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Robotic Process Automation (RPA) in the internal audit of large companies in Medellín, Colombia: Implementation and lessons learned

Automatización robótica de procesos (RPA) en la auditoría interna de grandes compañías de Medellín (Colombia): implementación y lecciones aprendidas

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Abstract

Internal audits have incorporated technologies such as Robotic Process Automation (RPA) to transform their practices due to the challenges of the modern business environment. Therefore, this study aimed to identify the various stages and lessons learned from adopting RPA in the internal audit process of large companies in Medellín, Colombia. The research had a qualitative approach of descriptive scope with a multiple case study through semi-structured interviews. It was found that RPA was implemented only in audit tests with mostly positive results and with differentiated success rates according to the technological infrastructure available; interviewees report increases in audit efficiency and coverage with more time dedicated to strategic activities and not to repetitive activities that can be automated with this technology.

Keywords: Robotic Process Automation (RPA), internal audit, large companies, Medellín.

Resumen

La auditoría interna ha incorporado tecnologías como la automatización robótica de procesos (RPA) para transformar sus prácticas debido a los retos del entorno empresarial moderno. Por ello, este estudio tuvo como objetivo identificar las diferentes etapas y lecciones aprendidas de la adopción de la RPA en el proceso de auditoría interna de grandes empresas de Medellín (Colombia). El artículo tiene un enfoque cualitativo de alcance descriptivo con un estudio de caso múltiple por medio de entrevistas semiestructuradas. Se encontró que se implementó la RPA solo en las pruebas de auditoría con resultados mayoritariamente positivos y con tasas de éxito diferenciadas de acuerdo con la infraestructura tecnológica disponible; los entrevistados informan aumentos en la eficiencia de la auditoría y en la cobertura con más tiempo dedicado a actividades estratégicas y no a actividades repetitivas automatizables con esta tecnología.

Palabras clave: automatización robótica de procesos (RPA), auditoría interna, grandes empresas, Medellín.

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Introduction

Adopting modern technologies in different areas of organisations is increasingly important, especially with RPA (Robotic Process Automation) (Griffiths & Pretorius, 2021), technology from which up-and-coming developments for auditing are expected (Kokina et al., 2025). This gradual adoption of technologies was accelerated during the COVID-19 pandemic and is still evident in the desire of organisations to modernise and digitise their processes (Muqattash et al., 2024). The implementation of RPA in auditing facilitates the replacement of various operational tasks previously performed by auditors, allowing them to focus on other activities of greater relevance (Huang & Vasarhelyi, 2019; Moffitt et al., 2018).

For these reasons, RPA has attracted different research interests since its inception (van der Aalst & Hee, 2002) because of the concerns involved, such as the degree of control and risk management in RPA (Eulerich et al., 2024), the joint work between RPA assistants or developments, and individuals (van der Aalst et al., 2018), as well as the complexities of its implementation with high failure rates (Cooper et al., 2019; Kokina et al., 2025), among others. Although RPA has gradually gained significant relevance in the business environment during the last two decades (Elnakeeb & Elawadly, 2025; Smeets et al., 2024), the literature revealed a limited availability of academic reports on its specific application in practical internal audit processes, especially in local contexts. Even extensive literature reviews such as the ones conducted by Tiron-Tudor et al. (2024) and Moreira et al. (2023) point out that articles in which the implementation of RPA has been studied are still scarce and needed in the literature, specifically through case studies in various organisations, which could include empirical evidence in the academic discussion, and give perceptions regarding RPA in internal audit.

Thus, conducting a local study is particularly important as the characteristics and organisational factors that enable the implementation of RPA have been illustrated as changing according to the context (Fedyk et al., 2022), so a local study allows referencing the factors to be considered in the implementation of this technology in a city with the context of Medellín. Even more so since disturbing failure rates have been shown in the implementation of RPA in auditing, as referenced by Cooper et al. (2019), and which has been maintained in the same sense in the literature as indicated by Fedyk et al. (2022) and Kokina et al. (2025).

This situation presents a valuable opportunity to examine how this technology has been adopted by large organisations in the city, identifying its main advantages and disadvantages, and generating evidence that can serve as a reference for other organisations undergoing similar digital transformation processes. Studying this phenomenon at present is crucial, not only due to the level of technological maturity RPA has reached, but also because of the urgent need to understand its implications for strengthening internal control, improving audit efficiency, and managing risks in an increasingly automated and competitive organisational environment.

