Robotic Process Automation (RPA) as a technological tool for automating the execution of audits

Automação Robótica de Processos (ARP) como ferramenta tecnológica para automatizar a execução de auditorias

Automatización Robótica de Procesos (ARP) como herramienta tecnológica para automatizar la ejecución de auditorías

Jefferson Humberto Figueroa Moreno
https://orcid.org/0000-0001-5212-1603
Full Professor at the Luis Vargas Torres Technical University of Esmeraldas, Ecuador. PhD (C) in Accounting Sciences at the University of Los Andes-Venezuela
jefferson.figueroa.moreno@utelvt.edu.ec (correspondence)

Gustavo Darío Robles Quiñónez
https://orcid.org/0000-0002-5860-6764
Full Professor at the Luis Vargas Torres Technical University of Esmeraldas, Ecuador. PhD (C) in Accounting Sciences at the University of Los Andes-Venezuela
dario.robles@utelvt.edu.ec

Fanny Graciela Egas Moreno
https://orcid.org/0000-0002-0188-6275
Full Professor at the Luis Vargas Torres Technical University of Esmeraldas, Ecuador. PhD (C) in Accounting Sciences at the University of Los Andes-Venezuela
fanny.egas@utelvt.edu.ec

Luis Admir Canchingre Bone
https://orcid.org/0000-0001-7295-6552
Full Professor at the Luis Vargas Torres Technical University of Esmeraldas, Ecuador. PhD (C) in Accounting Sciences at the University of Los Andes-Venezuela
luis.canchingre@utelvt.edu.ec

ABSTRACT

The purpose of the research was to analyze the Robotic Automation of Processes as a technological tool aimed at automating auditing processes. It is a technological alternative that uses robots called bots, which are configured in a simple way and enable a digital transformation in which they can learn and imitate tasks, which are then executed automatically. Regarding the study methodology, it was a documentary research, carried out through a review of documents, scientific articles, research, web pages, among other sources. Among the main audit activities that can be performed with the application of robotic automation of processes are identified reconciliations, queries to identify the accounts to be reconciled, trial balances, list of transactions, comparison of the lists with the consolidated reports. Similarly, analytical processes can be performed, such as starting the session with working papers of previous audits, queries to identify audited amounts; internal control processes such as population tests, purchase orders, documents and invoices, verification of prices against quantity of items, generating alerts when deviations occur. Finally, there are several advantages of this technology, such as the possibility of performing advanced data analysis, considerable reduction of audit costs, due to the reduction of human errors and therefore greater productivity, since the optimization of processes allows the staff assigned to the execution of the audit to focus their efforts on more strategic activities, such as the preparation of the final audit report**.**

Keywords: Audit automation; robotic process automation; robots and bots.

RESUMO

O objetivo da pesquisa foi analisar a Automação Robótica de Processos como ferramenta tecnológica voltada para automatizar processos de auditoria. É uma alternativa tecnológica que utiliza robôs chamados bots, que são facilmente configuráveis e permitem uma transformação digital na qual podem aprender e imitar tarefas, que depois executam automaticamente. Quanto à metodologia do estudo, tratou-se de uma investigação documental, realizada por meio de revisão de documentos, artigos científicos, pesquisas, páginas web, entre outras fontes. Entre as principais atividades de auditoria que podem ser realizadas com a aplicação da automação robótica de processos estão conciliações, consultas para identificação das contas a serem conciliadas, balancetes, listagem de transações, comparação das listas com os relatórios consolidados. Da mesma forma, podem ser realizados processos analíticos como iniciar a sessão com papéis de trabalho de auditorias anteriores, consultas para identificar valores auditados; processos de controle interno como testes populacionais, pedidos de compras, documentos e notas fiscais, conferência de preços versus quantidade de itens, gerando alertas quando ocorrerem desvios. Por fim, são várias as vantagens desta tecnologia, como a possibilidade de realizar análises avançadas de dados, redução considerável de custos de auditoria, devido à redução de erros humanos e, portanto, maior produtividade, devido à otimização de processos. realizar a auditoria para concentrar seus esforços em atividades mais estratégicas, como a preparação do relatório final de auditoria.

Palavras-chave: Automação de auditoria; automação robótica de processos; robôs e bots.

