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Robotic Process Automation in Audit and Accounting

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Abstract

Nowadays, Information Technology (IT) is part of virtually every business, and companies that cannot keep the pace with new technologies will disappear over time. Due to their nature of specific activities and exceeding other areas, professional accounting and auditing services can improve their performance through Robotic Process Automation (RPA). Furthermore, RPA can contribute to increasing the credibility of the accounting profession, as well as streamlining the activity in order to comply with the requirements imposed by professional standards but with much lower costs. This study is based on a review of the literature and through an exploratory approach opens a discussion on the concept of RPA and customises it in the field of professional accounting services by analysing robotics models specific to accounting and audit.

***Keywords**: RPA, audit, accounting, accounting profession*

***JEL Classification**: M41, M42, O33, C88*

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Introduction

The phenomenon of robotisation is a large and dynamic and has become more and more accentuated in the last years. As the business world tends to globalisation and the Internet progresses information flows become very fluid, and we are witnessing a rapid process of digitalisation of the whole society and even "Dataism" (Harari, 2018). The digital age emanates several significant changes in the labour market, such as jobs where people are no longer needed and are replaced with robots for particular processes (Harari, 2018), but also the emergence of new jobs calling for the development of new digital skills (Negroponte, 1999), along with the need for an integrated approach to information systems. (Fotache and Păvăloaia, 2015).

Robots have been utilised in various industries and production processes since the 1970s. Subsequently, robots began to be used in various service sectors, such as tourism and financial services and more recently in accounting and auditing (Vasarhelyi and Rozario, 2018).

By the nature of its specific activities, the field of accounting services has been directly influenced by the evolution and acceptance of information technologies (Țugui, 2006; Toader, 2012). Starting from general accounting software, accounting management, inventory and employee management, continuing with the development of ERP systems, and currently advancing to the area of cognitive technologies that include Robotic Process Automation (RPA), machine learning, computer visualisation, along with elements of artificial intelligence (AI), cloud data storage and manipulation of large data sets (big data) (Ionescu et al., 2014, Stanciu, 2016), together with their challenges regarding information security (Nastase and Caia, 2015), familiarisation with the facilities available to technology (Fotache and Pavaloaia, 2015), impact on the organisational environment and an integrated approach to processes (Bendovschi and Ionescu, 2015, Homocianu and Airinei, 2015).

Since many accounting and auditing activities are repetitive, involve tasks that interact with multiple systems, contain high levels of transaction processing, and require timely decision-making, the potential for using RPA in these areas is high ranking (Chan et al., 2018; Zhang, 2019).

RPA represents software integrated into the company's existing IT infrastructure. RPA can be programmed to perform repetitive tasks, thus releasing employees from their burden, in sectors such as invoices or transactions processing, filling in various types of documents and forms, online or offline worksheets, reporting, creating and updating databases, data verification or validation, database concatenations, data reconciliations.

In the general background of the digital age and particularising the case of intensive digitalisation of the accounting profession, our paper aims to address the subject of RPA and its challenges for this profession, a particularly current topic, which is beginning to be debated internationally and nationally, both by practitioners and academia. In this regard, the study is conducted through an analysis of the scientific literature published in prestigious international journals and brings two significant contributions to the development of knowledge. First, it identifies the patterns of implementation of RPA in accounting and audit, and secondly, it identifies in concrete terms what the implementation of an RPA implies and its possible future developments.

The results of the study can be useful to several categories of users. Firstly, it applies equally to practitioners in the field of accounting and audit, RPA solution providers and academia, and secondly, it is of interest to both professional and regulatory bodies.

Our paper is organised into four sections. Section 1 analyses the concept of RPA in general and how RPA has entered the field of accounting and audit. Section 2 presents the research methodology and describes its design, the justification of the applied method and the establishment of the set of analysed articles. Section 3 includes the results of the research, and at the end of the paper, we present the main conclusions, the limits of the study, as well as perspectives for further research developments in this field.

1. Overview of the concept of RPA and its impact on accounting and audit

Automation is one of the most critical steps in the process of digital business transformation. The automation of employees' tasks depends on people's capacity of perception and analysis, while the process automation depends on robots and RPA technology, respectively (Colesca and Dobrin, 2006). Thus, RPA can

be successfully implemented and used in any type of company or department, and the context of our study even in the case of companies that offer professional accounting and auditing services.

RPA refers to the automation of repetitive, structured, rule-based tasks and can be considered a type of software that mimics the activity of a human being in performing a task within a process (Cohen et al., 2019). It can make repetitive operations faster, more accurate and "does not tire", managing to free people from a large volume of work (Vasarhelyi and Rozario, 2018). In other words, RPA helps to increase the efficiency of the business process and to reduce human errors and costs (Osman, 2019). Moreover, it can interact with other software applications at the user interface level, but it is not intelligent, in the sense that it cannot adapt to changes and cannot make complex decisions (Zhang, 2019). RPA is a computer application that allows employees of a company to configure software on a computer or "robot" to run existing applications related to transaction processing, data manipulation, triggering responses and communicating with other digital systems (Kaya et al., 2019). RPA most commonly refers to software configuration for transferring data from multi-input sources such as emails and spreadsheets to registration systems such as ERP and customer relationship systems, like CRM (Cohen et al., 2019).

In a broader view, RPA is a combination of correlated technologies such as autonomous systems, machine learning, artificial intelligence and robotics (Anagnoste, 2017). More specifically, using the basic applications existing in the company, RPA accesses and manipulates spreadsheets, documents and emails in order to complete tasks. In the opinion of Kaya et al. (2019), RPA can easily automate current activities, processes in different departments such as production, finance and accounting, sales, acquisitions, supply chain management, customer service and human resources.

Unlike macros (Kokina and Blanchette, 2019), RPA robots can interact with multiple systems, work autonomously and perform routine tasks consisting even of binary decisions that do not require intelligence. A more sophisticated RPA evolves towards cognitive or intelligent automation, i.e. it becomes able to perform non-routine tasks that involve judgment based on professional rules applied even on unstructured data. RPA software can run on either a physical machine or a virtual machine, in sync with all systems inherited from the client: ERP, web applications, cloud, Citrix, Java, mainframe applications or other types of applications. (Anagnoste, 2017)

The potential for using RPA is high because many areas of audit and accounting involve tasks that interact with multiple systems, contain high levels of transaction processing and require real-time decision making (Kokina and Blanchette, 2019). In the field of accounting services, RPA represents an opportunity to improve the quality of services provided, although there are several concerns that the use of RPA will lead to the replacement of people with robots. In reality, Cooper et al. (2019) estimate that it will generate a change in the role of the professional accountant to allocate more time for analysis and forecasting activities, to the detriment of routine ones.

Throughout their evolution, the audit and accounting processes have incorporated a series of tools and processes created with computer support, which have often been interconnected by several manual steps and "clicks" of verification. RPA can take over and perform an entire predefined sequence of repeatable operations by automation. Certain parts of the audit process can be automated with the help of RPA, in particular, those prone to the use of workflows and those involving repeatable decisions. (Moffitt et al., 2018). RPA is a dramatic and disturbing change in current mostly manual audit practice but promises to allow auditors to operate at a much higher level (Vasarhelyi and Rozario, 2018). However, the RPA for audit services remains at an early stage due to the highly regulated nature of the audit and accounting services (Cooper et al., 2018).

