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Industry 4.0 and Accounting: a theoretical approach

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Abstract

This research aims to provide a systematic analysis of the impact of industry-4 on the accounting system, by analyzing the existing literature, contemporary concepts, data and gaps for future research directions.

This research uses information from existing literature collection of publishing databases from 2008 to 2022 were explored using the keywords «Industry 4.0» «accounting», «accounting information» in their title and abstract to examine which publications to be included. Based on the search, a total of 90 journal articles were selected, and information was collected.

The influence of Industry 4.0 on the accounting system is determined and the technologies affected by the fourth industrial revolution in terms of accounting (Big Data or Data Analytics, Cloud Computing, AI, Blockchain, Internet of Things (IoT), Robotic Process Automation) and changes waiting for the profession of accountant. The coordination of efforts of business, education and the state in the context of the development of Industry 4.0 technologies was noted.

Keywords: Industry 4.0; accounting; innovative technologies; accounting information.

1. Introduction

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The development of information and communication technologies and their entry into our daily lives in recent years is a sure sign that the world is on the threshold of the fourth industrial revolution. Industry 4.0 has been identified as a major contribution to the digital age. Its consequences affect society, creation, information, and including accounting. These changes are obvious. The question is how quickly a business adapts to a new business environment and how it adapts to new realities. Industry 4.0 creates the latest business models. To manage them, businesses need innovative solutions based on the capabilities of new digital technologies.

Some of these solutions are related to improving accounting. Incorrect information from one of the business departments affects the entire system. Especially in accounting, which records the financial movements of the business and reports on the results of them, the information from which is effective in making decisions that affect the whole business. Based on these results, the use of intelligent systems helps to reduce human errors and the system begins to operate faster.

The dynamics of processes in modern society and the role of business accounting are increasingly paying attention to innovations in accounting. The limited use of new technologies in accounting practice is a major limitation in assessing their effectiveness and usefulness. Digitization creates the latest capabilities for accounting. Among them: Big Data or Data Analytics, Cloud Computing, AI, Blockchain, the Internet of Things (IoT), Robotic Process Automation.

2. Literature review

The term «Industry 4.0», also known as the fourth industrial revolution, was introduced by the German researchers Kagerman et al. (2011) to help shape the future of the German economy to automate, share data and optimize the manufacturing process in real-time. It is based on the idea that physical processes can be monitored, managed and controlled in real-time by cyber-physical systems. The idea develops into an integral concept of digitalization of the economy. Industry 4.0 uses fundamental technologies such as cyber-physical systems (CPS) and the Internet of Things (IoT) to connect people, machines and other resources, as well as products and services in the real world.

Industry 4.0 is a virtual platform where participants in business processes communicate and interact directly. According to a study by Hermann, Pentek and Otto, the platform operates on the basis of four key components: cyber-physical systems; the Internet of Things (IoT); smart factory; the Internet of Services (IoS) (Hermann et al., 2015).

The impact of Industry 4.0 will undoubtedly be large, given the development of the global economy. The advent of Industry 4.0 has a significant impact on the global economy and affects international business, which is changing consumer benefits, improving asset quality by increasing data output, re-establishing relationships as learning the value of new ways of collaborating, digitally transforming existing models into new business models, especially open web platforms create new opportunities and increase competition (Di Vaio and Varriale, 2019).

Sustainability is also considered a major driver of Industry 4.0 (BEIER et al., 2017). Industry 4.0 technologies can be integrated into chains that are valuable by collecting and actively sharing data to provide real-time information on the flows of machines, production, operations and components; it helps managers to monitor, control and ensure the sustainability of the decision to restore products when needed. These renewal-based approaches replace the traditional linear approach, the philosophy of creation, use and disposal with a circular approach that benefits the organization and supply chains socially, economically and environmentally (Geissdoerfer et al., 2017).

Some authors have envisioned circular economy (CE) business models as the most competitive operational tools for developing SBM in Industry 4.0 environments (Bressanelli et al., 2018; Nascimento et al., 2019). Overall, Industry 4.0-based businesses rely on IoT connectivity, whereby «company» products and processes are interconnected and integrated to achieve greater value for both customers and internal company processes" (FRANK et al., 2019). While many industries have long been stuck in unsustainable but financially viable business models (Boons and Lüdeke-Freund, 2013), Industry 4.0 offers businesses sustainable longevity, efficiency and recovery while contributing to their social, economic and environmental costs (De Man and Strandhagen, 2017). More precisely, for SMEs, Industry 4.0-based business models can contribute if organizations focus on their ability to absorb new technological innovations and their respective innovation strategies (Müller et al., 2020).