Likewise, the city of Medellín holds particular relevance for this study, as it was declared a Special District of Science, Technology, and Innovation in 2021 through Legislative Act 01. This recognition highlights the city's commitment to digital transformation and positions it as a favourable environment for the adoption of emerging technologies (Legislative Act 01 of 2021, 2021). Against this background, this research seeks to identify the stages and lessons learned from the implementation of RPA within the internal audit functions of large companies in Medellín, Colombia. To achieve this objective, a qualitative research approach with a descriptive scope is employed, utilising a multiple-case study strategy that includes semi-structured interviews. This approach aims to pinpoint the stages involved in the RPA implementation process and the insights gained. The study is grounded in agency theory and contingency theory, enabling an exploration of the stages and lessons learned from the adoption of RPA in internal audit processes.

Hence, this research is justified due to its convenience, and both practical and theoretical implications (Hernández Sampieri et al., 2014). In the first place, it is convenient since it allows knowing the current applications of modern

technologies such as RPA in the internal audit process, its stages, and the lessons learned from the implementers for future adoptions in other companies of varied sizes and economic sectors.

Finally, this study also has practical implications because it allows the identification of lessons learned from implementing innovative technologies such as RPA in audit processes, enabling internal audit departments to develop the best practices. In addition, it contributes to the theoretical corpus of this subject by generating new analytical information through case studies. This research aims to contribute knowledge in this regard, guided by the following research questions: Which tasks have been automated through Robotic Process Automation (RPA) in the internal audit function, which ones are intended to be automated, and for what purposes has this automation been implemented? What are the perceived benefits and drawbacks of using RPA in internal audit functions? How is RPA integrated and used in each stage of the internal audit process? What mechanisms and resources are used to implement new technologies in internal audit departments? And, what are the main lessons learned from the implementation of RPA in internal audit processes?

Theoretical framework

This study seeks to identify the stages and lessons learned from the implementation of RPA in the internal audit of large companies in Medellín, Colombia that is why, based on the agency and contingency theories, which are commonly used in this type of study (Antwi, 2021; Bozkus, 2024), this type of audit will be related to that technology.

Agency theory and internal audit

Agency theory is one of the most critical theories in finance and economic theory (Panda & Leepsa, 2017). It stems from the studies of the economics of information and was developed extensively by Jensen and Meckling (1976). Based on the approaches developed years earlier by Berle and Means (1932), a series of explanations is proposed for the relationships and problems that occur within organisations regarding control and information based on the agency relationship. This relationship is understood as "a contract under which one or more persons (the principal(s)) engage another person (the agent) to perform some service on their behalf, which involves delegating some decision-making authority to the agent" (Jensen & Meckling, 1976) within the organisational environment.

Thus, if the participants are thought of in this relationship as rational economic subjects, each one will maximise its utility or benefit, which will trigger a series of agency problems or conflicts that can be seen and managed as incentive problems or institutional structure ones (Mitnick, 1975). Thus, in the maximisation, some interests may be positioned to the detriment of others —usually the interests of the agent over the principal's— due to the existence of an asymmetry of information disadvantageous to the latter and differences in the perception and assumption of risk between them (Jensen & Meckling, 1976; Singh et al., 2021).

Thus, in the face of agency problems, a series of solutions or treatment alternatives are theoretically proposed, such as the participation of agents in social ownership (agents as managers and as owners), executive compensation, movements in the organisational debt structure, perceptions of agents in the labour market, diversity on the board of directors, the presence of blockholders, or other structures in which the social capital is divided, among other things (Panda & Leepsa, 2017). These solutions undoubtedly pose agency costs that were seminally defined as the sum of monitoring costs, bonding costs, and residual loss (Jensen & Meckling, 1976), of which the audit is part of the supervision or monitoring costs.

This is how internal audit is presented simultaneously as one of the elements of agency cost and as a solution to problems originating from the diversity of causes identified in the literature (Panda & Leepsa, 2017). Thus, agency theory provides a theoretical component to auditing that has been explored extensively in research on external and internal audits (Antwi, 2021).

Contingency theory and internal audit

Contingency theory is founded on the belief that there is no one-size-fits-all solution to organisational challenges; instead, the effectiveness of practices is contingent on various contextual factors unique to each organisation (Mustafa, 2024).

Internal contingencies refer to factors within the organisation that influence its standard audit performance. These include organisational size, structure, strategy, compensation systems, and information systems (Chenhall, 2012). For instance, an organisation's size can impact the complexity of its necessary control and audit systems, while its structure may dictate how these systems are distributed and utilised across different hierarchical levels (AlSuwaidi et al., 2024).

According to this theory, no optimal organisational structure exists that suits all organisations; rather, the most effective structure is contingent upon the specific circumstances faced by each entity (Donaldson, 2001). For example, in environments characterised by high uncertainty, organisations may benefit from more flexible and decentralised structures that facilitate swift adaptation to change (Hongpukdee & Saraphat, 2024). Conversely, in more stable environments, hierarchical and centralised structures may prove more effective in ensuring control and efficiency (Gordon & Narayanan, 1984).

