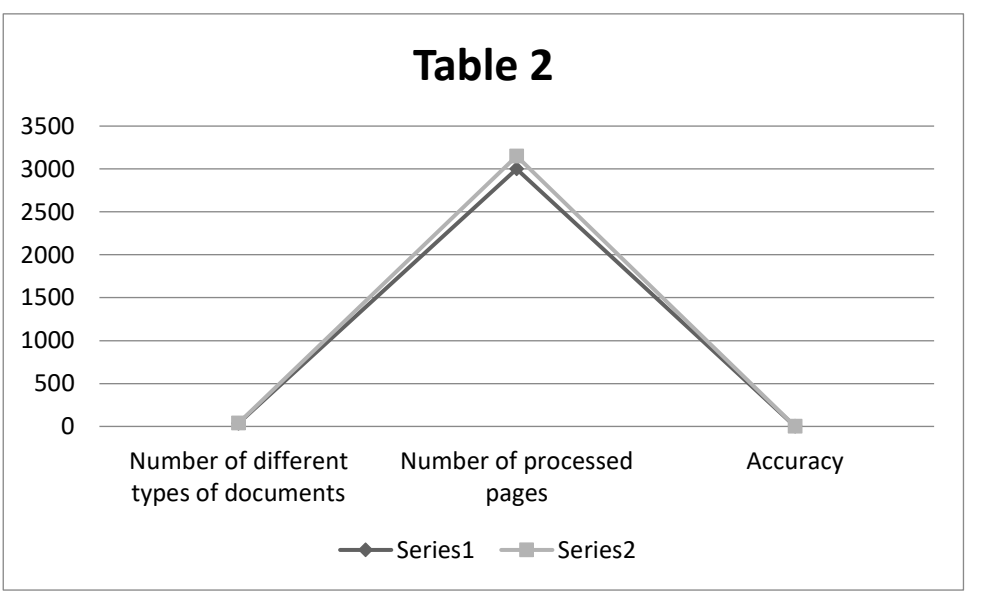

Chart2. ***The following approximate results***

All the accountants who used to work on tedious task of retyping documents and invoices into the company software, were more than satisfied with the end result, even though at the beginning they were mostly reserved and skeptical about the whole idea.

3. CONCLUSION

With applying new innovations and predefined algorithms, like customized digitalization, a significant boost can be achieved in both productivity and accuracy. Similar approach can be applied in an unlimited number of similar standardized document processing tasks in various organizations and companies, that usually generate or work with large number of documents and data. Also,with manual tedious human work, the organizations and companies are limited by the available human resources, which results with generating and keeping a lot of hard-copy documents, which were difficult to find, search or do some standardized processing of the data. We've seen that this software solution, do save a lot of time and money and would have a very attractive ROI (Return of Investment) value. This conclusion guaranties only higher use of similar software's in various companies or institutions in the future.

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