RESUMEN

La investigación tuvo como propósito analizar la Automatización Robótica de Procesos como una herramienta tecnológica dirigida a la automatización de procesos de auditoría. Es una alternativa tecnológica que utiliza robots llamados bots, que se configuran de manera sencilla y posibilitan una transformación digital en la que pueden aprender e imitar tareas, que luego ejecutan de manera automática. Respecto a la metodología de estudio, se trató de una investigación documental, realizada por medio de una revisión de documentos, artículos científicos, investigaciones, páginas web, entre otras fuentes. Entre las principales actividades de auditoría que se pueden realizar con la aplicación de la automatización robótica de procesos se identifican conciliaciones, consultas para identificar las cuentas a conciliar, balances de comprobación, listado de transacciones, comparación de los listados con los reportes consolidados. Del mismo modo pueden efectuarse procesos analíticos como iniciar la sesión con papeles de trabajo de auditorías anteriores, consultas para identificar montos auditados; procesos de control interno como pruebas de población, órdenes de compra, documentos y facturas, verificación de precios contra cantidad de artículos, generando alertas cuando se presenten desviaciones. Por último, son varias las ventajas de esta tecnología, como la posibilidad de efectuar análisis de datos de forma avanzada, reducción considerable de costos de auditoría, debido a la disminución de errores humanos y por ende una mayor productividad, por cuanto la optimización de procesos permite que el personal asignado para la ejecución de auditoría pueda centrar sus esfuerzos en actividades más estratégicas, como la elaboración del informe final de auditoría.

Palabras clave: Automatización de auditoría; automatización robótica de procesos; robots y bots.

INTRODUCTION

The role of Information Technologies (ICT) in organizations has changed considerably in the last decades. ICTs have gone from being a support for office tasks to become competitive tools for companies, increasing their operational capacity, improving the quality of their products or services, reducing costs or helping to control their databases regarding their human talent, payroll, suppliers, customers, among other uses.

The contribution of ICT has not only been used in business activities, but also in professional activities that over time have required this technological contribution to seek efficiency in the performance of their work and thus meet their proposed objectives.

Among the professional activities that have introduced technological resources in their processes is the audit, which has evolved and modernized different activities in order to achieve better results in its execution. Nowadays, it is no longer possible to think of an audit only as a physical documentary review, but it is necessary to move on to an audit in which several activities can be automated with the use of technological tools.

In this context, Robotic Process Automation with its acronym RPA, which will be used from here on throughout the document, is one of the tools that technology has made available to the audit so that, with the use of software, tasks can be automated on pre-existing digital systems through interaction with documents, screens and similar applications, without the need to modify the systems that serve as interaction.

According to Figueroa et al. (2020), RPA was born as a software-based alternative that allows automating business processes that, under the condition of rules, involve routine activities, results of defined structures and deterministic data, contributing to productivity, cost, time and error reduction in the execution of established tasks.

On the other hand, it is necessary to highlight that RPA is a mature technology, which uses agile, non-invasive software that generates great economic advantages, since its application can reduce to a great extent the personal workload in processes considered bulky *back office* processes, i.e. processes that have several repetitions, such as those executed in areas such as human resources, customer service, supplies, accounting, finance and auditing (Deloitte, 2020).

Although RPA, as mentioned by the authors mentioned above, has been presented as a technological alternative of great importance and usefulness, its application in auditing processes is scarce. Although it is a less intrusive technology with great advantages, its inclusion in audits has not yet reached the expected levels.

The research objective was to analyze RPA as an alternative for automating the execution of audits. It was then necessary to review the diversity of existing theories on robotic automation of processes, identify the audit processes that can be automated with RPA systems and finally, establish the advantages that would be obtained by incorporating this technology to the execution of audits.

The above-mentioned considerations allow us to justify the importance of the present study, aimed at identifying the ways in which RPA can contribute to the automation of structured auditing tasks and to define the research question that guided the study: How does RPA, as a technological tool, allow the automation of the execution of audits?

Regarding the methodology, it was a documentary research, qualified by Alfonso (2020) as a scientific procedure that is responsible for the collection, inquiry, analysis and interpretation of data on a specific topic in pursuit of the construction of knowledge. Based on the above, this study conducted a review of documents, articles, research, web pages, among other sources, from which it is possible to know and understand the theoretical basis on which the RPA is based.

The strategy used to identify and collect data on the topic of study was the integrative and systematic literature review, described by Velásquez (2020) as the critical grouping of data on a specific topic under investigation. In relation to the above, databases such as Scopus and Web Science were used, which, together with scientific articles and documents from reliable internet repositories, made it possible to address the theoretical reflections on PAR.

When considering the categories that structure the theoretical framework, aspects such as auditing, its nature and processes, audit automation, RPA with robots and bots, RPA technological platforms, importance of RPA in auditing, audit automation activities and procedures, and the advantages of RPA in auditing are identified in the research process.

At the end of the research process, the conclusions of the study are established in which a summary of the results obtained under the fulfillment of the proposed objectives is made, responding to these objectives, identifying audit processes that can be automated with the RPA and establishing the advantages that the auditor would obtain by incorporating this technology in the performance of its functions.

A CONTEMPORARY DISCUSSION ON RPA IN THE CONTEXT OF AUDITING

Initially, aspects related to auditing, its features, nature and purposes will be considered, continuing with aspects related to audit automation, from different points of view that address this current issue related to the use of technological tools in auditing processes in order to add efficiency and quality.

Audit: nature, purposes and processes

Auditing is a systematic process used as a control instrument in both public and private companies to verify that internal policies, procedures, accounting and internal control systems are effectively implemented by gathering information.