Contingency theory is frequently employed to analyse both external variables, such as technology, market competition, environmental uncertainty, and national culture, as well as internal factors, including organisational size, structure, strategy, compensation systems, and information systems (Otley, 2016).

Internal audit

Auditing is a practice used by management and means of production owners, agents, and principals to monitor compliance with controls associated with risks to organisational objectives (Montes Salazar et al., 2019). Specifically, internal audit is a kind of audit genre that, from within organisations, tends to ensure their proper functioning and compliance with organisational objectives to the extent that the risks related to these objectives are adequately mitigated by the controls implemented by the administration (De La Torre Lascano, 2018). Consequently, internal audit is considered the backbone and an essential element for implementing the accounting system in organisations (Al-Matari & Mgammal, 2019).

Meanwhile, the Institute of Internal Auditors (IIA, 2017) defines internal audit as an independent and objective safeguarding and consulting activity designed to add value and improve organisational operations. This activity contributes to organisations achieving their objectives by providing a systematic and disciplined approach to assessing and optimising the effectiveness of risk management, control, and governance processes (IIA, 2017).

On the other hand, according to the IIA standards, the internal audit function (IAF) must develop and adjust internal audit planning to reflect all changes and risks occurring in the business environment. Thus, the IAF can be considered by many members of an organisation as the internal watchdog that recognises inappropriate or even illegal behaviours and, at the same time, provides an assessment of the organisation's compliance with corporate policies and procedures. Similarly, the IAF plays a crucial role in risk management, as well as in control and corporate governance, so that these are effective and lead to improved business survival and success.

At the same time, the digitisation experienced in the business environment and the increasing use of digital technologies favour the standardisation and improvement of processes in organisations (Troshani et al., 2019). Also, the growth of challenges generated by current issues such as data protection, non-financial reporting, and cyber risks fostered the implementation of technologies within organisations and in audit processes (Lois et al., 2020).

Finally, the IAF benefits from taking advantage of technologies such as RPA to improve the coverage and convenience of audits to increase organisational efficiency. All this highlights the importance of internal auditing when analysing governance, strategic issues, and information technology aspects of

contemporary internal auditing (Canestrari-Soh & Martinov-Bennie, 2015).

RPA and Internal Audit

Audit experts have analysed and discussed the dichotomy between technology as a replacement for the auditor or as a complement for the auditor (Issa et al., 2016), whereby technologies such as big data, artificial intelligence, internet of things, blockchains, RPA, machine learning and deep learning, interactive data visualisation technologies such as dashboards, data mining, among others, acquire great importance in current audit practices mainly in large companies (De Santis & D'Onza, 2021; Salijeni et al., 2019).

An example of these information technologies is RPA which helps automate different activities based on rules and using bots (Zhang et al., 2023). A common definition of RPA used in the literature is provided by the IEEE Corporate Advisory Group (2017), which describes this technology as "a preconfigured software instance that uses business rules and predefined activity choreography to complete the autonomous execution of a combination of processes, activities, transactions, and tasks in one or more unrelated software systems to deliver a result or service with human exception management". Unlike other technologies such as artificial intelligence, RPA is characterised by its structured, rules-based approach.

On this, Solanki et al. (2024) identified three phases in the history of RPA applied to auditing: the Incursion of RPA Tools in the 2000's with simple applications in finance, customer service and human resources; Initial Applications (2016-2018) in routine audit tasks in data mining and the beginning of implementations in organisations; and a Maturation Phase (2019-2021) where RPA tools have started to be involved in more challenging and complex tasks of audit work where issues such as data security, ethical considerations, and the skills of auditors to use these tools started to be addressed.

Further, audit processes involve managing several repetitive activities for which RPA can be leveraged for speed and agility, allowing automating, and reshaping time-consuming processes to increase efficiency (Huang & Vasarhelyi, 2019; Moffitt et al., 2018). Audit activities amenable to automation with RPA include reconciling cash transactions, purchases and sales, inventories, salaries, and miscellaneous expenses, monitoring risk levels and issuing alerts if exceeded, and other operations that demand little professional judgment but are repetitive and time-consuming (Huang & Vasarhelyi, 2019; Moffitt et al., 2018).

In addition, using RPA also makes it possible to run tests on all the accounting data instead of having a conventional sample run, which decreases sampling errors (Huang & Vasarhelyi, 2019); additionally, implementing RPA can improve the identification of accounting irregularities, discrepancies, and fraudulent acts (Zhang, 2019). The integrity of the data recorded in the accounting can be confirmed by performing an automated comparison with the original documents (Perdana et al., 2023).

In summary, the application of automation does not necessarily cause the disappearance of the auditor role (Cooper et al., 2019), but rather, these tools are intended to replace replicable and routine tasks so that auditors focus on processes that demand their skepticism and professional judgment (Zhang, 2019). However, like any other intervention in the internal audit process, RPA is not devoid of errors or risks, so its application and its implications remain a topic of research interest (Eulerich et al., 2024).