The main advantages of RPA for companies providing professional audit and accounting services (Appelbaum and Nehmer, 2017, Tucker, 2017, Devarajan, 2018; Cohen et al., 2019; Ansari et al., 2019; Huang and Vasarhelyi, 2019; Gotthardt et al., 2020) would be as follows:

1. Replaces human resources, which lead to:
   a) avoiding possible conflicts between employee and customer due to the lack of emotional side of the robot (for example in the case of a human employee who may have a bad day, there is a risk that he/she will unload the nerves on customers, thus causing discomfort)
   b) avoiding the preoccupation of looking for specialised personnel in the field (we all know how

difficult it is to find someone who is devoted to a job, especially one with the necessary experience; thus the introduction of robots would lead to the uselessness of recruitment processes)

c) resistance to working under pressure (compared to a human, the robot is programmed to withstand loads in any conditions).

2. Reduces long-term salary costs; immediate costs increase when purchasing the software
3. Performs tasks regardless of their difficulty, because robots are specialised to cope with a high degree of work, with a whole programming system behind. For them, the idea of multitasking is not a challenge, but only part of their daily routine; and in terms of monotony, repetitive tasks do not affect their performance at work. Thus, the robot can satisfy any need of the customer is considered, a need that falls within its scope.
4. It does not require motivational factors: unlike a human being who is dependent on a source of motivation (bonuses, vouchers, holidays) to exceed his/her standards and successfully perform the duties, a robot is based on a mechanism that does not require motivation. Therefore, its purchase is advantageous to the employer.

On the other hand, the research literature publicises some disadvantages generated by the introduction of RPA in accounting and auditing activities. The same authors (Appelbaum and Nehmer, 2017, Tucker, 2017; Devarajan, 2018; Cohen et al., 2019; Ansari et al., 2019; Huang and Vasarhelyi, 2019, Gotthardt et al., 2020) draw attention to them:

1. RPA replaces human resources. The main disadvantage of purchasing a robot (in place of employees) is given by the substitution of people by a technological system, leading to the loss of their jobs.
2. Inability to adapt to uncertainty. While operating according to a well-defined programming system, robots are unable to cope with uncertainty. This weakness is evident in the situation where they are forced to react in some instances that are not predetermined by man because the chance to resolve the situation is impossible; for example, scepticism in the audit profession.
3. High risk of possible errors and malfunctions. No matter how intelligent and functional a robot is, like a sick human employee, it can also make specific errors. Implicitly there is a dependence on qualified personnel; No matter how independent a robot may seem to us, it is non-existent without a human force behind it since the robot depends on what a person wants the one who intervenes in its modifications, updates and repairs.
4. Reduces the number of potential customers. Independent accounting and audit firms that choose to introduce robots to manage various tasks may face an adverse reaction from customers due to this concept, the service robot being a recent innovation. This reaction implicitly leads to a reduction in the number of potential customers due to the lack of interest in the new invention.

The purpose of any RPA (Gotthardt et al., 2020) is to perform its intended task better than the previously used manual or technological methods. By integrating the AI component, RPA's actions bring it closer to human behaviour patterns. Therefore, in deciding to implement an RPA in general but also in particular, in the case of professional audit and accounting services, it is necessary to assess both benefits and potential risks.

RPA is of interest to both practitioners and academia. From a practical point of view, there are still quite a few unknowns regarding the implementation of RPA at the level of organisations, processes and tasks, without the risk of errors, to maintain a balance at the organisational level between automated and manual, human processes. (Kokina and Blanchette, 2019)

In this regard, our study aims to contribute to the development of knowledge by formulating answers to the following questions:

1) In which accounting and audit processes is RPA implemented?
2) What are RPA's patterns of implementation in accounting and audit?
3) What are future developments?

2. Research methodology

From a methodological point of view, we intended to write a literature review starting from the exhaustive analysis of the studies dealing with the subject of RPA in accounting and audit.

In this regard, we used the Google Scholar database on which we performed a search by keywords containing the expression "RPA in accounting and audit" and

separately by the search string ("Robotic process automation" OR "RPA") AND ("accounting" OR "audit"), without predefining a search period.

The first round of search generated a total of 40 articles that included these keywords in the title, abstract or keywords section. After removing the duplicates, we moved on to the second stage, downloaded and scan the articles by searching for the words audit and accounting and RPA. Then, the articles that dealt tangentially with one of the three research questions formulated were removed (i.e. either mentioned RPA only in a small number of sentences or only used the term robot, automatisation, without developing the idea of RPA). Therefore, the final sample contained 19 articles. In the third stage, these articles were sorted and grouped according to criteria such as year of publication, the number of authors per article, authors' country of origin, methodology used (Murcia et al., 2008). We thoroughly read the articles that made up the final sample and analysed them in order to formulate the answers to the three research questions. The papers included in the study are the most significant considering the relevance and number of citations using Google Scholar, last accessed on June 15, 2020, is included in the first three search pages.

The analysed articles address in whole or in combination one or more of the established questions as shown in the **Table no. 1**.

Table no. 1: Articles analyzed in terms of topics covered

No.	Authors	Year	RPA in accounting and accounting management	RPA in audit	RPA implementation
1.	Anagnoste	2017	X		
2.	Appelbaum and Nehmer	2017	X		
3.	Tucker	2017	X		
4.	Cooper et al.	2018	X	X	
5.	Devarajan	2018		X	X
6.	Fernandez and Aman	2018	X		X
7.	Moffitt et al.	2018		X	X
8.	Vasarhelyi and Rozario	2018	X	X	X
9.	Zhang et al.	2018	X		
10.	Zheng	2018	X		
11.	Ansari et al.	2019			X
12.	Cohen et al.	2019		X	X
13.	Jędrzejka	2019	X		X
14.	Kaya et al.	2019	X		
15.	Kokina and Blanchette	2019	X		X
16.	Kruskopf et al.	2019	X	X	
17.	Huang and Vasarhelyi	2019		X	X
18.	Zhang	2019		X	X
19.	Gotthardt et al.	2020	X	X	X

Source: Authors' processing

In the results section, after describing the sample of articles, we present three elements: RPA in accounting and accounting management, RPA in audit, RPA implementation, followed by future developments of the subject from a theoretical and practical point of view.

3. Results

3.1. Description of the analyzed group of articles

The scientific debates on RPA in accounting and audit are relatively recent, having been published more since

2017: 3 in 2017, 7 in 2018, 8 in 2019 and one in 2020, therefore we find an increasing evolution of the number of articles addressed by RPA in accounting and auditing.

Concerning the authors, there is a growing preference over the analysed period for teamwork on this topic; only six articles have a single author, two in each year: 2017, 2018, 2019. A possible explanation of this evolution could be the complexity of the topic and the need to approach it in work teams. The number of authors varies between a single author and teams reaching up to 6 authors for 2 of the analysed articles, formed by a group of researchers from Hanken School of Economics, Helsinki, Finland (Kruskopf et al., 2019; Gottardt et al., 2020).

Regarding the affiliation of authors, most articles (10) are written by authors with exclusive affiliation to US universities, followed at a considerable distance by universities from China, Finland, Turkey and other parts of the world or collaborations between them. US universities have the upper hand in terms of the number of publications on this topic, which indicates a significant interest in the topic. A possible explanation for this situation could be the fact that USA invests the most in technology and is home to both the largest accounting and auditing companies and the largest IT companies in the world (Murcia et al., 2008; Zhang, 2019). The analysis of the authors' affiliation shows that Rutgers University, Newark, New Jersey (USA), is the leading research centre in the field of RPA in the audit. In the top of the authors, with four articles as the primary author or co-author is one of the renowned professors of this university, Professor Miklos Vasarhelyi who together with his research team (consisting of colleagues and PhD students with whom he collaborates on the sample articles, e.g. Rozario and Zhang) is a pioneer in the implementation and impact of information technologies in the field of auditing and accounting of which we mention only a few: the XBRL standard, AI in audit and accounting and continuous auditing (Murcia et al., 2008; Zhang, 2019).