In manufacturing, Industry 4.0 has introduced new technologies that provide maximum results using efficient use of resources (Kamble et al., 2018). Cyber-Physical Systems (CPS), the Internet of Things (IoT) and other emerging technologies are opening the way for industrial development to improve productivity and efficiency across organizations.

3. Data and methodology

We used critical analysis and comparison of analytical reports, IMD World Digital Competitiveness Ranking 2021 report, PricewaterhouseCoopers report, Fortune Business Insights report and Industry 4.0 – Global Market Trajectory & Annual report on Industry 4.0, academic publications, CFA Institute and Focus Group Discussion surveys, research proposals for literature review and desk research of current business press reports, professional reports, Industry 4.0 technology company web pages, and modern accounting technologies

Concerning the scientific approach, this article uses a qualitative research design, the method of indirect observation, causal analysis and predictive synthesis, induction and description. To achieve the goals set, the following general scientific and specialized methods were used:

- theoretical generalization, comparison and systematization – to study the essence and features of modern Industry 4.0 technologies in accounting;

- system analysis – to determine the state and level of development of digital competitiveness of different countries of the world and their readiness to implement Industry 4.0 technologies;
- abstract-logical – for theoretical generalization and conclusion;
- graphical method – for visualization of modern technologies Industry 4.0 and visualization of digital competitiveness ranking 2019, 2020 and 2021.

4. Main results

Industry 4.0 is a concept in which production facilities are equipped with modern sensors and wireless technologies that visualize and reflect the entire production process. These sensors and wireless technologies are integrated with various technics, including artificial intelligence (AI), IoT, machine learning and cloud computing. The integrated use of these technologies in an Industry 4.0-enabled manufacturing environment allows manufacturers to make informed business decisions and improve production efficiency. By optimizing technology and material usage as well as asset performance, an Industry 4.0-enabled manufacturing environment improves business profitability.

The IMD World Digital Competitiveness Ranking 2021 presents the overall ranking calculated in 2021 for 64 economies of the world. The rating is calculated based on 52 criteria and determines the digital competitiveness of countries entrenched in three main factors: knowledge, technology and future readiness.

The Global Digital Competitiveness Ranking analyzes and evaluates the extent to which countries adopt and explore digital technologies leading to transformation in government practices, business models and society at large.

Among the countries that are among the top 10 digital competitiveness leaders in 2019, 2020, 2021 are the USA, Singapore, Hong Kong, Sweden, Denmark, Switzerland, the Netherlands, Norway, the Republic of Korea, Finland, Taiwan, China, UAE.

According to the Fortune Business Insights report, the market is geographically segmented into five major regions, namely North America, Europe, Asia Pacific, Middle East and Africa, and Latin America.

Europe has achieved the highest Industry 4.0 market share in 2020. European industry has made significant investments in technology and skills to maintain its position in the global market. Communication setup, network objects, real-time data processing and ubiquitous information are changing paradigms in industries. Tech giants including Siemens, Honeywell and General Electric are among the early adopters of the software and far ahead of its adoption.

As North American companies increasingly embrace the concept of smart manufacturing, the region is expected to dominate the market. Most of the factories operating in the market are now equipped with new machinery and smart manufacturing technologies, enabling other businesses to move from conventional production methods to smart manufacturing. Government initiatives and increased funding for research and development have become vital factors in making North America a dynamic region for market development.

Japan, China and South Korea are leading the market growth due to their comprehensive measures to introduce industrial automation and introduce disruptive technologies in the value chain of their production system in the region of Asia-Pacific.

In Latin America, the Middle East and Africa, the fourth industrial revolution is supported by government initiatives and awareness of the importance of introducing digital technologies to support the global market. For example, in September 2017, the UAE government launched the Industry 4.0 strategy for the country during its annual meetings. The strategy is designed to strengthen its position as a global center and increase support for the national economy. In addition, in Brazil, the leading players have come together to stimulate the introduction of technology assets in order to accelerate the adoption of advanced technologies.

The influence of Industry 4.0 on the accounting system has indirectly transformed the role of accounting into a more advanced digital system. As a result, the accounting will gradually evolve from a traditional to a technological system (Damayanti, 2019).

One of the processes that information systems can help improve the accuracy of the information and improve the organization's decision-making activities is accounting. An accounting information system is defined as the collection, recording, storage and processing of accounting records to provide information to decision-makers.

An accounting information system is the combination of people and technology in an organization that collects, records, stores, and processes data to provide the information needed to make informed decisions (Marshall and Paul, 2021).

According to Weygandt et al. (2019) an accounting information system is a system that collects and processes transaction data and provides financial information to internal and external parties.

Fontinelle notes that an accounting information system is a computerized way of tracking accounting activities using IT resources.