According to Diaz and Perez (as cited in Figueroa, 2022), regarding the ways of obtaining evidence in the audit process, they state that traditional tools provided by accounting are used; investigations are supported by physical elements such as financial reports, physical transfers, documents, contracts, payment receipts, among others.

Omoteso (as cited in Figueroa, 2022), considers that the audit process refers to the set of actions related to the collection, processing and evaluation of data that is performed with the purpose of determining compliance with laws, rules, regulations and showing an audit criterion.

It is important to note that the audit process is informational, since its input, execution and output (results) are based on information that varies according to the dependence of the objects to be evaluated and that currently has technological alternatives that allow its automation.

Audit automation

Audit activities can, in some way, be customized through plans, templates, manuals and computer programs that are constantly evolving (Rozario, 2019). Although automation processes have been present for at least a century, in auditing, automation is applied to isolated tasks, such as digitizing reports and processes, applying for this purpose statistical programs in the application of regressions or specific tests in auditing (Zhang and Vasarhelyi, 2018).

At the present time, technology has made available to auditing several technological tools that can contribute to a redefinition, a new design or structure of the audit processes. For this reason, it is considered that audit automation should go beyond choosing certain isolated tasks to improve; it should be thought of as an integral process of automation that allows obtaining more efficient review products.

According to Romero (2022), there must be a commitment by auditors to use and take advantage of new technologies, including machine learning, robotics, high-level technological capabilities that can contribute to obtaining better evidence of the audit work and obtaining perceptions that are closer to reality.

It needs to be made clear that the thinking should be oriented towards the inclusion of new technological capabilities that improve the quality of the audit, but not the technology by itself and as a whole. With digital transformation and automation, tasks considered complex can be performed in less time, tasks that needed many people can be done by a single machine, thus contributing to higher productivity of the process.

Around the achievement of this productivity of the audit process, for Zhang and Vasarhelyi (2018) the audit is made up of several procedures, that is, a sequence of actions that convert input data (the information being audited) into output data (the audit report with opinions) in function that these can be of use to provide reliable and useful information for decision makers.

It is important to note that automation contributes especially to the tasks in which data is compared and compiled, facilitating the analysis of information according to the environment in which it is presented. As an example, it could be considered that automation could allow the realization of automatic reconciliations in several accounts by previously defining the criteria, perform the validation of depreciation data, among other routine tasks that can be delegated to a machine.

According to Hernandez (2020), a more efficient use of auditors' working time should be promoted. Auditors should devote more time to the critical elaboration of reports instead of processing numbers, observing data and generating graphs that could be done by means of automation. Auditors could, with the application of automation, use the time freed up to critically reflect on their findings, focusing their efforts on a better exposition of recommendations in the report.

With regard to the above, it can be considered that audit automation can be carried out in different ways and with various technological alternatives, one of the best known and most important being RPA, an instrument that makes it possible to carry out some procedures considered repetitive in order to allocate the effort of human resources to audit processes of greater value.

Robotic Process Automation (RPA)

RPA refers to software whose objective is to make a certain process automated, in order to optimize activity times and minimize errors, as a set that determines the cost-benefit that generates profitability for those who use it. RPA focuses on the imitation that, through technology, can be made of work performed by humans, seeking to automate tasks considered structured in an agile, timely and cost-effective manner (Randall and Haddaway, 2021).

For their part, Pérez and Marrugo (2020) consider that RPA has already had a clear impact on the work performed today by skilled labor, so it is necessary to think about fundamental changes in the labor field, efficiently linking human activity with technological and robotic activity. RPA is software that automates repetitive activities performed by human labor, directly impacting the auditing profession. Auditors will undoubtedly continue to exist, but with the help of robotics, they will be able to focus their work on analysis and adding value to the audit and control products they produce.

When mentioning robotics, it is interesting to understand the term robot, which is referred to in RPA. Generally people relate it to human-like machines, however, RPA is not a physical robot as such, but is based on software configured to mimic and develop tasks or sequences that are repetitive and performed by humans; this is where robotics comes in. The robot interacts with the system just as a person could do, logging in with login credentials, browsing the Internet, moving files between folders, among other activities.

The robots related to RPA, according to Gutierrez (2020) serve for the optimization of processes performed in companies by a high number of employees and collaborators; these robots are forming a different alternative for organizations, making the incorporation of virtual workers through technologies, providing quantitative and qualitative benefits to companies seeking innovation.

The robot has the possibility of interacting with applications or systems related to the processes, imitating the interaction of the humans involved in that process, causing an increase in efficiency due to the fact that the robot can perform the tasks quickly, continuously and without errors (Langmann and Turi, 2021). Accordingly, it can be noted that robots are programmed with RPA and thus can carry out, automatically and independently, complete activities or selected steps of individual sequences that are traditionally and repeatedly performed by humans.