Regarding the methodology used in the analysed articles, we unanimously speak about qualitative research based on case studies with one or more entities, individual and semi-structured interviews, literature reviews or a combination of them. After these, we enumerate editorials and professional articles describing the impact of the RPA on accounting, auditing, the profession in general and education in the field, published in scientific or professional journals.

Case studies based on a single case allow researchers to have a detailed understanding of the influence of RPA at each management level of a company providing financial, accounting and audit services. Due to this consideration, we could find six studies in the group of articles: example of one of the largest international companies offering accounting services including invoicing, salaries, preparation of financial statements and other categories of reports, statements and elements necessary for decision making at the entity level such as the forecasting of cash flows, investments and financial planning (Fernandez and Aman, 2018); the case of a Finnish company in the field of car production (Gotthardt, 2020); a Chinese electricity company that aspires to automate its entire financial accounting activity by robotisation (Zheng, 2019); the case of a company in the field of selling fuel through pumping stations for bank settlement activities (Anagnoste, 2017) and the case of an accounting and auditing firm in which a framework proposed by Huang and Vasarhelyi (2019) or Zhang (2019) was tested for the implementation of RPA to automate parts from the auditing activity.

The articles based on a multiple case study (Kokina and Blanchette, 2019) consider several entities in the field of financial accounting services that are either in an incipient phase of RPA implementation or in the intentional phase. They select from these the respondents of semi-structured interviews to find out their experience and opinion on the effect of implementing RPA, certain functions and allow the establishment of similar typologies, found in different organisations.

The interview-based articles take into account between 10 and 20 respondents from different levels of management within organisations, such as vice presidents, human resources director, operations director, team manager, quality manager and specialists from operational areas (Fernandez and Aman, 2018), within RPA providers and organisations that have already implemented RPA (Kokina and Blanchette, 2019) or intend to adopt RPA (Cooper et al., 2019), with different activity profiles: services, production or trade.

After analysing the journals in which the articles were published, we noted the increased interest in the RPA subject of US publications from academia (”Journal of Emerging Technologies in Accounting” and ”Accounting

Horizons" of the *American Accounting Association*) and the professional environment („CPA Journal").

As regards the subject area of the journals, most articles are published in journals in the field of accounting from prestigious publishers or international conferences proceedings, followed by journals with a predominantly technical profile.

3.2. RPA models in accounting

Accounting involves the chronological and systematic recording of transactions and economical operations related to a period. Given the repetitive nature of operations with a large volume of transactions within a period and from one period to another, such as invoicing, salaries, settlements etc., by automating these processes companies can streamline the entire activity thus reducing costs and error risks (Tucker, 2017). Moreover, because the entire accounting activity involves going through well-defined steps through work procedures, companies that offer accounting services could fully benefit from RPA advantages. RPA copes with changes in legislation, usually quite frequent in the tax field, because software updates can be done very quickly (Jędrzejka, 2019).

There are several mentions in the literature about routine, repetitive processes and tasks that can be automated using RPA. Among them, the easiest to robotise are those targeting goods and services inputs by purchase followed by their payment, periodic closures and monthly internal or external reporting because they are routine and do not require complex professional reasoning or high-impact decision making. (Jędrzejka, 2019; Kaya et al., 2019; Kokina and Blanchette, 2019).

This first category of operations could be automated with the help of "task-oriented" robots that will only perform calculations and rely on humans just to handle exceptions. In other words, the manual work of "extracting data from one system, performing data processing and moving the adjusted data to another system" (Tucker, 2017) will be automated. One such example would be the "bank reconciliations" operation. Before the RPA, accountants had to analyse and link transactions manually, note discrepancies and create entries in the journal. Using RPA, the accountants identify, analyse and solve the causes that led to the discrepancies.

In particular, if we referred to the automation of the process of paying suppliers and collecting from customers in cash or by bank transfer, it would involve the following. Robots log in with their credentials, find new invoices, "couple" them with the related orders, request and wait for approvals, perform accounting records and other internal operations and finally, make the payment and send a warning message, an announcement on completing the operation. The process is repeated as long as there are pending and unpaid invoices. Extracting, validating and entering transaction data from/into many computer systems is faster and more accurate than a manual operation. An employee with accounting skills can control several robots, and only intervenes when exceptions occur. These refer, for example, to data that does not conform to the supported format, network problems, or other systems malfunction (Jędrzejka, 2019).

RPA can be extremely efficient in managing the receivables and payables by updating databases on customers, suppliers, debtors, creditors, issuing / receiving and processing invoices, approving, validating and making payments at maturity or issuing payment notices for amounts receivable, checking the correlations between the invoices issued and the goods or services to be delivered and respectively between the invoices regarding the purchased goods or services and the elements specified in contracts or purchase orders and the goods or received.

A practical example of automating invoice processing from suppliers (based on the RPA UiPath Studio solution) is provided by Gotthardt et al. (2020) in the case of a Finnish car manufacturing company. The company had to process about 2,000 invoices every day, with manual interventions for reading, validation, registration and posting invoices. The implemented automated process can be described as follows: The robot will open the invoice file in the email, and the PDF document will be opened in the background to extract relevant information (i.e. company name, invoice date, invoice reference number, description, total amount, VAT percentage and other taxes, total amount and contact information). After reading the text from the PDF, the information is extracted from the file. The robot also performs data conversions and format changes to validate the entry in the company's accounting system (e.g. SAP). After this extraction, the robot connects to SAP with encrypted connection data. Then, it performs a search to see whether there are any invoice entries for

the vendor. In this case, certain information can be adapted/taken from previous internal data. Subsequently, invoices are inputted with data extracted from the files. In the end, the information about VAT and other taxes is corroborated with the invoice and the database. The original file is then moved to the processed invoices folder in the email system.

There is another example presented by Anagnoste (2017), this time on cash receipts from customers and by bank transfer. In the case of the analysed company, selling fuel in pump stations, the settlement activity with the bank is managed by a group of 7 employees with accounting training, each of them managing 13 fuel delivery stations, working an average of 11 hours a day. By introducing RPA, the robot reconciles the settlement of the station manager with the bank, with the cash collected at the stations the previous day, and the specialised employees only have to investigate the differences that may occur when reconciling and to resolve them. After using an RPA that took over the reconciliation task, the working time for this activity at the company level decreased to one hour per day.

Studies from the research literature (Cooper et al., 2019, Kaya et al., 2019) mention other areas suitable for RPA implementation: treasury management, transactions between companies belonging to the same group, inventory management, employee records, salary calculation and settlement, and the related social contributions, evidence of fixed assets, expenses with depreciation and the establishment of tax and fee payments.

Travel expenses and their settlement can also be subject to automation starting with the planning stage of expenses for the next period and continuing with the reservation of transport, accommodation, event registrations and finally their settlement. The category of travel expenses includes transportation expenses with different means of transport, accommodation, fees for attending conferences, fairs, exhibitions for which an RPA can set the travel period, location and approved budget. For example, for the next year or period, it can perform a series of searches to optimise total costs (Cooper et al., 2019). With the help of RPA, these expenses can be monitored and, depending on its setting, reservations can be automatically requested for transport, accommodation and other expenses for that trip, and the responsible employee will make the decision based on the variants proposed by RPA or RPA will automatically reservations (if set for this decision).