Methodology

This research had a qualitative approach, which implies emphasis on understanding and exploring the qualities or categories of the study phenomenon and having the possibility to focus on the meaning and interpretation of social reality (Morrow & Smith, 2000). The above allowed the current study on implementing RPA in the internal audit of large companies in Medellín, Colombia, to understand the particularities, perspectives, and experiences related to this process.

The scope of the research was descriptive, which means that it seeks to specify the properties and characteristics of the study phenomenon; in addition, the usefulness of this

scope allows for presenting and analysing situations as they occur in their natural context, without manipulation of variables (Hernández Sampieri et al., 2014). Therefore, applying this scope in the study on RPA provided a detailed and contextualised understanding of the implementation process.

To collect the necessary information, semi-structured interviews were applied because, with them, the flexibility and personal nature of these interviews are emphasised, which allowed the researchers to delve deeper into the participants' responses and gain a richer and more detailed understanding of their perspectives and experiences (Peters & Halcomb, 2015). The first version of the interview protocol was developed based on the literature review (Betti & Sarens, 2021) and the categories of analysis found in it. This protocol was validated through a pilot test conducted with an experienced internal audit professional.

A preliminary database was then established containing information on potential organisations to be interviewed that met the selection criteria, namely: **1)** being a large company in Medellín, **2)** having an established auditing system, and **3)** having implemented RPA in the auditing process. Subsequently, an official communication was sent to a group of professionals who held positions as vice presidents, directors, or internal audit analysts in the leading consulted companies. The selection of the positions to be contacted was based on the interest in obtaining a comprehensive view of the RPA implementation process from the different hierarchical levels and roles within the audit area. Vice presidents and audit directors provided a strategic perspective on the decisions related to the adoption of this technology, the expected objectives and alignment with the organisation's vision; auditors and audit analysts provided detailed information on the operational execution, technical challenges, and lessons learned from the implementation of RPA in their organisations.

After purging the database of potential interviewees that is, verifying the veracity of the information initially collected and eliminating duplicate records, as well as professionals who did not fully meet the established criteria (for example, professionals who, although auditors, were not directly involved in the RPA implementation process) the semi-structured interview was applied to seven auditors, vice presidents, directors, or analysts of the companies that were previously selected during the year 2022.

Below is a Table summarising the participant organisations by anonymising them. However, their names are not disclosed due to the anonymous nature of their participation, an element included by the researchers to reduce bias in the interviewees' responses.

After conducting the research interviews, the semi-automatic transcription of the recordings was obtained, and the interview transcripts were coded using the axial method (Strauss & Corbin, 1998). This made it possible to structure the information to facilitate the analysis of the results obtained. It began with axial coding, a systematic process that linked the categories identified in the interviews to their subcategories, organising them around a central axis. This process involved identifying the conditions, actions, and consequences associated with each category, in

Table 1. Companies interviewed

Organisation code	Industry	Annual revenue (millions of USD)	Number of interviewees
O1	Insurances	129.77 to 423.29	2
O2	Financial services	1 277.46 to 2 920.42	1
O3	Infrastructure	2 600.30 to 4 134.27	2
O4	Pensions	67.17 to 202.52	2

Ex*change* rate of 3 945.32 Colombian pesos (COP) for each dollar of the United States (USD).

Source: Based on the general reports of each company.

order to regroup the data from the previous stage and construct more precise explanations of the phenomenon under study and the answers of each interviewee.

Results

The results presented below come from the codification and analysis of the semi-structured interviews used to collect information and are divided according to the categories of analysis.

Agency theory and internal audit

Internal audit participates in the agency costs as a supervision or monitoring cost, which in the implementation of this type of initiative is varied, and its success in implementation depends mainly on the degree of technological appropriation and development of the company. Thus, by having the technical and financial infrastructure to acquire and use the licenses for the RPA systems they implemented, the organisations interviewed obtained immediate results that varied in their effectiveness, mainly according to the type of task they set out to automate. Thus, for example, O4 expressed that implementing this system did not have many drawbacks. However, incorporating this technology in the day-to-day audit functions later proved they were not susceptible to automation with RPA.

On the other hand, as mentioned above, the organisations generally used capabilities and technologies they already had, except for O4, which resulted in the acquisition of new systems for the automation of some audit tasks. However, O2 reported that open-source tools, online courses, and free software are increasingly used for this type of implementation, where success is not guaranteed, as was the case for O4. Thus, the cost of implementation that these projects demand is reduced, and the number of auditors with these capabilities is increasing, going from a few with knowledge in technology who implement these changes to most auditors who do it on their own, as described by O4 and O3. This, in the experience of all interviewees, allows the authors to assert that these automations are increasingly conducted by the entire audit team and not by a few with engineering or technology-related training.