Through the use of robots, RPA is known as the technology with the greatest potential to make processes efficiently automated. This automation is performed by robots, as software agents known as bots, in charge of executing tasks, establishing graphical interface communications autonomously without human operation. RPA robots or bots can manipulate and communicate with enterprise applications and systems, streamlining processes and lessening the burden that generally falls on people (Practia, 2020).

According to Bermudez (2020), the RPA with the application of bots, has characteristics of flexibility because it can quickly adapt to the practice of all types of processes that are performed in an activity, because it can mimic the human act of such activities; the RPA is made up of four components that allow the realization of key processes:

- A robot or bot which is the software that executes daily and repetitive tasks with the prior programming of an algorithm; the robot can also record the actions of humans and then develop them according to the parameters defined by the operators.

- A graphical interface that allows interaction with users, in addition to giving them the possibility to program various tools of the robot without compromising its structure.

- A hardware that can be used physically or virtually, a tool that generates a cost reduction for its application.

- It has the ability to be compatible with various platforms used by users, so the RPA can, like a human being, access platforms, systems or processes (Bermudez, 2020).

Based on the description of the RPA system components, it can be noted that this type of tool has the ability to perform tasks that, until now, have only been performed by people, such as opening and replying to emails, inserting files to send to customers and users, using web applications in various processes, moving documents between folders, performing statistics, mathematical calculations, browsing and collecting data from the Internet, among others.

It is also important to note that RPA is a technological automation that, over time, has transformed the ways in which the activities of an organization are carried out. This condition can be considered as a limitation of this RPA tool, because it does not have the capacity to perform activities in which value judgments need to be made and which are only done by people, such as the reflections in the final audit reports.

RPA technology platforms

For Le Clair et al. (2020), currently, RPA technology has been widely accepted and used by several companies due to

its benefits, since they are constantly under high pressure to digitize their operational activities and, with this technology, they have the possibility of developing routine processes in a fully automated way. Thus, the RPA, among the different service alternatives, has:

- Process automation: contributes to the increase and agility in administrative, financial, procurement, supply management, accounting, human talent and customer service activities, among others.

- Automated assistant: processes such as voice recognition and online assistance are also part of RPA. When companies have very congested call centers, they use this technology that can give answers as employees do, with natural language and not as software in code; thus, time and human resources are optimized.

- Technology support and management: Through RPA technology it is possible to improve service-related operations, investigating and resolving internal and external user requirements, optimizing the monitoring of networked devices without the use of people (Le Clair et al., 2020).

All the RPA automation, assistance and support activities allow us to understand that there is a wide range of options with which the audit automation process can be carried out with sufficient capacity to respond to the demands that this new technology process would require.

According to Practia (2020), this type of current RPA technology has many suppliers, including AutomationEdge, Pegasystems, Another Monday, UiPath, AntWorks, EdgeVerve Systems, Jacada, WorkFusion, Automation Anywhere, NICE, Softomotive, Kofax, HelpSystems, Datamatics, Blue Prism, Kryon, NTT, Servicetrace, among others. Among the diversity of RPA technology offerings, the most prominent are UiPath and Automation Anywhere.

As can be seen, there are already several companies in the automation market that provide RPA technological services, and any organization or activity, to the extent of its economic capabilities, can insert this tool that would help improve operational processes. In the execution of audits, whether of private firms or public entities, it would be very helpful for the automation of activities that, until today, are only done by humans.

Importance of PAR in auditing

Society is constantly changing at a fairly rapid pace and this is mainly due to technology, which presents new developments on a daily basis. New technologies have even come to mimic human activities, performing repetitive tasks faster and more accurately than people themselves. This is why auditing could change the way it executes some operations through robotic automation of processes, a tool that would reduce time, costs and increase the efficiency of control processes.

According to Rai et al. (2020), RPA applies software tools, such as those offered by companies like UIPath and Automation Anywhere, which allow the transformation of manual audit procedures into automated processes performed by bots; RPAs are currently becoming the possibility of a drastic change in the practice of auditing. It is important to note that a great dilemma arises among audit professionals, thinking that they can be replaced by robots in the execution of their tasks. The truth is that their jobs will not be eliminated, but rather, the use of RPA will allow auditors to perform their operations at a higher professional level, because this technology allows them to free up time to perform work of greater significance such as the critical judgment for the audit report.

For Rai et al. (2020), RPAs, as well as bringing opportunities, also generate responsibilities in internal audit. Auditors have the possibility of reliably advising and collaborating with departmental managers or directors to improve control levels, as processes can be redefined and automated with this technology. Similarly, one of the responsibilities that RPA clearly brings with it has to do with understanding the different risks introduced by this technology, ensuring constant controls and reviews of the design and operation of the bots.

Audit automation activities and procedures

According to Murillo (2020), there are several auditing activities that could be carried out by means of RPA, among which the following stand out:

- Reconciliations: RPAs can perform automatic reconciliations under a previously established process. It initiates a session on the servers and then enters queries to identify the accounts to be reconciled. It then extracts the list of transactions, imports them into the Excel program where it calculates the totality of the transactions to finally make a comparison of the final list against the totals reported in the balance sheets.