In addition to these operations, RPA can be useful in performing more complex operations. Robots oriented towards "process efficiency and automation" can be used for such operations (Tucker, 2017). An RPA with the AI mode attached could manage entire processes, such as closing the monthly balance, from the first operation to the last, without human intervention. In the case of exceptions (anomalies), RPA may send messages to the "task-oriented" accounting robot (a lower level robot with administrative tasks only), its contact for further investigations.

Another example of a process that can be automated refers to periodic closure and reporting (Kaya et al., 2019). It includes coordinating the collection and verification of large amounts of data from several entities, which is done with the help of spreadsheets, tables, separate lists of records. Problems related to "concatenating, connecting or updating data from different sources that require manual data transfer" plus data cleaning lead to errors but are also time-consuming. The current regulatory and legal reporting requirements are becoming increasingly demanding for the accounting department of large companies.

Closing balance sheets, consolidating situations at group level and publishing financial statements within the strict deadlines specified by law or at group level requires proper coordination, a competent team and good corporate governance. Also, the closing process at the end of a period has a direct impact on the outcome of the reporting, because the complete character of the use of the report derives from the accuracy, completeness and actuality of the information. We affirm that an RPA can be incorporated on:

- Monthly, quarterly and annual closing operations with the issuance of the accounting journal, of the registers on different categories of operations, specific verifications of the purchase and sales journals, reconciliation of accounts, balances and even consolidations
- Monthly, quarterly, annual reports both internal to management that include financial and operational performance information, as well as mandatory and regulated external or voluntary at the choice of the organisation.

RPA can also be used in the exercise of the accounting function of control and forecasting by short-term planning and budgeting various activities or processes in

the short, medium and long term, by taking into account several scenarios in a short period, which makes the decision making the process more efficient (Kaya et al., 2019).

Cooper et al. (2019) expand the RPA's applicability area by considering the automation of a work-in-process (WIP) analysis within a client's operations. Currently, the vast majority of companies have an ERP, an integrated set of software applications used to collect, store, manage and interpret data from their business activities. The example of the cited authors refers to the manual process for implementing and testing a WIP, that (currently) takes about four weeks. Thus, ten employees can process about 2,000 WIP analysis cases per month, spending about 10-15 minutes for each case. An RPA would complete each case, on average, in four minutes and the operations performed could be as follows: constantly monitor a mailbox and check if the ERP system is up to date; when the RPA receives a WIP analysis request via email, it connects to the ERP system and executes an ERP report on the WIP; then "cut and paste the data" into a template file (Excel type) and run a macro command to create the pivot tables needed to complete the WIP analysis. RPA then automatically emails this completed WIP analysis to the requesting party.

By analysing each of the components of the accounting system separately, Kokina and Blanchette (2019) propose a synthesis of modes in which ordinary accounting tasks can be automated using RPA. Here are included sales of goods and services to customers, from receiving an order to receiving the value of the service or goods delivered. Another example is the purchase of goods and services from suppliers, from contracting the supplier to its payment; or recording a transaction until it is reported.

Each operation flow is detailed in sequences of operations which in turn are detailed in simple tasks, and for each task, the procedure is described.

For example, the sales / providing services procedure includes the following sequences:

- customer database which includes the creation of the customer, maintenance of information on that customer, setting delivery limits for the customer, customer solvency checks, validation as a VAT payer,
- placing the order of goods or services by the customer
- invoicing, which includes issuing the invoice, setting the due date according to the sales policies and placing the customer in different risk categories, with sales volumes, additional services to the invoicing if necessary, identification of exceptions regarding invoicing, re-invoicing if necessary
- cashing the value of the invoice with the identification of duplicates, automatic receipts
- following up the cashing process, with issuing warnings regarding the payment terms at predetermined intervals to the clients, analysing other disputes with the client in question, the litigations in which the client is involved, maintaining the communication with the client.

In a holistic approach, Zheng (2019) deals with RPA at the level of the entire financial accounting activity in the case of an energy company and takes into account all its components: primary accounting, management accounting and financial accounting with its set of reporting to third parties. This vision of accounting automation has as a starting point, the definition of some characteristics of accounting tasks and processes:

The operation/process must be repetitive.

Data must be standardised (subject to the same type of template).

There should be a set of standard rules that allow the decision of solving the accounting operation/process.

3.3. RPA models in audit

RPA is becoming increasingly used by large audit firms and replaces several human activities in the financial audit of the set of annual financial statements, which is an algorithmic approach, could be presented as a succession of four stages (Cohen et al., 2019):

1. defining the role of the auditor and the terms of employment
2. planning the audit that would include deadline details and the departments covered by the auditor
3. compiling audit information, or more precisely, collecting and cleaning information from accounts and financial statements
4. preparing the auditor's report.

Audit firms, especially large ones, have begun over time to incorporate into their work a series of software and computer tools designed to improve their rigour and

efficiency. However, even today, a large number of manual, repetitive and dull tasks based on clear procedures take up much of the auditors' time. In particular, during the audit mission of the financial statements, the auditor performs a series of operations, some of which can be successfully automated: preparing data for auditing, organising files, integrating data from multiple files, performing basic audit tests, copying and pasting data and manual annotations.

On the one hand, their automation is achievable because audit procedures are well defined, based on professional standards and regulations, are subject to quality control by professional and supervisory bodies, have high-risk stakes, and on the other hand, would lead to time and cost savings, and could avoid human errors (Cohen et al., 2019; Cooper et al., 2019).

In order to improve the efficiency and effectiveness of audit practices, large audit firms have begun to rethink their entire business process by integrating new technologies into their current business (Cohen et al., 2019). The suitable areas in which there are examples of RPA utilisation mentioned by the research literature are as follows (Cohen et al., 2019; Cooper et al., 2019, Huang and Vasarhelyi, 2019): audit tests, revenue audit, stock audit, pension plan audit, loans audit, documents auditing, e-commerce website audit and continuous auditing.

a) Audit tests

After analysing the practices of implementing RPA in BIG 4 companies in the USA, Cooper et al. (2019) discuss the use of RPA to automate audit tests on the confirmation of receivables and payables, of their collection and payment. In the implementation phase, the RPA is run in parallel with the work performed by the auditors and the results are compared to ensure the correct performance of the assigned task. Performing several such tests increase confidence in the actions of an RPA. For the automatic performance of these types of audit tests in the US, there was developed a *Confirmation.com* software solution that can perform over 40 types of such tests and has begun to be widely used in various countries by more and more accounting and auditing companies (Huang and Vasarhelyi, 2019).

Based on the audit plan, a robotic confirmation procedure using this software would involve four steps:

- preparing the application form,
- initiating the confirmation requests through the *Confirmation.com* website based on the information provided by the application form,
- accepting the confirmation,
- downloading documents and extracting the account balance for additional audit tests.

UiPath, a Romanian company, also offers a robotic confirmation solution based on redesigning the confirmation process in the form of a flow chart with eight sub-charts (Huang and Vasarhelyi, 2019):

1. login to the *confirmare.com* website,
2. extracting information from the application form prepared in advance,
3. selecting the customer company (if the customer does not exist it will be generated on the spot)
4. selecting the bank account (if it does not exist it will be added as a new account)
5. verifying the authorisation from the client (if it was not granted, it could be requested on the spot
6. initiating the confirmation request
7. monitoring the requests
8. downloading the completed confirmations and extracting the necessary account balances.

