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Procedia Computer Science 256 (2025) 685–695

Procedia Computer Science

www.elsevier.com/locate/procedia

CENTERIS – International Conference on ENTERprise Information Systems / ProjMAN – International Conference on Project MANagement / HCist – International Conference on Health and Social Care Information Systems and Technologies 2024

Audit framework for control Robotic Process Automation projects

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Abstract

This study aims to review existing literature on audits within the technological domain, with a specific focus on Robotic Process Automation (RPA), in order to develop a framework tailored to the RPA technology lifecycle for effective audit control. The methodology involves a systematic review of pertinent literature sourced from academic and scientific databases, followed by an analysis to identify gaps. A proposed framework, aligned with the RPA technology lifecycle, integrates essential criteria for conducting audits focused on RPA project control, thereby addressing identified deficiencies. The results of this synthesis highlight areas for further investigation and the development of a comprehensive framework that caters to the specific needs of RPA projects. In conclusion, this research consolidates pertinent findings from the literature review and introduces a novel framework aligned with the RPA technology lifecycle, integrating crucial audit criteria. The ultimate goal is to bridge research gaps and offer practical guidance to RPA technology users, thereby enhancing project control and performance.

Peer-review under responsibility of the scientific committee of the CENTERIS - International Conference on ENTERprise Information Systems / ProjMAN - International Conference on Project MANagement / HCist - International Conference on Health and Social Care Information Systems and Technologies

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1877-0509
Peer-review under responsibility of the scientific committee of the CENTERIS - International Conference on ENTERprise Information Systems / ProjMAN - International Conference on Project MANagement / HCist - International Conference on Health and Social Care Information Systems and Technologies
10.1016/j.procs.2025.02.168

Keywords: Robotic Process Automation (RPA); RPA Lifecycle; Literature Review; Project Management.

1. Introduction

In the era of digital transformation, numerous companies are actively seeking innovative solutions to streamline their operations and enhance overall efficiency. Among these solutions lies the adoption of Robotic Process Automation (RPA), a technology crafted to automate repetitive and standardized tasks formerly executed by human agents. Nevertheless, the implementation of RPA presents considerable challenges.

In a recent study, [1] emphasized significant contributions concerning key facilitating technologies, methodologies, frameworks, tools, and techniques for intelligent and sustainable systems [1]. RPA, essentially, aims at automating business processes or their components through software robots, replicating human interactions within graphical user interfaces [2]. These software robots play a pivotal role in automating tasks associated with Backoffice and Administration, traditionally carried out by human collaborators [3]. Notably, the surge in various RPA approaches has led to a substantial 60% growth in the RPA software market in 2018 [4]. Organizations are propelled by the objective of developing and delivering products or services in desired quantities while ensuring a prompt response to market demands or opportunities [5]. Furthermore, the adoption of RPA serves the dual purpose of relieving employees from mundane tasks [6]. Despite the benefits, some employees may resist automation integration, apprehensive of potential job displacement [7]. Within the broader context, RPA can be perceived as a tool or technology aligned with the Industry 4.0 paradigm, contributing to the advancement of intelligent and sustainable systems.

Auditing stands as an indispensable practice across various sectors to ensure compliance, transparency, and operational effectiveness. In the business domain, auditing involves the systematic and independent analysis of records, processes, transactions, and financial statements of an organization, with the primary objective being to ensure adherence to established standards, regulations, and norms, thereby instilling confidence in stakeholders [8].

When applied to Information Technology (IT) projects, auditing assumes a crucial role in ensuring the integrity, security, and efficiency of technological processes. In the realm of RPA, auditing assumes even greater significance. RPA involves process automation through software robots, and auditing in this context aims to ensure accuracy, compliance with privacy and security regulations, and optimization of operational efficiency. Consequently, a comprehensive understanding of auditing in the context of RPA projects is vital for addressing specific challenges, ensuring operational integrity, and contributing to project success and evolution [9].

The central research question driving this work is formulated as follows:

- **How can one develop an audit framework to manage Robotic Process Automation (RPA) projects effectively?**

The objective of this study is to devise an audit framework for the effective management of RPA projects, encompassing the entire RPA technology lifecycle and addressing essential criteria to ensure accuracy, regulatory compliance, and operational efficiency optimization.