- Analytical: In this case, the bots log into the working papers of the last review process, after which it enters a query to identify the audited amounts. Subsequently, an extraction of the previous year's balances is performed, a comparison is made of the total amount of income of the current year against the total income of the previous year. If there are differences between the balances, exceeding the limit established by the administrators, the bots issue an alert to the

auditor to carry out the corresponding revisions.

▪ Internal Control Testing: bots can perform the calculation of the total sales population, being able to test the effectiveness of the company's internal controls. With this type of automated activities, the auditor can reduce risk by sampling and assessing the risks of the audit process with greater accuracy.

▪ Similarly, control activities such as "Three Way Match" could also be performed with RPAs, auditing invoices, shipping documents and purchase orders in the same process. With previously defined algorithms and limits, the bots can automatically check prices and quantities against the uploaded documents, generating alerts to the auditor when the data does not match exactly (Murillo, 2020).

In view of the activities shown above, it is important to make clear and insist that robots do not come to replace auditors, but rather are presented as allies to take on routine tasks that take time away from work, freeing them for better management in the field of critical judgment and advice. If auditing, on the other hand, refuses to adapt to these realities that come with technological innovation, time will continue to be wasted on tasks that can be performed quickly and accurately by machines.

Advantages of RPA in auditing

The RPA becomes an alternative to improve the operability of audit activities, reflected in the quality of the review products that are made available to the audited entities. RPA brings with it many benefits that optimize the audit activity. For Van der Aalst et al. (2020), among the most notable advantages of the application of RPA in auditing processes are:

▪ Cost reduction: Performing repetitive tasks by means of bots allows minimizing costs by not needing people or time for execution.

▪ Reduction of errors: The fact that there is less human intervention means that errors in the auditing process can be reduced.

▪ Customer experience: Be able to perform auditing processes 24/7, because bots can perform tasks constantly and automatically.

▪ Capacity and scalability: It is not intended to perform all audit processes through RPA, because this technology will not replace the traditional form of critical judgments for the preparation of final reports.

▪ Control of compliance with obligations: Enables control and compliance assurance processes for activities defined by legal bodies.

▪ Traceability and analysis: The RPA is a tool that offers a purely digital solution, because traceability and consequently the detection of opportunities that help to improve the conditions of the audit work can be explicitly counted on (Van der Aalst et al., 2018).

The aforementioned makes it possible to state that with the advent of RPA it is possible to quickly and easily automate tasks that are repetitively performed in auditing processes and that require simple skills to be carried out. Preparing for the future in the audit area requires an openness to ideas and the possibility of inserting technology to develop a more efficient and quality work. Figure 1 shows a proposed analytical scheme for the development of the results and discussion of this research.

Figure 1. Analytical flow proposed in this research
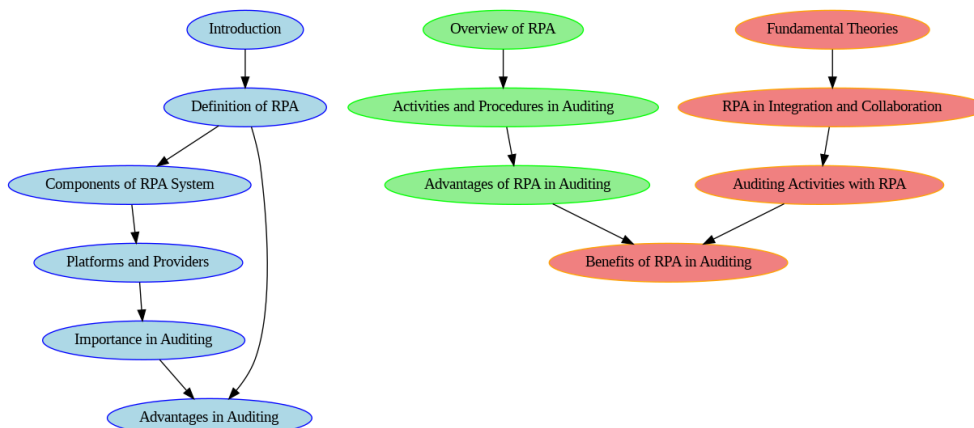
Source: Prepared by the authors

The analytical flow diagram effectively elucidates the multifaceted content pertaining to Robotic Process Automation (RPA) and its application in auditing. The diagram is thoughtfully divided into three distinctive sections, each represented by a unique color – blue for theoretical foundations, green for practical applications, and orange for advantages. In the blue segment, the theoretical foundations of RPA are introduced, elucidating its role as a technological alternative that integrates systems and fosters collaboration among various units and processes. This section establishes a theoretical framework, offering readers a foundational understanding of RPA's conceptual underpinnings.

Transitioning into the green section, the diagram delves into practical applications of RPA in auditing. It sheds light on specific operational processes such as conciliations, analytical procedures, and internal control tests. By emphasizing these tangible applications, the diagram bridges the gap between theory and practice, providing readers with concrete examples of RPA's efficacy in real-world auditing scenarios. The orange portion of the diagram outlines the advantages associated with the incorporation of RPA in auditing processes.