In addition to automating audit tests on third-party confirmations, *UiPath*'s software can be used in a company's financial management to automate third-party confirmations over specific periods or even continuously (Huang and Vasarhelyi, 2019).

b) Revenue audit

Revenue is generally a high-risk area in audit engagements, and the automation of tasks that do not require complex auditor reasoning has the potential to improve audit quality by reallocating auditors' work to analysing differences (Moffitt et al., 2018; Vasarhelyi and Rozario, 2018). Software robots can automate revenue auditing because it is a rules-based process and includes structured phases such as reconciliations, analytical procedures and dual-purpose procedures (internal control tests and analytical tests). Reconciliations are a significant part of any audit activity in which RPA can become useful, as it involves a large amount of data collected from various sources that must comply with several pre-configurable rules (Devarajan, 2018).

In revenue audit, RPA reconciliation and analytical procedures involve connecting auditors via the secure file transfer protocol (FTP) to the client's site to retrieve related audit evidence, including listings for current and previous sales and balances. The RPA can then calculate total sales and compare them to the total in the trial balance. It can generate an alert if the total difference in revenue from the current and previous listings exceeds the predetermined significance threshold. Therefore, RPA can also assist auditors in conducting dual-purpose audit tests as follows:

- Allows the section to the client
- Introduces search for the three required digital documents (sales invoices, sales orders and shipping documents)
- Extracts from the three documents
- Imports from the mentioned documents
- Checks between the existing data in these three documents
- Generates sales transactions that contain price or quantity differences

An RPA for revenue auditing provides extensive coverage of recording operations in the income accounts, reduces time spent on audit tasks, and instructs auditors to focus on higher priority tasks, such as assessing items that are non-compliant or represent nonconforming exceptions (Moffitt et al., 2018).

c) Stock audit

Zhang (2019) discusses RPA in stock audit and proposes the use of drones to scan identification tags attached to stocks by radio-frequency identification (RFID). The RPA module, combined with AI, can send images with the product subject to the inventory of an AI with image processing functions. RPA can then instruct the AI tool to count the products in the image. The RPA will then notify the auditor to review and adjust the results according to what it has completed. When the stock inventory check is ready, RPA sends the result to the auditor. Furthermore, RPA can be useful for inventory management involving automation through the following operations:

- extracts the date of receipt of each item from the customer's inventory system,
- retrieves the delivery date, looking for the tracking number on the carrier's website,
- compares the two data among systems to determine the accuracy of the receipt date.

d) Pension plans audit

A complex example of RPA use is the case of auditing pension plans, respectively, employee benefit plans (EBP). Due to the particularities of pension plans, the number of audit firms specialising in these types of audits is low, and at the same time, these audit firms have a high workload. After analysing the case of such a US company that audits more than 800 EBPs annually, with sizes between 100 and 90,000 participants, Cohen et al. (2019) show the benefits of RPA. EBP audits are time-consuming, especially in the phase of the substantive procedure, when auditors manually import audit data into Excel (or other digital formats) and perform various aspects of EBP testing (including writing and executing Excel functions as well as copying/pasting data from/in different tables). Defined contribution (DC) plan audits account for 88% of the company's total EBP audit commitments, and limited purpose audits account for 93% of total DC plan commitments. In a limited audit, an auditor excludes procedures that would otherwise be performed for investments, which are considered the most significant assets of the plan. Some of the significant accounts for testing are as follows: 1) contributions (employee, employer, and rollover), 2) benefits paid, and 3) notes received from participants (loans) (Cohen et al., 2019).

Besides, for the automation of the audit of pension plans, Gotthardt et al. (2020) analyse the possibility of robotisation and reading operations by scanning pension plans and extracting key elements from these plans. Based on the key terms extracted, auditors perform substantive procedures on selected samples, investigate exceptions, and finalise the audit through the audit report. In this way, RPA can collect and organise digital pension plans and send them to a so-called "computer vision" mode, which can automatically extract key terms. The RPA can then input the extracted key terms into a database ready for background testing. If it is unable to process the pension plan, if the digital plan is unclear, the RPA will notify the auditors of this task. When performing substantive procedures, the RPA can perform test queries and thoroughly test all pension plans, not just one. If all goes without exception, RPA can complete the audit and allow the auditor to draw the audit conclusion based on the information provided (Gotthardt et al., 2020).

e) Loans audit

During loans audit, loans to bank customers and related interest are tested using the RPA to determine whether the amounts owed under the plan have been identified, assessed, recorded and recovered in the financial statements. Loan audit tests include activities such as collecting and preparing audit evidence and performing rule-based audit tests; to these is further added the verification of the reconciliation of the balances of the loan amounts and the interest rates between different sources (Cohen et al., 2019).

f) Documents auditing

A significant part of audit documentation can also be automated (Cohen et al., 2019), using a combination of tools such as Microsoft Access in automated audit tests (more precisely through SQL queries), and RPA for collecting audit evidence and performing automated tests in Access. In essence, RPA was used to automate the phases an auditor performs to import data from Excel to Access. Finally, RPA performs the pre-scheduled audit tests; therefore, the auditor's time is limited until the test results are available. Also, RPA software event logs are available to verify that the process is running as expected. From our point of view, the described example is the brightest, most precise and detailed example of automating auditors' work, in terms of identifying digital tools, even if the solution is not implemented "definitively".

Base on a case study, Kruskopf et al. (2019) presents the audit of documents within PwC with ABBYY FlexiCapture (USA). A smart RPA increases the efficiency of data transfer in data collection and document processing. ABBYY uses artificial intelligence to provide fast solutions related to content (by transferring data from invoices), contracts and other documents, structured and unstructured. Regarding the document upload operation by the auditor on the ABBYY server, RPA can: automatically identify document types, improve images, identify which documents should be processed, extract the necessary data and transfer it to a spreadsheet or another approved digital source.

g) E-commerce website audit

The audit of an e-commerce website is included in the category of an operational audit, which is usually performed by the internal audit team to evaluate and improve e-commerce operations (Zhang, 2019). One of the aspects of auditing an e-commerce website is to check the position of a product on a particular platform, after finding it by a keyword. The ranking reflects the effectiveness of promoting the campaign's products and can be used by the internal auditor to evaluate performance and make recommendations for improvement if needed. At present, check the ranking of a product is usually done manually. In order to audit and monitor product rankings by keyword on different e-commerce platforms, internal auditors manually search for each keyword on each platform and observe how the product is ranked. Internal auditors have a list of keywords to search for it. When the keyword list is long, and also, there are product categories on multiple platforms, the manual procedure requires auditors to choose a sample of keywords at random or based on their knowledge of the customer/industry. Despite this, even a well-defined sample may not be representative (Zhang, 2019).

The *UiPath* software was used to build the prototype and was configured to mimic the auditor's actions to open the web browser by accessing *Amazon.com* and typing in the keyword. The pattern recognition feature in *UiPath* software, called "Image Exist," checks to see whether an image exists in the user-specified GUI. In the configuration, a user must provide a sample image for the search, adjust the desired accuracy on a scale from 0 to 1 that expresses the minimum required similarity between the searched and found image, and choose the recognition algorithms for the desired image.

The default algorithm is "Basic", which has average speed and a low cost. Another option is "Improved", which provides more accurate results, but employs more resources. Image detection is based on machine learning and was used to allow the RPA to see if and how often it appears on the first page of a keyword search. If there are configuration errors, *UiPath* will notify the user by pointing to a blue triangle next to the error. The experiments described in (Zhang, 2019) were performed on CARLab, Rutgers laboratory server.

h) Continuous auditing

Continuous auditing is another activity that can be automated. The IPA-based audit workflow (RPA and AI) can help coordinate and control audit processes,

enhancing the efficiency and effectiveness of each audit engagement. The novelty consists in the possibility of RPA to access the client system this time from the "layer" of the user interface without invading the "layers" of the client's application and database; thus, (almost) real-time data acquisition is expected to be more accessible, resulting in more timely and frequent audits (Zhang, 2019).