The structure of this study is as follows: Section 2 identifies and analyzes relevant literature; Section 3 presents the research framework; Section 4 conducts a discussion of results; and finally, Section 5 presents the conclusion. This study concludes with the bibliography.

2. Methodology

2.1. Identification of Relevant Articles

To understand the current state of scientific efforts in the examined field and evaluate the suitability of the research proposal, it is crucial to undertake a literature review. This approach allows us to explore established models and frameworks, identify gaps, and make more focused contributions. The literature review is a comprehensive process involving the exploration and analysis of various scholarly sources, such as scientific

articles, theses, dissertations, and other relevant works. This thorough investigation empowers us to grasp the different approaches taken by respected researchers and the significant findings they have achieved so far.

The review in this chapter relied on carefully selected data sources considered pertinent to the research question. The valuable information presented in this article was extracted from a compilation of contributions by esteemed authors who have explored the subject or its various aspects. The pool of scrutinized articles was obtained from the online database "B-on," chosen for its ability to provide access to the complete content of a wide range of scientific publications in indexed journals, as well as publications in internationally indexed scientific conferences within the ISI WOS and/or Scopus systems. "B-on" stands out as one of the most comprehensive databases, covering thousands of peer-reviewed journals across diverse scientific fields. Researchers can access a majority of well-known international scientific databases through the online scientific library "B-on" of the Portuguese Foundation for Science and Technology. This platform was used to conduct the underlying search process for this work based on the three groups (Group 1, Group 2, and Group 3).

- **Group 1:** “RPA” Or “Robotic Process Automation” Or “Intelligent Process Automation” Or “Tools Process Automation” Or “Artificial Intelligence in Business Process” Or “Machine Learning in Business Process” Or “Cognitive Process Automation” Or “Information Technology” Or “IT”.

- **Group 2:** "Auditing" Or "Audit" Or "Audited".

- **Group 3:** “Implementation” Or “Model” Or “analysis” Or “development” Or “framework” Or “Control Project” Or “Project Management” Or “Control” Or “Project”.

The research tests were conducted using the "B-on" platform, employing the three groups and the OR operator to connect either the Title, Keywords (KWs), or the Abstract (AB) within the specified sets. Table 1 illustrates the count of articles discovered in each research test.

Table 1. Research tests performed through the “B-on”.

	Title	OR	Keywords (KW)	
Set 1	(Group 1 AND Group 2 AND Group 3)	OR	(Group 1 AND Group 2 AND Group 3)	n = 499

Next, throughout the research process, a set of filters were applied, based on the sets of publications obtained, and the results obtained, in terms of number of publications, are summarized in Table 2.

Table 2. Publications obtained through the B-on, after the application of some filters.

	Set 1
Initial result:	499
1 - Restrict to: Peer Reviewed	351
2 -Type of fonts: Academic Journals; Conference Materials; Books; Ebooks	348
3 - From: 2010 to 2024	283
4 - Language: English	206
5 - Restrict to: Full Text	198
Final result:	198

After the applied filters, a reading of the title, the key terms and the resume of each of the articles was carried out to verify which articles were directly related to the research. From the carried-out research, 499 papers were obtained, applied the filters we verified a total of 198 articles and of which only 20 were framed with the theme. Figure 1 represents a flow diagram of the literature search carried out, and respective screening of the methodology used in this research work.