Key concepts such as advanced data analysis, cost reduction, and increased productivity are highlighted, underscoring the transformative impact of RPA on auditing practices. This section serves to conclude the narrative by accentuating the overarching benefits of integrating RPA into the auditing landscape.

RPA and auditing: the technological context

For Omoteso (as cited in Figueroa 2022), the audit process consists of several activities that seek to collect, process and evaluate data in order to determine whether those responsible for managing an organization and the various procedures that comprise it, comply with the laws, rules or regulations that have been established for management. In this context, the development of the audit process has undergone changes over time, allowing the integration of technological elements in its execution that can achieve more efficient results and higher quality products through automation.

Thus, although automation processes have been present in society for more than a century, for Zhang and Vasarhelyi (2018) in auditing activities their application is still isolated and infrequently applied. Given what is expressed by the authors, it is considered that auditors acquire a greater commitment and openness to the adaptation of new technological tools in the performance of their duties, which contribute to the improvement of the audit quality they perform, so that several tasks that need the effort of many people, need only the occupation of a machine, freeing time for auditors to devote greater importance to the application of their judgment for the preparation of final audit reports.

One of the technological alternatives available for auditing is the robotic automation of processes which, through the use of software, allows many of the tasks that are currently performed by people to be automated. In relation to what has been described by Figueroa et al. (2020), RPA is an alternative based on software, whose purpose is to automate processes under systemic rules, involving routine activities, generating productivity in the tasks, reducing costs, minimizing time and errors in the execution of established tasks.

When mentioning software in terms of RPA, it is interesting to understand the term robot, which is referred to in RPA. Generally people relate it to human-like machines, however, the RPA is not a physical robot as such, but is based on software configured to mimic and develop tasks or sequences that are repetitive and performed by humans; that is where robotics acts. This is why Practia (2020) considers that RPA robots or bots can manipulate and communicate with company applications and systems, streamlining processes and reducing the burden that generally falls on people.

It is important to note that processes with RPA application have already been adopted by several companies in the world for the benefits it provides in the performance of routine and complex tasks. According to Le Clair et al. (2020) RPA, according to Practia (2020), has many suppliers, highlighting among others, AutomationEdge, Pegasystems, Another Monday, UiPath, AntWorks, EdgeVerve Systems, Jacada, WorkFusion, Automation Anywhere, Softomotive, Kofax, HelpSystems, Datamatics, Blue Prism, Kryon, NTT, Servicetrace.

It is necessary to put into context the importance that RPA would have in auditing, because as mentioned by Rai et al. (2020), although these technological alternatives have many opportunities, they also bring with them many responsibilities for the auditor, because despite the application of bots, auditors will continue to do their job, especially in the application of their judgment in determining the reports derived from the audit.

Taking into consideration Murillo's criteria (2020), among the main audit activities that can be automatically performed by the bots are transaction reconciliations, analytical activities from previous audit reports, determination of automatic balance differences with alerts, internal control tests, as well as verifications of invoices, shipping documents and purchase orders simultaneously, prices and inventory quantities, among others.

Figure 2 above shows a generated Word Cloud for the combined English texts on Robotic Process Automation (RPA)

that provides a visual representation of the key thematic elements. The prominence of terms such as "RPA," "automation," and "processes" reflects the central focus on technological automation. This aligns with the overarching theme of the texts, emphasizing the transformative impact of RPA on various organizational activities and auditing processes.

Figure 2. Word cloud with essential topics detected in the RPA associated with the audit

Source: Prepared by the authors

Furthermore, the Word Cloud highlights specific activities associated with RPA implementation, such as "reconciliations," "analytical processes," and "internal control tests." These terms underscore the practical applications of RPA in streamlining tasks traditionally performed by humans, enhancing efficiency, and reducing the likelihood of errors. The inclusion of "24 hours a day" emphasizes the continuous and precise nature of RPA operations, showcasing its potential to revolutionize the temporal dynamics of business processes. Moreover, this diagram encapsulates the core concepts of RPA, portraying its role in reshaping organizational workflows and amplifying the capabilities of auditing practices. The visual representation serves as a succinct overview, guiding readers toward the central themes explored in the associated scientific articles or discussions on the integration of RPA in contemporary business and auditing landscapes.

Finally, all the above considerations allow us to affirm that many of the advantages of RPA can be the reduction of costs and errors, the possibility of 24/7 work being carried out by means of bots. However, despite the above advantages that may lead one to believe that people are no longer needed, it is necessary to make clear and insist that robots do not come to replace auditors, but rather are presented as allies to assume routine tasks that subtract work time, freeing auditors for better management in the field of critical judgment and advice.