According to Hall (2010), an information system is a set of formal procedures by which data is collected, processed into information and distributed to users. It consists of three main subsystems: transaction processing system; general ledger system and financial reporting system; management reporting system.

Belfo and Trigo (2013) emphasize that an accounting information system focuses on five cycles such as income, expenses, human resources, production and finance.

According to CPA Australia, accounting is the process of recording, processing, analyzing and summarizing the transactions of a business and communicating this information for decision-making. Financial statements traditionally present information based on historical data useful for decision-making by stakeholders such as potential investors, lenders, suppliers and customers (Belfo et al., 2015).

As a business enters a new economy, information based on historical data may receive less attention. The business community in the new era of real-time enterprise demands more up-to-date information covering a complex set of enterprise software products and services. They require a new business accounting called Real-time Accounting (Vasarhelyi and Alles, 2008).

Technologies influenced by the fourth industrial revolution in terms of accounting will be the following: Big Data or Data Analytics, Cloud Computing, AI, Blockchain, the Internet of Things (IoT), Robotic Process Automation. Let's consider them in more detail.

Big Data. The biggest impact on Industry 4.0 accounting will be Data Analytics or Big Data – data analytics associated with relational databases in an accounting information system. Big Data identification allows accounting and finance to take on a more strategic role and help shape the future.

According to (Gandomi and Haider, 2015), big data are information assets of great volume, speed and variety, requiring cost-effective, innovative forms of information processing for better understanding and decision-making.

The existence of big data during Industry 4.0 is undeniable. They change the information life cycle from traditional to modern by removing multiple processes such as acquiring, classifying, transforming, indexing, and searching, and adding multiple processes such as collecting, sieving, synchronizing, preprocessing, and monitoring (Coyne et al., 2018).

The existence of extensive data significantly changes the accounting process. Since big data is primarily composed of unstructured data generated from audio, video, and images, traditional accounting software and database system cannot properly analyze the generated financial statements (Warren et al., 2015). Big data is changing the perspective of accounting, providing real-time accounting and leaving a periodic basis (AL-Htaybat et al., 2017). It is likely that in future accounting, the data will not be stored, but will be implemented in a system that needs to be accounted for in the organization's accounting information system. Big data requires accounting practitioners to adjust their system to capture a huge set of data and unstructured events and report on financial statements that will benefit investors and all stakeholders.

Big Data will reduce the time that accountants spend on collecting, checking and processing data and increase the time for analysis, provide business insight. This will change the role of accountants in the company (Stanciua and Gheorghe, 2017; Ucar et al., 2018).

The development of real-time accounting, which must face the presence of big data and the new dimension of intellectual capital (IC), requires an accountant who is not only an expert in the field of accounting, but also has experience as a business professional. The accountant must possess the skills of defenders of the design and maintenance of information systems for decision-makers.

At the same time, accountants must be able to distinguish critical data and ideas from what is obtained from the data. Accountants do not need to fully understand the structure of a database or perform their own analysis of the data. The results of data analysis must be understandable to accountants, and accountants must be able to determine how these results can add value to the business (Gamage, 2016).

Cloud Computing. Another major influence of Industry 4.0 on the role of accounting is cloud computing.

The evolution of accounting is changing the expectations of clients and accountants are forced to adjust the way they do it to meet the requirements. People are willing to do less paperwork as they need to focus on what they are passionate about in the things they want to do. This means that people will have to depend on technologies to help them work in a more integrated way. One of the current technological trends is the rapid development of cloud technologies (Khanom, 2017).

Cloud Accounting is one of the advanced forms of digital accounting (Tugui, 2015). Its emergence is the result of personal platforms created over the past 6–7 years (so-called clouds or cloud spaces) on the Internet, which makes it easier to access boring data anywhere, anytime and from any type of device that supports the Internet.

Dimitriu and Matei (2015) consider cloud accounting as a service in the business model. Cloud accounting is a transformation of accounting applications and a solution for a modernized business environment.

According to Sobhan (2019), a cloud system or cloud computing is an on-demand delivery of computing services that does not require active management by service users. It offers services consisting of hardware and software via the Internet. In the cloud system, services such as data and software can be accessed from anywhere and anytime via the Internet through a cloud application service provider.

Cloud Accounting is a combination of cloud computing and accounting using a web server to create a virtual accounting information system. Cloud accounting services consist of three models: Infrastructure as a Service (IAAS), Platform as a Service (PAAS), and Software as a Service (SAAS) (Mohammadi and Mohammadi, 2014).

When switching to cloud accounting, accountants being not adapted to technologies, will face more difficulty in their roles than accountants aware of the transition through the era of globalization and digitalization (Tarmidi et al., 2014). To be able to analyze a lot of data, accountants must be equipped with analytical skills such as SQL Query, Tableau, Power BI (Salem et al., 2021).