In addition, online training and materials are shared among all audit team members within each organisation, instead of resorting to hiring or incorporating knowledge into the organisation through external parties, which increases the cost. In the same way, licenses were usually centralised in a technology area and shared with the implementers of these issues in the internal audit departments (O2, O3 and O4), which meant that those tools that were used only by the internal audit process were discarded because of their pressure on the expenditure (O4 and O3).

Contingency theory and internal audit

The variability between organisations' formal structure and available resources makes an analysis based on this theory ideal. In this sense, for example, it is observed how internal contingencies associated with staff training, biases, the way information is organised and managed, among other factors, are determining factors when evaluating the efficiency of RPA implementation in internal auditing.

Besides, regarding internal variables such as the size of the organisation, O3 formulates that this type of technology is useful for large structures where information is abundant and distributed across different sources, but that small organisations with limited budgets for innovation initiatives may lack the capital to implement it.

Similarly, auditor training is consolidated as a fundamental variable to consider, as the way tools are developed and parameterised must consider auditor confidentiality and independence. In this regard, O2 believes that auditors must have the necessary knowledge to ensure a secure implementation of the tool.

Finally, O4 notes that the changing technological environment requires increasingly comprehensive and sophisticated internal audit processes that allow the organisation to continue auditing its critical areas. However, they note that RPA is not the solution to all problems because its implementation, to be effective, requires very clear rules that are not always the case in the

business world. Thus, an additional task is now being set up to audit the auditing robot, so "the auditor, who constantly monitors how the robot behaves, is aware of the results, and if there are any changes, they quickly realise that something has happened in order to make the necessary adjustments to the robot. However, I have heard of cases in other organisations where parameters are modified or the system is modified, and the RPA didn't realise it and continued operating with rates or information that were not there, and this caused operational problems", that is, the tool needs to be change as fast as the changing environment, as indicated by O2.

Internal audit

The way internal audits are conducted in organisations is highly homogeneous: planning, execution, presentation of results, and follow-up. In this regard, it is consistent among the interviewees that RPA was used only to execute the audit tasks. In this way, several inputs participated in the planning such as identifying auditable units, their processes and strategic risks, structuring work plans, and determining the installed capacity to perform the audit. Despite this homogeneity, O3 reported benchmarking in companies within their industry looking for the best practices to audit specific areas, and O1 reported that their planning was diminished with the implementation of RPA in the audit process, which made it more general to perform tests. Thus, it was evident that all interviewees used RPA only in substantive audit tests, with no impact on the planning, socialisation, or presentation of results.

Robotic Process Automation (RPA)

The interviewees mentioned a collective understanding of the concept of RPA, understanding it as the automation of processes, which, as mentioned by O1, changed the way auditors operate to make the processes more automatic, efficient, and with the minimum possible error. This was agreed by interviewee O2, who understood RPA as a tool that simulated the auditor's behaviour. In addition, the interviews highlighted efficiency as the primary purpose of implementing RPA in organisations, where interviewee O3 emphasised that it was a tool that facilitated the analysis of substantial amounts of information, as well as the extraction of reports. In turn, interviewees O2 and O3 agreed that implementing RPA contributed to greater efficiency in all types of resources, where this system was responsible for executing repetitive tasks. As implied by O2, this technology "is more efficient from a time reduction and economic point of view to have a process assistant, in this case RPA, to take care of these repetitive tasks".

Additionally, O1 disclosed that the tasks that could be automated with RPA involved transactions within routine processes; for example, he said that previously, downloads and database cross-checking were done manually. However, now the bot could automate this process, and the auditor would receive a report with which he could analyse the information; in this sense, O1 "sets the robot to automatically make the audit working paper, which is a report or a memo that the robot builds automatically".

Additionally, O3 mentioned that RPA allowed for better analysis of copious amounts of information, extracting information with reports and logs, and managing them more appropriately. On the contrary, O4 indicated that the automation process with RPA they implemented did not add value to the audit since the first bot they built extracted information on a web page for later analysis. However, the page constantly presenting changes, required that the robot have more excellent maintenance management, and therefore, they decided to implement other technologies from an analytical point of view and statistical analysis. "It now makes it easier for us to extract information with much larger reports and records and manage them more appropriately", as referred by O3.

Regarding the tasks automated with RPA, O3 pointedly mentioned the creation of providers at unusual times related to dynamics originated by the COVID-19 pandemic. O1 and O2 mentioned that the main task for which they implemented RPA was to extract and collect information based on specific parameters designated by an auditor in charge of receiving it and performing the

pertinent analysis subsequently. "With the robot we have the certainty that there is no change, no direct modification to the information that is extracted, but it is taken directly from the system and this greatly reduces the probability of a modification or fraud within this information to be analysed", as indicated by O3. It is important to note that O1 had 73% of the audited units supported by robotics.