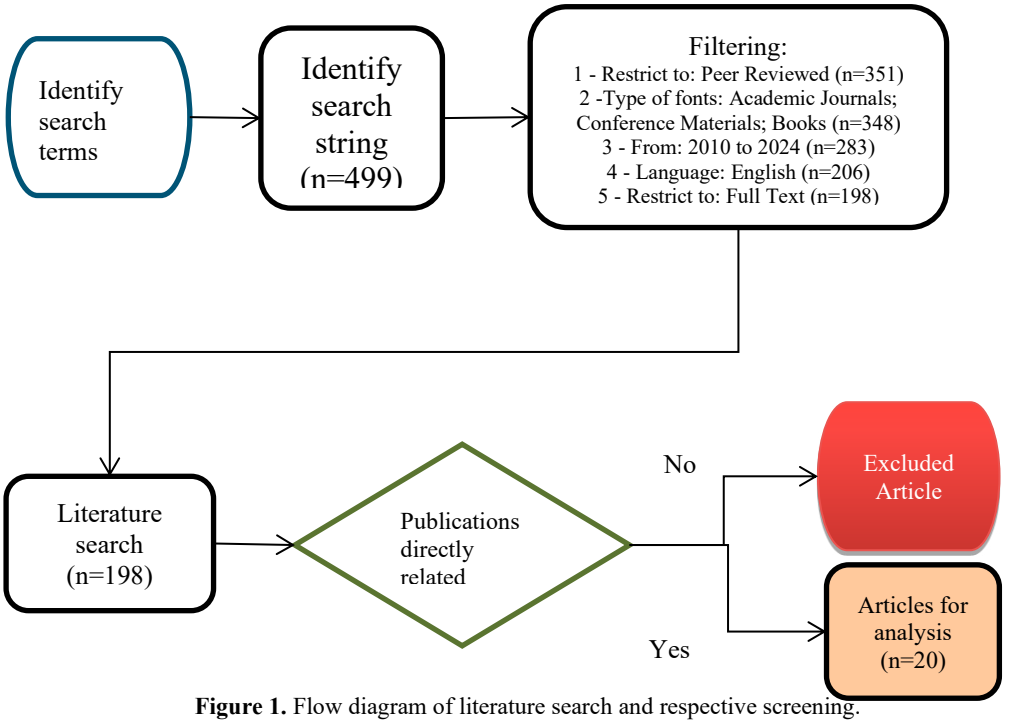

Figure 1. Flow diagram of literature search and respective screening.

To ensure the relevance and quality of the articles included in the review, rigorous selection criteria were applied. Firstly, only peer-reviewed articles were considered, with the aim of maintaining a high standard of credibility and scientific validity. Additionally, the articles were selected based on their direct relevance to the topics of robotic process automation (RPA) and auditing in IT projects. The chosen articles also had to be published between 2010 and 2024, written in English, and available in full text. In the end, 20 articles were deemed suitable for in-depth analysis, reflecting a strict focus on key themes central to the research.

The literature review methodology adopted in this study follows the principles of a Systematic Review, aiming to identify, select, and critically analyses the existing literature on auditing in RPA projects. The systematic review seeks to be replicable and transparent, ensuring a rigorous approach in the selection and analysis of articles. Methodical steps were followed, including the definition of inclusion and exclusion criteria, the application of stringent filters, and the categorization of articles based on relevance and quality. While a scoping review also broadly explores the literature, our study focuses on articles that offer theoretical and practical depth, aiming to construct a robust framework for auditing in RPA projects. Thus, the systematic review was chosen for its suitability for this type of study, which requires a detailed and careful evaluation of the selected articles.

2.2. Articles Synthesis and Analysis

In this section, firstly we present the RPA cycle that we think is of great value for the analysis, after identifying the articles, we present two tables, where the first shows which sector each of the articles addresses, RPA and IT, consequently, some of the phases of the RPA life cycle are also addressed and, finally, what type of contribution the article is. In the second table, after analysis, the main criteria that we believe to be of great importance for an RPA audit were identified and we identified which articles address these criteria.

Foremost among our deliberations shall be the elucidation of the RPA lifecycle stages, as delineated in the esteemed publication [10]. Drawing upon the scholarly work of [10], the RPA lifecycle delineates a coherent progression comprising the following discrete phases:

1. **Analysis:** This initial phase is marked by a comprehensive examination of extant processes, aimed at discerning ripe opportunities for automation.
2. **Requirements Gathering:** Subsequent to the analytical phase, diligent efforts are directed towards meticulous documentation and comprehension of the precise requisites and objectives underpinning the RPA project.
3. **Design / Project Development:** Herein lies the creative genesis, wherein the blueprints for automation workflows are meticulously crafted, and the substantive development of the RPA solution is earnestly pursued.
4. **Testing Phase:** Rigorous scrutiny characterizes this pivotal stage, wherein the developed RPA solution undergoes exhaustive testing to ascertain its fidelity to prescribed functionality and adherence to stipulated requirements.
5. **Deployment & Hypercare:** As the culmination of development approaches, the RPA solution is deployed into the operational milieu, accompanied by a phase of intensive support and remediation, colloquially known as "hypercare," to promptly address emergent issues.
6. **Go-live and Support:** This denouement heralds the official integration of the RPA solution into operational workflows, concomitant with the institution of sustained support mechanisms and ongoing maintenance activities.