The cloud accounting system has brought advantages such as data accuracy, faster data entry and update, integrated and centralized system, easy access to mobile devices, human resource efficiency and cost savings. However, it experiences security issues such as account hijacking, broken APIs and interfaces, broken authentication, broken credentials, and data breaches including a stable internet connection.

An interview with the Focus Group Discussion (Krueger and Casey, 2000; Wilkinson, 2004) showed that the accounting information system has evolved into a digital system that has influenced Industry 4.0, and accountants will not double-entry manually in line with technological developments. Traditional accounting will be gradually replaced by an automated accounting system supported by technology in the digital age.

According to questionnaires, 90 % of respondents agreed that cloud accounting is the digital transformation of accounting from a traditional to a more offline accounting information system that has influenced Industry 4.0 in the direction of business and the role of accounting (Özcan and Akkaya, 2020).

Artificial Intelligence (AI). Artificial intelligence is the science of designing, creating and constructing a machine (computer) or computer program that would have an intelligence similar to that of a person. Intelligence in this case is the ability to act or solve problems in the way that people use their intelligence. The scope of intelligence covers many aspects of the abilities of the human intellect, such as reflection, knowledge, planning, learning, natural language processing, and the ability to manipulate objects. With artificial intelligence, the machine is expected to have general intelligence, just like humans.

BlockChain. Blockchain is a digital data storage system consisting of many servers (multiserver). In blockchain technology, data created by one server can be replicated and verified by another server, which is why blockchain is often compared to a bank's cash book containing all customer transaction data. However, this general ledger is available to all blockchain users and is not limited to authorized bank employees. With blockchain, a transaction no longer has to depend on a single server, because the transaction will be replicated throughout the network.

The nature of the network is peer-to-peer, blockchain users can also avoid a variety of frauds that can occur due to data modification or hacking. On the blockchain, each block (a special area that contains all the changes in a transaction) consists of a hash, which is an identifier of digital data. Now each block contains the hash of the previous block. Each block in this system is interconnected and if there is an attempt to change the data in one block, then it must change the data in another block. Each block, protected by cryptography, is connected to create a network. Through the blockchain, intermediate transactions will be much more efficient than regular transactions, which still require the existence of intermediaries.

Robotic Process Automation. One of the main technologies as a sub-technology of the Industry 4.0 model is Robotic Process Automation (RPA).

Robotic Process Automation is the application of technology that allows employees to configure computer software or «robots» to capture and interpret existing applications for transaction processing, data manipulation, response initiation and communication with other digital systems (IRPA & AI, 2017) .

Robotic process automation is a combination of related technologies such as stand-alone systems, machine learning, AI and robotics. These latest technologies have shaped the structure of RPA solutions and become the basis for RPA. It works by clearly replicating the actions of today's employees, using existing core programs, accessing websites, and manipulating spreadsheets, documents, and e-mail to complete tasks (Lamberton et al., 2017).

The functions of finance and accounting are always under pressure in terms of improvement and new technologies. RPA technology will undoubtedly affect accounting and finance.

The automated workplace of accounting will significantly change the role of the accountant. Much time-consuming, manual work will be replaced by technology, so accountants will be able to focus on strategies and analysis. RPA and automation will destructively change accounting processes and operations. RPA will be particularly inefficient, and accounting professionals will focus more on strategic operations in the context of strategic accounting management. RPA will also provide automated internal control / audit and automated critical financial reporting.

According to Axson (2015), transaction tasks will move to integrated solutions for business services that use robotics, and this will automate or eliminate up to 40 % of transaction accounting work by 2020. As a result, staff can spend more time supporting decision-making, forecasting, and performance management.

This technology not only improves the efficiency of accountants, but also creates access to financial data in real-time, so that reporting and analysis can be performed simultaneously and continuously. RPA does not replace accountants; it develops their work in a progressive and positive way and allows them to focus on the greatest value they can give to their organization (Spanicciati, 2016).

In addition, auditors will have to audit robotics. Any type of automation has certain degrees of risk. RPA has its own learned algorithm and a faulty algorithm can have a huge impact on hundreds of bots using the same faulty algorithm. Hence, without human verification, there may be some dramatic and disastrous results. The auditor should check the RPA.

Industry 4.0 and ERP-systems. An ERP (Enterprise Resource Planning) system is a business process management software that manages and organizes a company's business processes, all in a single integrated platform. Activities that can be managed with an ERP system include finance, sales, customer relations, manufacturing, inventory management, supply chain management, human resources, payroll, etc. (Trunina et al., 2018).

Basically, an ERP system unifies the entire organization into a single package and provides all the necessary information about business activities through a common database, which is accessible to all programs in the system. Therefore, it does not require multiple systems that do not communicate with each other to manage various processes such as accounting, HR, CRM, supply chain, etc.