On the other hand, O1 and O3 wanted to automate all repetitive tasks in the audit area so that auditors could concentrate on those processes that added value to have more criteria for decision-making and strengthen organisational management processes. In addition, O2 declared that RPA would be implemented in the required processes, considering technical feasibility.

Finally, O1, O2, and O3 specified that automation with RPA was not used in the audit planning stage. However, they emphasised that using RPA in the execution stage of the audit tests allowed them to obtain a more excellent follow-up in a shorter period than before. Specifically, O1 mentioned that it took months to perform the audit tests, and now it takes some minutes with the support of RPA: "it used to take us three months, four, six, depending on the scope. Now it automatically runs every month and in three to five minutes the whole test comes out".

Lessons learned

The advantages of implementing RPA in the internal audit presented by the organisations are similar; they all agree that one of the main advantages is the optimisation of time and excellent data coverage. With the implementation of RPA, it is not necessary for a person to be constantly performing this task, and a test that could previously take between four and eight weeks now takes three to five minutes, in addition to the fact that the bot complies with a constant periodicity with the same degree of effectiveness. In addition, with RPA, there is no longer talk of samples because it can be run and cover 100% of the data.

Despite these similarities, some organisations highlighted other advantages: O1 enunciated that this implementation provides greater accuracy, lower probability of error, and timeliness, while, O2 highlighted that automating a process made it possible to use that person's time in more analytical processes, thus adding more value to the audit area.

However, the organisations raised different disadvantages with this implementation. O1 commented that RPA cannot be applied to everything for now, as not everything is amenable to automation, stating, "it is very important to know when to dedicate resources to automation and when not to; because if it is going to be something that is not going to be executed frequently, it may not be very viable to maintain very costly automations". In this line of discourse, O2 mentioned that "that is why we have tried to develop in the auditors a certain analytical capacity to know when it is feasible to automate and if it is feasible, to raise our hand to support them in that automation and if it is not feasible, to help them to extract the information in a different way that does not necessarily have to be with RPA". A lesson learned from the implementation of RPA is to know that this technology is not suitable for all circumstances.

O2 stated that systems can change, and if a change occurs and the robot is trained with a specific system, those changes can affect it. Therefore, the robot will continue to run and generate inaccurate or erroneous information, which may lead to the materialisation of risks. Moreover, O3 expressed that one of the disadvantages is related to the need to incur licensing costs in order to use this technology; O4 expressed a much more critical view. It evidenced that one of the main disadvantages of implementing RPA is that the value that auditors are contributing is beginning to be questioned and that if the trends are observed, the audit profession will most likely disappear.

Regarding the lessons learned, all the organisations addressed various elements. O1 expressed that the most important lesson was to let go of the fear of thinking that technology will replace people and, instead, seize the opportunity to transform the different processes. Both O2 and O4 emphasised that during this process, they understood the importance of recognising when and when not to automate since it is not

always the best option if a process is not done nonstop, or the implementation cost is higher than its benefits.

O2 also raised the importance of establishing clear definitions, starting automation based on the need, and finding the best solution, since another type of technology may be more efficient in some cases. He also enunciated that establishing an effort-impact matrix is an excellent option to determine the most viable needs to prioritise with RPA. O3 mentioned that implementing this technology is a continuous improvement process.

Contrary to the other organisations, O4 expressed that for them, implementing RPA in the internal audit process was inefficient; they realised that it was not helpful for the audit exercise and preferred to use another less complex technological tool through which they conducted statistical analysis. From this point of view O4 stated that "firstly, it is to have clear definitions, and the second thing is that people participate in the construction of automation based on their needs".

On the other hand, the lessons learned in terms of professions or staff training were similar in the organisations; they all raised the challenge and the importance of changing people's mindset in implementing RPA. O1 expressed the need to change the thinking that innovative technologies will replace the auditor since they will not but will force them to transform themselves. O2 stated that not everything can be solved with the same tool (RPA); therefore, training personnel adequately is necessary, providing clear definitions, and generating organisational learning. In addition, O3 expressed the importance of acquiring new technological skills without neglecting the need to know the processes to be audited. Likewise, O4 revealed the difficulty presented by the staff (mainly accountants) in developing and internalising these technological skills, because they had to develop a different teaching method through which they could obtain more noteworthy progress.

In conclusion, regarding generational differences, O2 identified that age has some influence on the ease of adopting modern technologies such as RPA. It stated that younger people use it more quickly than much older people, who find it more difficult. O1 and O3 did not report any age-related difficulties or differences in adopting such technology; since their teams are made up of people with technological skills, they have not identified any generation gap.