Other audit processes that could be included in the sphere of automation with the help of RPA are as follows (Devarajan, 2018):

- Collecting and cleaning data. Audit involves collecting data from various sources and validating data to complete audit reports. RPA can automate data collections with a high level of accuracy and reduce the time of handling/cleaning processes;
- Controls testing. RPA could be used in automating the audit of segregation of duties, exceptions reporting, management controls;
- Risk assessment. RPA can automate data collection, data classification and identify core trends as part of the annual risk assessment process.

RPA is a form of process improvement using technology; when applied to the audit, RPA is expected to not only replace manual and ordinary audit tasks but also to motivate the re-engineering of audit processes. An RPA must also incorporate a high-performance dashboard used by auditors to obtain information on RPA's accuracy (error rates, identified exceptions) and efficiency (processing time, non-use time, and maintenance time).

3.4. Implementing RPA in an accounting and auditing services

The introduction of RPA involves, like any new technology, the complete and integrated redesign of information processes and systems, the reorganisation of the entire flow of activities and also a reset of the elements related to the organisational culture within companies (Colesca and Dobrin, 2006, Fotache and Păvăloaia, 2015).

The RPA implementation process includes the definition and analysis of the characteristics of the activities to be automated, the analysis of the risks inherent in such a process, as well as choosing an RPA licensed software. RPA implementation can take several months or several years, depending on the complexity of the operations and activities for which the automation is desired (Huang and Vasarhelyi, 2019). Because it is not a simple implementation of a technology (Devarajan, 2018, Kokina and Blanchette, 2019) or disparate automation of operations or activities, RPA implementation through its overview of the entire flow of activities within the company, allows it to identify the bottlenecks in specific processes, to simplify/standardise and streamline the entire set of processes within the company.

Although the literature presents successful cases of RPA implementation in accounting and auditing firms, Gotthardt et al. (2020) consider that there is still no consensus on the requirements for security, scalability, usability and change management in such of software (Jędrzejka, 2019).

In summary, the factors that can critically influence the successful implementation of the RPA are the general characteristics of the RPA implementation process, the acquisition of RPA licenses and managing the risks related to the entire implementation process.

a) General characteristics of the RPA implementation process

Proactive planning is crucial to implementing any new system in an organisation. Together with the proper management of the whole process, the chances of a successful completion increase within the pre-established conditions in terms of the period and the allocated budget (Fernandez and Aman, 2018).

The design of the whole process with all its components which is to be automated must take into account the chaining of the components but also the interaction with the employees and can also contribute to a successful RPA implementation. Automation does not improve processes as such, because it works on the tasks that create the processes. Poorly designed processes with unnecessary activities will not be improved by default through automation (Jędrzejka, 2019). Without prior analysis and review, automation can lead to implementation failures or meagre implementation yields.

All process tasks and activities intended for automation must be identified and documented. The first goal of an RPA implementation is to obtain an extremely detailed list of all the actions performed by an employee to complete a particular task. All workflows and decision-

making paths should be known as clearly and explicitly as possible. Process extraction methods can prove to be very advantageous here, as they allow the discovery of the real process flow (and not those assumed) by exploring the logs in the available information systems (Jędrzejka, 2019).

The four elements mentioned above represent as many critical factors in the success of RPA implementation.

The specialised literature proposes a series of general RPA implementation schemes that can be customised for accounting and auditing companies (Vasarhelyi and Rozario, 2018, Moffitt et al., 2018, Huang and Vasarhelyi, 2019, Zhang, 2019 and Devarajan, 2018).

Processes considered suitable for automation are identified based on the characteristics showed in **Table no. 2**.

Table no. 2. Characteristics of processes that can be automated

Authors	Characteristics
General for RPA implementation	
Fung (2014)	1) high volume of transactions, 2) limited exception handling, 3) manual computer processes predisposed to errors or recovery, 4) limited human intervention, 5) stable environment, 6) frequent access to multiple systems, 7) high value of transactions, 8) ease of breakdown into clear IT processes, 9) clear understanding of manual processing costs.
Specific to RPA in accounting and audit	
Moffitt et al. (2018) (a,b,c)	a) to involve a significant amount of human effort to execute them, b) to be repeatable at a very clear interval, c) their solution to be based on a clear set of rules,
Huang and Vasarhelyi (2019) (b,d,e)	d) the activity to be well defined, e) to be “mature” (should have been in organizations for a long time).

Source: Authors' processing

In general, software implementation involves a complex process that affects employees, how they work, but also internal processes. Successful implementation involves business processes, strict and pre-established requirements, and clearly defined strategic guidance instructions. To overcome the implementation's challenges and to increase the long-lasting impact on the productivity and performance of the company, the successive stages of each of the following questions must be followed (Moffitt et al., 2018; Vasarhelyi and Rosary, 2018):

1. What process should be targeted for automation?
2. How can procedures be refined in small steps, suitable for automation?
3. What procedures can lead to automation?
4. Is the data in a machine-readable format?
5. Based on the evaluations carried out in the previous stages, what procedures must be targeted for the actual automation?
6. Does the RPA work as planned in the prototyping stage?
7. Can areas for improvement be identified based on evaluation and feedback?

In order to monitor the RPA implementation process, a "roadmap" can be used that takes into account the stage of understanding the processes that will be automated, the data standardisation stage and the stage of testing the operation based on real data (Moffitt et al., 2018 and Vasarhelyi and Rozario, 2018).

Zhang (2019) draws attention to the fact that for RPA implementation, in addition to the IT department and specialists, there must be involved professional

accountants who currently manage those activities at the entity level, because they will be the direct beneficiaries of the automation process (Kokina and Blanchette, 2019). Of course, this implementation will involve in the future the need to acquire new digital skills (Kokina and Blanchette, 2019).

b) Acquisition of RPA licenses

There are already RPA software tools made available to companies by various vendors, which can be used for partial or total implementation. So far, no RPA service provider can offer customised solutions for each type of company (depending on size or field of activity) and for each way of organising the compartments. Each software has its strengths and weaknesses. The most important providers of RPA implementation solutions on the market are (Cohen et al., 2019; (Vasarhelyi and Rozario, 2018):

- Automation Anywhere (USA)
- BluePrim (UK)
- UiPatch (Romania)
- RedWood (Netherlands)
- Workfusion (USA)
- Openspan (USA).

In our opinion, the RPA software solutions present on the market are in a continuous adaptation to the particularities of the companies that will implement them. Furthermore, software companies will collaborate with their customers to develop and improve their portfolio. As implementations increase and success stories prove overwhelming, we will probably see in-house solutions developed by large accounting and auditing firms.

c) Managing implementation risks

RPA implementation requires an entirely different approach to understand and manage risks through a system of internal controls and of monitoring activities by stakeholders. Implementing the RPA does not increase the overall risk within an organisation as long as adequate internal controls are in place. Moreover, the elaboration of risk levels and the establishment of preventive controls are essential, being part of the RPA control framework (Kokina and Blanchette, 2019).

Internal controls refer to the ability to implement mechanisms that ensure reliable reporting, compliance with relevant regulations and risk reduction in the automated environment. In the absence of adequate internal controls, users will not be able to rely on the information provided by using automation software (more or less autonomous from the human factor). Thus, the performance of RPA implementation will decrease and negatively influence the process (Kokina and Blanchette, 2019).