Today, ERP systems are seen as the most basic information systems that businesses have to support their operations. In addition, it is believed that institutional businesses will not be able to operate if there is no ERP and a customer relationship management (CRM) system. However, the existing ERP and CRM systems on the way to the future of the industry have significant obstacles (Stojkic et al, 2016). Existing ERP systems do not quickly provide adaptation to production planning. At the same time, it is clear that traditional structural automation is not enough to meet the requirements of Industry 4.0. In addition, they are known not to have a flexible enough structure to quickly integrate with dynamic variables for factory workflows and offer the best solutions. These points can be cited as an example of an obstacle to existing ERP systems (Rojko, 2017).

The Internet of Things (IoT). Industry 4.0 contains technologies, any of which are related to ERP systems in one way or another. Starting with the Internet of Things (IoT), which is the first Industry 4.0 technology that ERP systems must support.

With the support of IoT, all other Industry 4.0 technologies could be linked to ERP systems. IoT should be the point of integration between Industry 4.0 and ERP systems. The integration of this technology in Industry 4.0 is closely related to communication protocols between machines and different frameworks, which should be harmonized in the future.

Now, in most cases, data on production warehouses, production planning, quality control, processes and other sources are entered manually into ERP systems. The use of the Internet of Things would help to automatically enter data into ERP systems collected from different production sources, and this would eliminate the data entry error. Data entry using IoT equipment will also help change the approach to ERP systems (Gërvalla and Ternai, 2019). There will be another connection between ERP and Big Data Analytics and other Industry 4.0 technologies. Using Big Data Analytics, ERP systems can allow real-time collection and evaluation of data from different sources and can help in decision-making, quality control, cost optimization and other aspects. In addition, Simulation, another Industry 4.0 technology, can be linked to ERP through the use of Big Data Analytics to predict and evaluate the performance of systems that are analytically difficult to model in order to validate and optimize resources.

Industry 4.0 and Intellectual Capital (IC). Under the conditions of Industry 4.0 in the current digital ecosystem, accounting may face the problem of measuring intangible assets and Intellectual Capital (IC). After all, intangible assets will be focused on big data. As mentioned earlier, the structure of the big data set, which consists of audio, images, video, will be difficult to record in a traditional accounting system. The problem depends on how to measure intangible assets, which for the most part cannot be reflected in the financial statements.

Torre et al. (2018) note that the traditional accounting system works poorly with the digital system because the digital system requires more intangible investments than physical assets, which are potentially difficult to measure and report in financial statements. The debate over the measurement and reporting of intellectual capital requires companies to provide more information that is reliable for all investors. Some types of disclosure and lack of awareness of intangible assets force management to provide uninformed value that may differ materially from decision-making (Seetharaman et al., 2004).

One of the alternatives is compliance with IFRS (International Financial Reporting Standard). IFRS states that IC reporting in financial statements is voluntary if the company does not recognize IC as its intangible asset (Liao et al., 2013).

Liou et al. (2013) also noted that International Accounting Standard No. 38 (IAS 38) states that intangible assets require companies to recognize intangible assets, whether acquired or created independently, if it is probable that future economic benefits associated with the item will flow to the Group relating to the asset are received by the entity and if the value can be measured reliably. The main emphasis is on the identification of research and development. Research can be classified as cost, and development can be capitalized only after establishing the technical and commercial feasibility of the asset for sale or use. Adoption of IFRS will increase the disclosure of ICs in financial reporting, especially for high-tech companies in the UK 38 (IAS 38) states that intangible assets require companies to recognize intangible assets, whether acquired or self-generated, if it is probable that the future economic benefits associated with the asset will flow to the entity; and if the value can be estimated reliably.

On the other hand, the application of IFRS may not be a solution, as the presentation of intangible assets may not help investors assess the value of intangible assets. Some experts (Liou et al., 2013) also argue that the IC measurement response does not yet have an unambiguous answer, and they are pessimistic that accounting rules will take into account the possibility of capitalizing intangible assets. IFRS allows a company to capitalize its intangible assets, which are classified as development costs if the costs are incurred after technical and commercial expediency for sale or after creation. At the same time, the provisions for the valuation of intangible assets, including IC, differ in various countries.

Industry 4.0 and Extensible Business Reporting Language (XBRL). It is believed that for Industry 4.0, real-time credentials will be presented to users with information faster and more efficiently. In today's system, this is visible in real-time when credentials are provided to information users via XBRL (Extensible Business Reporting Language). XBRL is a financial reporting language that is rapidly spreading around the world. XBRL is the name of a framework that allows real-time presentation of financial information on the Internet and enables electronic communication (Toraman and Abdioglu, 2008).