Discussion

The results showed that applying RPA in internal audits is not a universal solution. The challenges identified, including incompatibility with specific audit tasks, underscore the necessity of conducting a comprehensive assessment before proceeding with implementation. The variety of technological strategies adopted by different organisations suggests that a single formula for success does not exist; rather, it is crucial to tailor approaches to the specific circumstances of each organisation. This aligns with both agency theory and contingency theory.

In line with the theory, the results observed that internal audit assumes a crucial role in mitigating agency costs, specifically in terms of supervision or monitoring. In implementing RPA, the studied organisations showed varying degrees of success, linked mainly to their technical and financial infrastructure. Companies with adequate resources obtained immediate results, highlighting the importance of internal technological development. However, cases were identified where the incorporation of RPA technologies in daily auditing functions encountered limitations, especially in tasks that proved not amenable to automation.

In agreement with the theory, the results of this research confirm the importance of internal auditing as a monitoring and safeguarding mechanism. The homogeneity in the conduct of internal audits among the organisations studied, characterised by the phases of planning, execution, presentation of results, and follow-up, reflects the systematic and disciplined application recommended in the literature (IIA, 2017). However, exciting nuances emerge that reveal the adaptability of internal audit practices to the particularities of each company.

Contingency theory posits that there is no one-size-fits-all solution to organisational challenges. Instead, audit systems should be flexible

and tailored to the unique requirements of each organisation (Otley, 2016). This viewpoint aligns with the current study's findings, demonstrating that implementing RPA in internal audits varies based on each company's technological infrastructure and maturity. For instance, some organisations interviewed identified tasks unsuitable for automation through RPA, underscoring the importance of a comprehensive evaluation before implementation.

Additionally, contingency theory highlights that environmental uncertainty significantly influences the structure and application of control and audit systems. In environments characterised by high uncertainty, organisations need adaptable systems capable of responding to unforeseen changes (Chenhall, 2012). The findings of this study support this notion, indicating that adopting RPA in internal audits can enhance a company's ability to manage uncertainty by automating routine tasks. This, in turn, allows them to focus resources on more valuable activities, such as adapting to changes driven by the environment.

The application of RPA in substantive testing, as indicated by interviewees, highlights the ability of this technology to perform repetitive and routine tasks faster and more accurately than traditional methods. It is interesting to note the variations in internal audit planning that arise with implementing RPA. While most interviewees follow a homogeneous process, some report the influence of RPA in reducing planning, making it more general to facilitate audit testing. This finding can be interpreted as a strategic adaptation of internal audit practices to the introduction of disruptive technologies such as RPA. However, it can be observed that the use of RPA is completely limited to the performance of substantive audit tests, not to other stages.

Efficiency then emerges as a central objective in implementing RPA, supporting the existing literature that highlights how this technology contributes to resource optimisation (Huang & Vasarhelyi, 2019). Previous studies found that automation of routine tasks is a crucial feature of RPA, highlighting the ability to perform activities such as downloads and database cross-referencing faster and more accurately than by manual methods. This is in line with what was found in this research, where this ability of RPA to perform transactions within routine processes, such as the extraction and collection of information based on specific parameters, is highlighted by several interviewees.

The organisations participating in implementing RPA in internal audit shared some of the advantages and disadvantages identified, as well as the lessons learned during this process. As for the advantages, they all agree on the significant optimisation of the time spent on auditing tasks, allowing a more excellent coverage of data in an efficient manner. Some organisations also highlight the accuracy and reduction of the probability of error, underlining the reliability of the information generated by RPA. In addition, the ability to free up human resources to focus on higher-value analytical tasks is highlighted, according to the perspective of one of the organisations.

However, the disadvantages identified vary. Some organisations point out limitations in the applicability of RPA, indicating that not everything can be automated. Vulnerability to system changes is another concern, as RPA can generate inaccurate or erroneous information if systems change. The costs associated with RPA licensing are also mentioned as a disadvantage, and one organisation takes a critical view regarding the risk of questioning the value added by auditors as RPA expands.

In terms of lessons learned, the importance of overcoming the fear and perception that technology will replace people by emphasising the opportunity to transform processes rather than fearing substitution is highlighted. Careful selection of processes to automate is revealed as a crucial lesson, recognising the repetitiveness of the process and its impact. The organisations also highlight the need for staff training, clear definitions, and a focus on continuous improvement. The importance of changing the mindset of staff and acquiring recent technology skills is a key challenge, with one organisation emphasising the need to break down mental barriers when addressing RPA issues.

Theoretical implications

Implementing RPA in the internal audit of large companies in Medellín has important theoretical implications. The theoretical framework highlighted the importance of internal audit as a backbone for the proper functioning of organisations, being key in implementing the accounting system and contributing to governance and mitigation of agency problems. However, introducing RPA poses new challenges and opportunities in this context.