A proposal for a research agenda towards future studies in auditing RPA

The research agenda presented in the Table 1 outlines a comprehensive exploration of the integration of Robotic Process Automation (RPA) in auditing practices. In the first focus area, the impact of RPA on auditing efficiency is examined, exploring potential causal relationships such as the correlation between RPA integration and enhanced decision-making processes. Variables under investigation include auditing efficiency, RPA integration, and control factors like auditor experience and firm size. The research will utilize a literature review and comparative analysis, spanning auditing firms of varying sizes and sectors.

The second focus area delves into the ethical implications of RPA adoption in auditing, analyzing how ethical considerations influence the decision to adopt RPA. Variables include ethical decision-making, the perception of RPA, and control factors like auditor ethics training. An ethical impact assessment will be employed, focusing on areas with sensitive ethical concerns in auditing practices.

The third focus area explores technological and contextual influences on RPA adoption. Variables encompass technological readiness, organizational context, and organizational culture. Methodological approaches involve surveys and interviews, aiming for a cross-industry analysis and case studies on challenges and successes in diverse contexts.

Lastly, the role of RPA in decision support in auditing is investigated, examining causal relationships between RPA use and data-driven decision-making, enhanced auditing insights, and overall audit quality. The study employs experimental designs, real-world scenarios, and longitudinal analyses to understand the evolving landscape of decision support with RPA in various audit scenarios. This research agenda provides a comprehensive roadmap for future studies in the dynamic field of

RPA integration in auditing practices.

Table 1. A proposal for a research agenda

Research Focus Areas	Possible Causal Relationships	Variables for Investigation	Methodological Approach	Contexts or Cases for Analysis
Impact of RPA in Auditing Efficiency	RPA integration correlates with enhanced auditing efficiency.	Dependent Variable: Auditing Efficiency	Literature Review, Comparative Analysis	Across auditing firms of different sizes
	RPA contributes to improved decision-making in auditing.	Independent Variable: RPA Integration		Private and public sector institutions
	RPA use is linked to a reduction in errors in auditing processes.	Control Variables: Auditor Experience, Firm Size		Analysis of successful error reduction through RPA
Ethical Implications of RPA Adoption in Auditing	Ethical considerations influence the adoption of RPA in auditing.	Dependent Variable: Ethical Decision-making	Ethical Impact Assessment	Examination of RPA use in ethically sensitive auditing areas
	Auditor perceptions of the ethical implications of RPA.	Independent Variable: Perception of RPA		Comparative study of ethical considerations in RPA vs. traditional
	RPA as a tool for promoting unbiased and ethical auditing.	Control Variables: Auditor Ethics Training		Auditing practices
Technological and Contextual Influences on RPA Adoption	Technological readiness affects the successful adoption of RPA.	Dependent Variable: Technological Readiness	Surveys, Interviews	Cross-industry analysis of technological readiness for RPA adoption
	Contextual factors influencing RPA implementation success.	Independent Variable: Organizational Context		Case studies on challenges and successes in diverse contexts (e.g., manufacturing, finance)
	Role of organizational culture in RPA integration.	Control Variables: Organizational Size, Industry Type		
RPA's Role in Decision Support in Auditing	RPA facilitates data-driven decision-making in auditing.	Dependent Variable: Data-Driven Decision-making	Experimental Design, Real-world Scenarios	Analysis of RPA-driven decision support in complex auditing scenarios
	RPA enhances auditing insights and analysis.	Independent Variable: RPA Implementation		Longitudinal study on the evolution of decision support with RPA
	Relationship between RPA use and overall audit quality.	Control Variables: Auditor Expertise, Data Complexity		Implementation of RPA in various audit scenarios

Source: Prepared by the authors

FINAL CONSIDERATIONS

The theoretical foundations made it possible to understand that RPA is a technological alternative that allows systems to be integrated into a single automated platform and that contributes to collaboration between departmental units and processes within a given activity. RPA technology uses robots, also known as bots, which are easily configured and enable a digital transformation in which these bots can learn and imitate tasks, which they then execute automatically. Another feature of RPA is the interaction that bots can have in the same way as workers, with the difference that these tools can be operational 24 hours a day and act precisely and quickly.

Among the main auditing activities that can be performed with the RPA application are operational processes such as reconciliations, from queries to identify the accounts to be reconciled, the trial balances, the list of transactions, to the comparison of the lists with the consolidated reports. They can also perform analytical processes such as logging in with the working papers of previous audits, queries to identify the audited amounts, comparison of total revenue amounts between several years, to the generation of alerts if the amounts differ from the thresholds set by the company's administrators. The bots can also perform internal control tests, scheduling their activity in the execution of population tests, purchase orders, documents and invoices, verification of prices against quantity of items, generating alerts when deviations occur.

Finally, there are several advantages to be derived from RPA. One of the main benefits has to do with the possibility of performing advanced data analysis; no matter whether the data to be analyzed is extensive or voluminous, RPA can perform the operations in terms of accuracy, speed and reliability. Another advantage is cost-effectiveness, because when RPA is implemented, auditing costs are considerably reduced, due to the consequent reduction of human errors and the avoidance of losses due to poor auditing processes. Finally, there is also greater productivity, since the optimization of processes achieved with RPA allows the personnel assigned to audit execution to focus their efforts on more strategic activities or those that require greater concentration, such as the preparation of the final audit report, thus improving the management capacity, efficiency and planning of the audit processes.