XBRL (eXtensible Business Reporting Language) is an international standard for providing IFRS financial statements in electronic form.

This format is widespread in the world, since it allows processing large volumes of qualitative and quantitative indicators. It is based on the metadata set out in the taxonomy and the relationships between concepts described.

Some of these advantages are as follows (IIas et al., 2014):

- the significant time spent on analyzing the financial statements of enterprises is reduced;
- provision of an easy access to financial information that needs to be obtained around the world;
- allowing real-time financial analysis;
- permitting to quickly and easily see the financial condition of enterprises;
- allowing to compare the financial statements of companies operating in different countries.

A 2016 CFA Institute survey to measure awareness of XBRL members shows significant results. This survey included 362 CFA members in the US, Europe, Middle East, Africa, and Asia-Pacific who were trying to measure their XBRL awareness. In the 2016 survey, 55 % of members do not know about XBRL, 35 % of them know about XBRL but do not use it in financial reporting, and 10 % of members use XBRL. This finding is almost identical to the results of surveys conducted in 2007, 2009 and 2011 (CFA Institute).

Given all the benefits of XBRL in terms of financial reporting, it is understandable its great importance for all users of information. However, it is clear that the level of use of XBRL applications is not high, as shown by periodic CFA surveys.

In other words, it is clear that participants did not benefit from this reporting language and there were few important benefits or beneficiaries. It is believed that the level of awareness and use of XBRL is expected to provide great benefits to users through applications developed with Industry 4.0.

5. Conclusions

The conducted research suggests that during the period of Industry 4.0 the human factor in enterprises will significantly decrease, but it is the human factor that will become more active at important moments in decision-making. Although it is known that all accounting procedures can be performed by intelligent systems, it is believed that a human factor will be necessary to ensure effective control over the system being created.

Technology will not supplant accountants, but on the contrary, will help enrich their knowledge, skills and abilities; allocate time for accountants to analyze and manage the company's activities; make it easier for accountants to perform routine activities and operations. The evolution of digital transformation in the accounting information system will speed up the work of an accountant for more accurate, efficient, real-time reporting.

For this reason, accountants must have a sufficient level of knowledge in many areas, such as knowledge of robotics systems, software, knowledge of engineering and computer science, as well as project management skills.

References:

1. Axson, D. (2015), *Dealt Y Di Ital: Good-Bye To Finance As You Know It*, [Online], available at: http://Ww2.Cfo.Com/Analytics/2015/10/Death-Digital-Good-Bye-Financeknow/
2. Belfo, F., Trigo, A. and Estébanez, R.P. (2015), «Impact Of Ict Innovative Momentum On Real-Time Accounting», *Business Systems Research Journal*, Vol. 6, No. 2, pp. 1–17.
3. Belfo, F.A. and Trigo, A. (2013), «Accounting Information Systems: Tradition And Future Directions», *Procedia Technology*, Vol. 9, pp. 536–546.
4. Bonilla, S., Silva, H., Terra Da Silva, M. Et al. (2018), «Industry 4.0 And Sustainability Implications: A Scenario-Based Analysis Of The Impacts And Challenges», *Sustainability*, No. 10 (10), pp. 37–40, doi: 10.3390/Su10103740.
5. Boons, F. and Lüdeke-Freund, F. (2013), «Business Models For Sustainable Innovation: State-Of-The-Art And Steps Towards A Research Agenda», *J. Clean. Prod*, No. 45, pp. 9–19, doi: 10.1016/J.Jclepro.2012.07.007.
6. Bressanelli, G., Adrodegari, F., Perona, M. and Saccani, N. (2018), «Exploring How Usagefocused Business Models Enable Circular Economy Through Digital Technologies», *Sustainability*, No. 10 (3), 639 p., doi: 10.3390/Su10030639.
7. Cigen (2017), *The Role of Robotic Process Automation (RPA) in Accounts Payable Process Management*, [Online], available at: https://www.cigen.com.au/the-role-of-robotic-process-automation-rpa-in-accounts-payable-process-management/
8. Coyne, E. M., Coyne, J.G. and Walker, K.B. (2018), «Big Data information governance by accountants», *International Journal of Accounting & Information Management*, Vol. 26, No. 1, pp. 153–170.
9. Cpa Australia, Accounting Concepts And Principles (2012), BPP, Learning Media Ltd, Australia.
10. Damayanti, C.R. (2019), «Accounting and Its Challenges in the New Era», *Annual International Conference of Business and Public Administration*, AICoBPA.
11. De Man, J.C. and Strandhagen, J.O. (2017), «An Industry 4.0 research agenda for sustainable business models», *Procedia CIRP*, No. 63, pp. 721–726, doi: 10.1016/ j.procir.2017.03.315.
12. Dimitriu, O. and Matei, M. (2015), «Cloud Accounting: A New Business Model in a challenging context», *Procedia Economics and Finance*, No. 32, pp. 665–671.
13. Di Vaio, A. and Varriale, L. (2019), *Port 4.0: Accounting, controlling and reporting tools in the organizational and operational processesforsustainable performance?*, Springer-Verlag, Berlin.
14. Fontinelle, A., *Introduction To Accounting Information Systems*, [Online], available at: http://www.investopedia.com/articles/professionaleducation/11/accounting-informationsystems.asp/
15. Gamage, P. (2016), «Big Data: Are Accounting Educators Ready?», *Accounting and Management Information Systems*, No. 15 (3), pp. 588–604.
16. Gandomi, A. and Haider, M. (2015), «Beyond the hype: Big data concepts, methods, and analytics», *International Journal of Information Management*, Vol. 35, No. 2, pp. 137–144.
17. Gërvalla, M. and Ternai, K. (2019), «The Impact of Industry 4.0 to the ERP Approach», *SEFBIS Journal*, No. 13, pp. 56–62.
18. Geissdoerfer, M., Savaget, P., Bocken, N.M. and Hultink, E.J. (2017), «The circular economy: a new sustainability paradigm?», *Journal of Cleaner Production*, No. 143, pp. 757–768, doi: 10.1016/j.jclepro.2016.12.048.
19. Hall, J.A. (2010), *Accounting Information Systems*, Southwestern Educational Publishing 840.
20. Hermann et al. (2015), *Design Principles for Industrie 4.0 Scenarios in Working Paper*, No. 1/2015, [Online], available at: http://www.thiagobranquinho.com/wpcontent/uploads/2016/11/Design-Principles-for-Industrie-4_0-Scenarios.pdf
21. ResearchAndMarkets.com, *Industry 4.0 – Global Market Trajectory & Analytics Report*, [Online], available at: https://cutt.ly/4I3ShVo
22. Kagermann, H., Lukas, W.D. and Wahlster, W. (2011), «Industrie 4.0: mit dem Internet der Dinge auf dem Weg zur 4», *Industriellen Revolution. VDI Nachr.*, No. 13 (1), pp. 2–3.
23. Kamble, S.S., Gunasekaran, A. and Gawankar, S.A. (2018), «Sustainable Industry 4.0 framework: a systematic literature review identifying the current trends and future perspectives», *Process Saf. Environ. Protect*, No. 17, pp. 408–425, doi: 10.1016/j.psep.2018.05.009.
24. Khanom, T. (2017), «Cloud Accounting: A Theoritical Overview», *IOSR Journal of Business and Management*, Vol. 9, No. 6, pp. 31–38.
25. KPMG (2017), *Managing Risk in Robotic Process Automation*, [Online], available at: https://home.kpmg.com/xx/en/home/insights/2017/03/managing-risk-in-roboticprocess-automation.html