Traditional agency theory, centred on the agent-principal relationship, is challenged by introducing technologies such as RPA. This technology emerges as a tool that automates routine tasks and redefines the dynamics between agents and supervisory processes. Decreased reliance on samples, time optimisation and increased data coverage introduce substantial changes regarding how internal audit addresses agency issues.

Practical implications

RPA has proven to be an effective tool for optimising processes and improving operational efficiency in internal audit tasks. This suggests that companies can leverage RPA to improve productivity and focus human efforts on more strategic aspects of auditing. The introduction of RPA raises the need for a strategic assessment before implementation. Lessons learned highlight the importance of recognising when to automate and when not to automate, considering process repeatability and technical feasibility.

Implementing RPA requires cultural transformation and the development of new skills in personnel. Organisations stress the importance of overcoming the fear of replacement and adequately training staff. This implies an adaptation in auditors' mindset, recognising that technology will not replace their role but will force them to transform themselves and acquire new technological skills. On the other hand, there is a question of the value of auditors in an increasingly automated environment. This aspect highlights the need for continued reflection on the auditor's role and how the profession can evolve in response to emerging technologies. Organisations must strategically consider balancing automation by preserving the value added by audit professionals.

Finally, this study is an informative contribution for organisations that are thinking about implementing or have already begun to implement RPA, both in audit and in other areas of the organisation. By looking at the lessons, missteps, and opportunities for improvement of the organisations involved here, it is possible to avoid pitfalls in the implementation of this technology. Finally, the study raises questions for readers about the trend and desire to automate everything, and prompts reflection on what cannot be automated — at least with the current state of technology —, what is not wished to be automated, and the consequences of either scenario for the auditing profession.

Future lines of research

For future research, it is suggested that longitudinal studies be conducted to assess the long-term impact of RPA implementation on internal audits. These studies could analyse how audit practices, operational efficiency, and auditors' perception of value added evolve as the technology becomes more deeply integrated into operations.

Further research could address the dynamics of organisational change resulting from RPA implementation and could provide a deeper understanding of how firms culturally adapt to automation. Specific challenges and practical strategies to facilitate technology acceptance and adoption in the internal audit arena can be explored.

Moreover, given the interconnectedness of RPA with other technologies such as big data, artificial intelligence, and data mining, future research could explore the synergistic integration of these technologies in internal audits. Cases where multiple technologies collaborate to provide more holistic and advanced solutions can be investigated.

Ethical considerations and data security in the context of internal audit automation deserve continued attention. Future research could explore the ethical challenges associated with

automated decision-making and how they can be effectively addressed to ensure ethical and secure auditing practices.

It is also necessary to conduct more focused research on internal audit and the potential gap that exists in terms of technology implementation between this type of audit and external audit. As referenced in literature reviews from recent years, studies on RPA and large audit firms abound, but not so much with respect to small businesses and SMEs, for example, or on internal audit departments.

Likewise, and considering that this study was conducted in a Global South country, researchers are urged to investigate the intrinsic differences that technology implementation has in these latitudes compared to the Global North. In this regard, it must be considered that literature has been much more prolific in the North than in the South, which means that conclusions, especially concerning implementation and utilisation figures, can vary considerably. That is, if the technological implementation gap between countries in one and the other group is considered.

Lastly, and also in line with the literature, research on the application of RPA specifically, as well as other emerging technologies, to external and internal audit processes is imperative, where technology is not applied only in substantive audit tests. That is, to review how technologies are being implemented in stages such as planning, reporting, or audit follow-up.

Conclusion

The implementation of RPA within the internal audit functions of large companies has demonstrated significant value in optimising processes and enhancing operational efficiency. This research emphasises the necessity of considering each organisation's unique circumstances, including environmental uncertainty, strategic objectives, organisational culture, and the coordination of control systems, to design and implement a more effective internal audit system tailored to the specific needs of each company.

Furthermore, the findings highlight the importance of conducting a comprehensive assessment before RPA implementation, the need for cultural transformation, and developing new skills among staff members. Providing adequate training and fostering a mindset shift among auditors are essential to fully capitalise on the benefits of automation and effectively address the challenges related to system changes and the limited applicability of RPA.

In conclusion, integrating RPA into internal audit processes streamlines operations, enhances efficiency, and redefines the interaction between stakeholders and oversight mechanisms. As technology becomes increasingly embedded in operations, it is vital to continuously evaluate its long-term effects and explore strategies that facilitate the acceptance and adoption of technology within the internal audit landscape. The evolution of the audit profession in response to emerging technologies, along with ongoing reflection on the value added by audit professionals, will be crucial in ensuring future ethical and safe audit practices.

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