Moreover, Gotthardt et al. (2020) identify four different cyber risks related to the implementation and use of RPA: privileged access abuse, disclosure of sensitive data, security vulnerabilities and denial of service. These risks are factors that can be exploited by malicious users to access sensitive data processed in an RPA system (Jędrzejka, 2019).

In summary, the implementation of RPA in accounting and audit firms can be successfully achieved after proper preparation of infrastructure, processes and governance mechanisms. Mistakes or decisions made without vision before/during the RPA implementation stage result in non-compliance with the expected automation plan. Of course, this dependence on human decision demonstrates that human personnel will remain irreplaceable, as the responsibility for organising processes (automated or not) rests with them (Jędrzejka, 2019). Upon successful completion of the RPA implementation, the human resource of the entity should also be considered. Professional accountants hired should be involved from the identification phase of activities that can be automated and also receive adequate RPA training to understand the functioning of these robots and how they interact in their current work with them (Cooper et al., 2019).

We can conclude that the automation of specific processes by using robotics is a significant step towards the digitalisation of the business environment. The implementation is also both influenced by people' ability to perceive and adapt, and by the RPA technology that will be used.

3.5. Future research directions

RPA field is still in its infancy and requires the development of knowledge through future studies to allow a more accurate outline of the overall picture but also a detailed one of the RPA phenomenon with applicability on accounting and audit (Vasarhelyi and Rozario, 2018; Cohen et al., 2019; Ansari et al., 2019, Jędrzejka, 2019).

The biggest challenge of implementing RPA in general and in this case in our study is how employees will be able to interact with RPA and the whole set of emerging technologies that come with it. Technology, in general, has had a significant impact on the accounting profession over time, and now, even more, when disruptive technologies will lead to significant changes in the accounting and auditing profession both in terms of practical activity and the education of future specialists (Zhang et al., 2018).

The potential of accounting processes automation using RPA is high, and robots will replace professional accountants for a considerable part of their tasks, especially repetitive and routine ones. This process could lead to the loss of some positions in accounting and auditing firms at the beginner level or those with little experience, and at the same time new positions on the labour market may appear within them (Kruskopf et al., 2019). The responsibilities of future accountants will go beyond the current sphere of accounting and financial reporting and move towards complex data analysis, forecasting and consulting. This change entails the need to improve skills and competences regarding new technologies and the handling of large volumes of data, as well as their efficient integration (Jędrzejka, 2019); on the other hand, skills of analysis and synthesis, critical thinking and communication (Zhang et al., 2018). Communication and collaboration skills, emotional intelligence, along with critical thinking and complex problem solving will be critical, coupled with creative thinking, adaptability and patience in continuous learning (Fernandez et al., 2018; Cooper et al., 2019; Jędrzejka, 2019).

The emergence of new skills will also require the emergence of new jobs, whose names could be such as professional accountant specialised in the analysis of large data sets (data scientist), in Blockchain or cloud accounting, or database analyst or cybercrime specialist or systems integrator or data security specialist (Zhang et al., 2018; Kruskopf et al., 2019; Jędrzejka, 2019).

Therefore, further research is needed to examine the negative effect of RPA implementation on the behaviour of professional accounting employees, on the organisational culture of companies, on costs and benefits in the short and medium-term at company level (Fernandez and Aman, 2018).

RPA also implies a change in the education of future professional accountants, aspects that involve a thoroughgoing study. In order to meet current technological challenges and succeed in preparing future specialists in the field, accounting education should include in the curriculum courses on cybersecurity, RPA, blockchain, cloud accounting and analysis of large data sets (Kruskopf et al., 2019) but even minimum programming skills (Cooper et al., 2019), courses that provide technical skills appropriate to the requirements of the future labour market.

The quality of accounting education is a factor that directly influences the success of employees and organisations, so it is necessary to restructure its content by taking into account today's technological changes. Of course, the basic knowledge contained in the current curriculum of accounting and auditing studies will always be necessary; they form the core of the profession. Also, new courses imposed by technological progress must take place in the study curricula (Zhang et al., 2018; Kruskopf et al., 2019). They will help develop the technical and social skills of future professionals designed to assist them to engage and integrate into the labour market. Technical skills include analysis, understanding of the software and its capabilities, as well as data security knowledge. It can be said that there are skills that can help the employee to interact with programs, with AI, with robots in general. Many tasks will become hybrid human-robot tasks. Although technical skills have always been considered necessary, they now tend to become essential, as they will allow employees to bridge the gap between machines and humans (Kaya et al., 2019).

RPA implementation raises several questions at the company level that deserve to be considered in future research, regarding the efficiency and effectiveness of RPA adoption, as well as issues related to the security of a robot in its work of 'accountant/auditor' (Zhang, 2019), calculation of implementation risks (Kaya et al., 2019; Gotthardt et al., 2020). Besides, intentional or unintentional errors, embedded in the robot, could hinder the effectiveness of the audit and even cause serious errors. In terms of security, if the robots are not well managed or manipulated (by malicious users), they can cause dangerous information leaks (Huang and Vasarhelyi, 2019).

Moreover, the incorporation of specific AI modules in the RPA could cause employees to rely excessively on robots to the detriment of their judgments. In order to strengthen qualities such as 'professional scepticism

and judgment', various professional training should be promoted and analysed in future articles.

At the macroeconomic level, Cooper et al. (2019) identify the issue of regulation as the main factor in delaying the application and adoption of RPA in the audit. About this issue, future studies could analyse the necessary changes in the regulations for RPA use at the level of international/national bodies for the accounting and auditing profession, at the level of supervisory regulations regarding the effects and implications of RPA in accounting and auditing.

Conclusions

In the context of continuous and dynamic development of technology, we are witnessing an apprehension of all fields by a phenomenon that seems to represent, without a doubt, our future: the robotisation of services. The gradual integration of robots in our daily lives and professional activities leads to a series of inevitable questions, to a small part of which, respectively to those related to RPA, we tried to offer some possible answers based on consulting the research literature.

RPA is becoming more and more present in the financial accounting activities of large companies and also of companies specialised in providing accounting and auditing services, due to the large volume of data needed to be processed and due to reductions of costs, of time processing and errors that RPA generates.

At present, organisations that have started implementing RPA benefit from the automation of specific activities and processes in accounting and audit, especially those that are structured, repeatable, procedural and straightforward. Those wishing to implement RPA in their accounting and auditing activities should start this process by classifying tasks according to complexity, followed by standardisation and by process optimisation, adjustment of structures in the business flow and processes. Furthermore, after the inclusion of "digital employees", and the automation of some activities with the help of RPA, a redefinition of the internal controls will be required.

The accounting profession can play an even more critical role in the future by adapting to and mastering the requirements of new emerging technologies. Future generations of successful professional accountants will need, in addition to traditional knowledge, further knowledge in the areas called IT, AI and RPA but also developed social skills.

Since RPA is a relatively new field, our study was based on a relatively small number but recent articles, published in the last three years, which present discussions and approaches carried out internationally. RPA is a field in full expansion for further developments, and we intend to consider additional databases. Also, we want to approach other research methodologies, namely conducting interviews of specialists who have already participated in Romania, but not only, to RPA implementations in accounting and auditing firms, and also case studies at the level of companies.

Another development is aimed at the field of education, where we will develop studies and come up with proposals for concrete curricular models to facilitate the introduction of RPA knowledge, first in master's programs related to accounting and then in continuing education programs organised for accounting and auditing professionals by representative, regulatory and supervisory bodies.