REFERENCES

Alfonso, I. (2020). *Técnicas de investigación bibliográfica*. Editorial Contexto.

Bermúdez, C. (2020). RPA Automatización robótica de procesos: una revisión de la literatura. *Revista Urepublicana 8*(15), 111-122. http://ojs.urepublicana.edu.co/index.php/ingenieria/article/view/710/533

Cohen, M., & Rozario, A. (2019). Exploring the use of robotic process automation (RPA) in substantive audit procedures. *The CPA Journal*, *89*(7), 49-53.

Deloitte Inc. (2017) *Automatización robótica de procesos*. Editorial Deloitte Consulting Group S.C.

Figueroa J., López, E., Villa J. y Ferro, R. (2020). *Informática Aplicada a la Ingeniería*. Editorial Springer.

Gutiérrez, C. (2020). *La ventaja competitiva detrás de la implementación de RPA en procesos de BackOffice en la industria del retail en Argentina*. Editorial Universidad de San Andrés.

Hernández, A. (2020). *Impactos de la Automatización y/o la Robótica*. Editorial Universitat Politècnica de Catalunya.

Huang, F., & Vasarhelyi, M. A. (2019). Applying robotic process automation (RPA) in auditing: A framework. International Journal of Accounting Information Systems, 35, 100433.

Langmann, C. y Turi, D. (2021). Grundlagen: Automatización robótica de procesos. *Revista Springer 5*(2), 5-18. https://link.springer.com/chapter/10.1007/978-3-658-34680-5_2#citeas

Le Clair, C., Cullen, A. y King, M. (2020). *El Mercado RPA*. Editorial Forrester.

Moffitt, K. C., Rozario, A. M., & Vasarhelyi, M. A. (2018). Robotic process automation for auditing. Journal of emerging technologies in accounting, 15(1), 1-10.

Murillo, J. (2020). *Robots: transformando la gestión de la Auditoría Interna*. Editorial Pwc. https://www.pwc.com/ia/es/publicaciones/analisis-pwc/Publicaci%C3%B3n-RobotsTransformandoLaGestionDeAuditoriaInterna.pdf

Pérez-Morón, J. y Marrugo-Salas, L. (2020). *Automatización robótica de procesos en la profesión contable*. Editorial BContext.

Practia, Inc. (2020). *Procesos de RPA*. Editorial Practia Global.

Rai, D., Siddiqui, S., Pawar, M. y Goval, S. (2020). Automatización robótica de procesos: la fuerza del trabajo virtual. *Revista Computer Science & Communication Engineering 5*(2), 28-32. https://www.ijfrcsce.org/index.php/ijfrcsce/article/view/1850

Randall, J. y Haddaway, N. (2021). Metodología para el mapeo sistemático en Ciencias Ambientales. *Revista Editorial Environ Evid 5*(7). https://environmentalevidencejournal.biomedcentral.com/articles/10.1186/s13750-016-0059-6

Romero, K. (2022). Estudio de mapeo sistemático de la automatización robótica de procesos [Tesis de posgrado, Universidad Politécnica Salesiana] Repositorio digital UPS. https://dspace.ups.edu.ec/handle/123456789/23054

Rozario, A. (2019). *Tres ensayos sobre innovación en auditoría*. Editorial Universidad Rutgers.

Sotelo, A. (2018). *Soluciones basadas en automatización robótica de procesos (RPA) para la integración de sistemas empresariales y automatización de procesos de negocio en el sector seguros* [Tesis de posgrado, Universidad Politécnica de Madrid] Repositorio digital UPM. https://oa.upm.es/54781/

Tamayo, M. (2020). *El Proceso de la Investigación Científica*. Editorial Limusa.

Van Der Aalst, W., Bichler, M. y Heinzl, A. (2020). Automatización robótica de procesos. *Revista Ingeniería de Sistemas de Información y Negocios 60*(4), 269-272.

Velásquez J. D. (2020). *Una guía corta para escribir revisiones sistemáticas de literatura parte 1*. Editorial DYNA.

Zhang, C. y Vasarhelyi, M. (2018). *Automatización inteligente de procesos en auditoría*. Editorial Universidad Rutgers.

Contribution of each author to the manuscript:

Task	% of contribution of each author			
	A1	A2	A3	A4
A. theoretical and conceptual foundations and problematization:	20%	20%	20%	20%
B. data research and statistical analysis:	20%	20%	20%	20%
C. elaboration of figures and tables:	20%	20%	20%	20%
D. drafting, reviewing and writing of the text:	20%	20%	20%	20%
E. selection of bibliographical references	20%	20%	20%	20%
F. Other (please indicate)	-	-	-	-