26. Krueger, R.A. and Casey, M.A. (2000), *Focus groups: A practical guide for applied researchers*, 3rd ed., CA: Sage, Thousand Oaks.
27. Lamberton, C., Brigo, D. and Hoy, D. (2017). Impact of Robotics, RPA and AI on the Insurance Industry: Challenges and Opportunities. *Journal of Financial Perspectives*, Vol. 4, No. 1, pp. 10–13.
28. Liao, P.C., Ling-Ching Chan, A. and Seng, J.L. (2013), «Intellectual capital disclosure and accounting standards», *Industrial management & data systems*, Vol. 113, No. 8, pp. 1189–1205.
29. Liu, C. (2017), «International Competitiveness and the Fourth Industrial Revolution», *Entrepreneurial Business and Economics Review*, No. 5 (4), pp. 111–133, doi: 10.15678/EBER.2017.050405.
30. Maciejewski, M., and Głodowska, A. (2020), «Economic development versus growing importance of the financial sector: Global insight», *International Entrepreneurship Review*, No. 6 (3), pp. 77–90, doi: 10.15678/IER.2020.0603.06.
31. Marshall, B. et al. (2021), *Accounting Information Systems*, Pearson Education Limited.
32. Mcintosh-Yee, L. (2018), *How Robotics Process Automation (RPA) Is Changing Accounting*, [Online], available at: http://www.centreviews.com/2018/03/rpa-is-changing-accounting/
33. Meskovic, E., Garrison, M., Ghezal, S. and Chen, Y. (2018), «Artificial Intelligence: Trend in Business and Implications for The Accounting Proffesion», *Internal auditing*, Vol. 33 (3), pp. 5–13.
34. Mohammadi, S. and Mohammadi, A. (2014), «Effect of Cloud Computing in Accounting and Comparison with the Traditional Model», *Research Journal of Finance and Accounting*, Vol. 5, No. 23.
35. Müller, J.M., Buliga, O. and Voigt, K.I. (2020), «The role of absorptive capacity and innovation strategy in the design of industry 4.0 business Models-A comparison between SMEs and large enterprises», *European Management Journal*, doi: 10.1016/j.emj.2020.01.002.
36. Nascimento, D.L.M., Alencastro, V., Quelhas, O.L.G. et al. (2019), «Exploring Industry 4.0 technologies to enable circular economy practices in a manufacturing context: a business model proposal», *Journal of Manufacturing Technology Management*, No. 30 (3), pp. 607–627, doi: 10.1108/JMTM-03-2018-0071.
37. Onyshchenko, O., Shevchuk, K., Shara, Ye. et al. (2022), «Industry 4.0 and accounting: directions, challenges, opportunities», *Independent Journal of Management & Production*, No. 13 (3), pp. 161–195, doi: 10.14807/ijmp.v13i3.1993.
38. Salem, S., Nurdayadi, N. and Alfiandri, A. (2021), «Cloud Accounting: The Development of Accounting Information System in Industry 4.0 in Indonesia», *Conference Series*, No. 3 (2), pp. 282–294, doi: 10.34306/conferenceseries.v3i2.597.
39. Seetharaman, A., Lock Teng Low, K. and Saravanan, A.S. (2004), «Comparative justification on intellectual capital», *Journal of Intellectual Capital*, Vol. 5, No. 4, pp. 522–539.
40. Sieja, M. and Wach, K. (2019), «The Use of Evolutionary Algorithms for Optimization in the Modern Entrepreneurial Economy: Interdisciplinary Perspective», *Entrepreneurial Business and Economics Review*, No. 7 (4), pp. 117–130, doi: 10.15678/EBER.2019.070407.
41. Stanciua, V. and Gheorghe, M. (2017), «An Exploration of the Accounting Proffesion – The stream of Mobile Devices», *Accounting and Management Information Systems*, No. 46 (3), pp. 369–385.
42. Tarmidi, M., Rasid, S., Alrazi, B. and Roni, R. (2014), «Cloud computing awareness and adoption among accounting practitioners in Malaysia», *Procedia – Social and Behavioral Sciences*, No. 164, pp. 569–574.
43. Toraman, C. and Abdioğlu, H. (2008), «Genişletilebilir İşletme Raporlama Dili (Gird) Ve Gelir İdaresince Kullanımı», *Afyon Kocatepe Üniversitesi İ.İ.B.F. Dergisi*, No. 10 (2), pp. 79–109.
44. La Torre, M., Botes, V.L., Dumay, J. et al. (2018), «The fall and rise of intellectual capital accounting: new prospects from the Big Data revolution», *Meditari Accountancy Research*, Vol. 26, No. 3, pp. 381–399.
45. Trunina, I., Vartanova, O., Sushchenko, O., and Onyshchenko, O. (2018), «Introducing ERP System as a Condition of Information Security and Accounting System Transformation», *International Journal of Engineering & Technology*, Vol. 7 (4.3), pp. 530–536.
46. Tugui, A. (2015), *Meta-Digital Accounting in the Context of Cloud Computing*, [Online], available at: http://www.irma-international.org/viewtitle/112311/
47. Ucar, M., Kizil, C. and Oguz, O. (2018), «Problems of Accounting Professionals Residing In Instanbul and the Suggested, Solutions», *Emerging Markets Journal*, No. 8 (1), pp. 18–30.
48. Vasarhelyi, M.A., and Alles, M.G. (2008), «The "now" economy and the traditional accounting reporting model: Opportunities and challenges for AIS research», *International Journal of Accounting Information Systems*, Vol. 9, No. 4, pp. 227–239.
49. Vasarhelyi, M.A. and Rozario, A.M. (2018), «How Robotic Process Automation Is Transformin Accountin and Auditin», *The CPA Journal*, [Online], available at: https://www.cpajournal.com/2018/07/02/how-robotic-process-automation-istransforming-accounting-and-auditing/
50. Warren, J., Moffitt, K. and Byrnes, P. (2015), «How Big Data will change accounting», *Accounting Horizons*, Vol. 29, No. 2, pp. 397–407.
51. Weygandt, Kimmel, and Kieso (2019), *Financial Accounting with International Financial Reporting Standards*, John Wiley & Sons.
52. Wilkinson, S. (2004), «Focus group research», in D. Silverman (ed.), *Qualitative research: Theory, method, and practice*, *Thousand Oaks*, CA: Sage, pp. 177–199.