REFERENCES

1. Anagnoste, S. (2017), Robotic Automation Process, The next major revolution in terms of back office operations improvement, *Proceedings of the International Conference on Business Excellence,* Volume 11: Issue 1, pp 677-686, DOI: 10.1515/picbe-2017-0072
2. Ansari, WA, Diya, P., Patil, S., Patil, S. (2019), A Review on Robotic Process Automation – The Future of Business Organizations, *2nd International Conference on Advances in Science & Technology (ICAST) 2019* on 8th, 9th April 2019,by K J Somaiya Institute of Engineering & Information Technology, Mumbai, India, http://dx.doi.org/10.2139/ssrn.3372171
3. Appelbaum, D., Nehmer R. (2017), The Coming Disruption of Drones, Robots, and Bots How Will It Affect CPAs and Accounting

Practice?, *CPA Journal*, https://www.cpajournal.com/2017/07/03/coming-disruption-drones-robots-bots/

4. Bendovschi, A.C., Ionescu, BS. (2015), The Gap Between Cloud Computing Technology and the Audit and Information Security Supporting Standards and Regulations, *Audit Financiar*, vol. XIII, no. 125
5. Chan, SWS., Ip, S., Wan, CFC., Yiu, HFD. (2018), How would the emerging technology affect the future of auditing?, *Outstanding Academic Papers by Students (OAPS)*, City University of Hong Kong, http://dspace.cityu.edu.hk/handle/2031/9133
6. Cohen, M., Rozario, AM, Zhang,CA. (2019), Exploring the Use of Robotic Process Automation (RPA) in Substantive Audit Procedures. A Case Study, *CPA Journal*, July
7. Colesca, S., Dobrin, C. (2006), Rolul Tehnologiei Informatiei în Reproiectarea Proceselor de Afaceri, *Rev. Tinerilor Economişti*, Univ. din Craiova, FEAA, vol. 1(6), April, http://feaa.ucv.ro/RTE/006-20.pdf
8. Cooper, LA, Holderness, DK, Sorensen, TL, Wood, DA. (2019). Robotic Process Automation in Public Accounting, *Accounting Horizons,* 33, https://doi.org/10.2308/acch-52466
9. Devarajan, Y. (2018), A Study of Robotic Process Automation Use Cases Today for Tomorrow's Business, *International Journal of Computer Techniques*, Volume 5, Issue 6, http://www.ijctjournal.org/Volume5/Issue6/IJCT-V5I6P3.pdf
10. Fernandez D., Aman, A. (2018), Impacts of Robotic Process Automation on Global Accounting Services, *Asian Journal of Accounting and Governance*, vol 9, http://dx.doi.org/10.17576/AJAG-2018-09-11
11. Fotache, D., Pavaloaia, V.D. (2015), Enterprise Resource Planning's Revolution for the "Facelift" of Accounting Profession, *Audit Financiar*, vol. XIII, no. 130.
12. Fung, HP. (2014), Criteria, Use Cases and Effects of Information Technology Process Automation (ITPA), *Advances in Robotics & Automation*, vol. 3, issue 3
13. Gotthardt, M., Koivulaakso, D., Paksoy, O., Saramo, C., Martikainen, M., Lehner,O. (2020), Current State and Challenges in the Implementation of Smart Robotic Process Automation in Accounting and Auditing, *ACRN Journal of Finance and Risk Perspectives*, vol 9, https://doi.org/10.35944/jofrp.2020.9.1.007
14. Harari, Y.N., (2018), Homo Deus. Scurtă istorie a viitorului, *Editura Polirom*, Bucureşti, 2018.
15. Homocianu, D., Airinei, D. (2015), On-Line Dynamic Dashboards in Audit Activities, *Audit Financiar*, vol. XIII, no. 125 – 5
16. Huang F, Vasarhelyi, M. A. (2019), Applying robotic process automation (RPA) in auditing: A framework, *International Journal of Accounting Information Systems,* vol. 35, no.100433, https://doi.org/10.1016/j.accinf.2019.100433
17. Ionescu, B.S., Prichici, C., Tudoran, L. (2014), Cloud Accounting – A Technology that May Change the Accounting Profession in Romania, *Audit Financiar*, vol. XII, no. 110 – 2
18. Jędrzejka, D. (2019), Robotic process automation and its impact on accounting, *„Zeszyty Teoretyczne Rachunkowości" Stowarzyszenie Księgowych* tom 105 (161), Polsce
19. Kaya, CT, Turkyilmaz, M, Birol, B. (2019), Impact of RPA Technologies on Accounting Systems, *Muhasebe ve Finansman Dergisi Journal*, vol. 82, Issue April, Istanbul, DOI: 10.25095/mufad.536083 https://mufad.org.tr/journal-/attachments/article/997/14.pdf
20. Kokina,J, Blanchette, S. (2019), Early evidence of digital labor in accounting: Innovation with Robotic Process Automation, *International Journal of Accounting Information Systems*, Volume 35, December, 100431, https://doi.org/10.1016/j.accinf.2019.100431

21. Kruskopf, S., Lobbas, C., Meinander, H., Söderling, K., Martikainen M., Lehner OM. (2019), Digital Accounting: Opportunities, Threats and the Human Factor, *ACRN Oxford Journal of Finance and Risk Perspectives*, Vol 8, Special Issue Digital Accounting
22. Negroponte, N. (1999), Era digitală, *Ed. All*, Bucureşti
23. Moffitt K., Rozario A. M., Vasarhelyi M. A. (2018), Robotic Process Automation for Auditing, *Journal of Emerging Technologies in Accounting,* vol 15, no. 1, https://doi.org/10.2308/jeta-10589
24. Murcia, FDR., Murcia, FCS., Borba, JA. (2008), Continuous Auditing: A Literature Review, Revista *Organizações em contexto*, vol 4, issue June
25. Năstase, P., Caia, F. (2015), Study Regarding Information Systems Audit for E-business, *Audit Financiar*, vol. XIII, no. 123 – 3
26. Negroponte, N. (1999), Era digitală, *Ed. All*, Bucureşti
27. Osman, CM. (2019), Robotic Process Automation: Lessons Learned from Case Studies, Rev. *Informatica Economică*, vol. 23, no. 4
28. Stanciu, V. (2016), Considerații privind auditul financiar în era Big Data, *Audit Financiar*, Vol. 13, Issue 128
29. Toader, S. (2012), Unde ne va duce viitorul? Evoluția profesiei de audit, *Audit Financiar*, vol. X, no. 86 – 2
30. Tucker, I, (2017), Are you ready for your robots?, *Strategic Finance*, Vol. Nov., https://sfmagazine.com/post-entry/nov..2017-are-you-ready-for-your-robots/?....campaign=buffer
31. Țugui Al, Gheorghe A.M. (2016), Identificarea dificultăților întâmpinate de profesia contabilă în accesarea documentelor în contextul economiei digitale din România, *Audit Financiar*, Vol.14, Iss.3,
32. Vasarhelyi, MA., Rozario, AM. (2018), How Robotic Process Automation Is Transforming Accounting and Auditing, *The CPA Journal*; New York, Vol. 88
33. Zhang CA., Dai J., Vasarhelyi, MA. (2018), The Impact of Disruptive Technologies on Accounting and Auditing Education How Should the Profession Adapt? *CPA Journal*, Vol. September
34. Zhang, CA. (2019), Intelligent Process Automation in Audit, Research Institute of Economics and Management, *Journal of Emerging Technologies in Accounting*, Vol. 16, no. 2
35. Zheng, S. (2019), Financial Management Innovation of Electric Power Enterprises Based on Robotic Process Automation, *Advances in Social Science, Education and Humanities Research*, Proceedings of the 3rd International Seminar on Education Innovation and Economic Management, Atlantis Press, https://doi.org/10.2991/seiem-18.2019.53`