Table 3. Comparative table of identified articles.

Article	RPA	IT	RPA lifecycle	Contribution
[11]	x	x		Model
[12]	x	x		Literature review
[13]	x	x		Model
[14]	x			Framework
[15]	x	x		Model
[16]	x	x		Model
[17]	x	x		Literature review
[18]		x		Model
[19]		x		Literature review
[20]	x	x	1. Analysis	Case study
[21]		x		Model
[22]	x			Framework
[23]	x	x	5. Deployment & Hypercare; 6. Go-live and Support	Case study
[24]	x			Literature review
[25]	x	x	1. Analysis	Case study
[26]	x			Literature review
[27]		x		Model
[28]	x			Literature review
[29]		x		Model
[30]	x	x	1. Analysis	Case study
% Area p/ articles	75%	75%	20%	

Analyzing the previous tables, it is possible to verify the following observations:

- 75% of the identified articles address the RPA topic.
- 75% of the articles focus on the IT area.
- 20% of the articles specifically target the RPA lifecycle, covering at least one phase.

- Regarding contribution types:
  - 40% of the articles contribute with a model.
  - 20% present case studies.
  - 30% are literature reviews.
  - 10% propose frameworks.

After the first table, will present another table with the main criteria that were identified after analyzing the articles, which are important to consider for an RPA audit.

Table 4. Identification of criteria and respective articles.

Criteria	RPA Articles	IT Articles
Strategic alignment	[14, 22, 23, 30]	[11, 12, 13, 19, 24, 25]
Technical feasibility	[14, 22, 23, 30]	[12, 13, 16, 19, 25]
Process identification	[14, 23]	[13, 15, 17, 20, 25]
Benefit Estimate	[14]	[11, 12, 18, 25]
Requirements documentation	[14]	[12, 15, 17, 20]
Requirements validity	[14]	[12, 15, 17]
Requirements prioritization	[14, 22, 23, 26, 30]	[12, 15, 17]
Solution architecture	[14, 23]	[11, 12, 17, 19, 21, 25]
Good development practices	[14, 23]	[12, 15, 17]
Security	[14, 23]	[11, 15, 16, 27]
Test planning	[14, 23]	[15, 16, 25]
Integration testing	[14, 23]	[13, 17, 25]
Performance testing	[14, 23]	[11, 16, 25]
Deployment plan	[14, 23, 28]	[11, 12, 18, 25]
Post-deployment support	[14, 23]	[11, 12, 25]
Performance monitoring	[14, 23]	[11, 15, 17, 25]
Smooth transition	[14, 23]	[11, 12, 18, 25, 29]
Continuous quality assurance	[14, 23]	[13, 15, 17, 19]
Continuous improvement	[14, 23]	[11, 12, 25]

Analyzing the previous table, it is possible to see those 19 important criteria to take into consideration in an RPA audit were identified, as well as which articles address each of these criteria.

3. Proposal for an audit framework

In this segment of our scholarly discourse, endeavor to proffer a meticulously crafted audit proposition tailored for projects within the realm of Robotic Process Automation (RPA).

Subsequently, a granular exposition of the identified criteria shall ensue, meticulously tailored to each respective phase.

Then, after analyzing the identified articles, the criteria that are part of this proposed structure for RPA projects will be presented for each of the phases of the RPA life cycle.

Table 5. Audit criteria RPA projects - Analysis.

1. Analysis	
1.	**Strategic alignment:** Check whether the RPA project is aligned with the organization's strategic objectives.
2.	**Technical feasibility:** Assess the technical feasibility of the project in relation to existing systems and IT infrastructure.
3.	**Process identification:** Ensure that all candidate processes for automation have been identified and prioritized appropriately.
4.	**Benefit Estimate:** Evaluate benefit estimates to ensure they are realistic and measurable.

Table 6. Audit criteria RPA projects - Requirements Gathering.

2. Requirements Gathering	
5.	**Requirements documentation:** Ensure that all functional and non-functional requirements have been documented clearly and comprehensively.
6.	**Requirements validity:** Ensure that the captured requirements meet the needs of the business and end users.
7.	**Requirements prioritization:** Ensure that requirements have been prioritized according to their importance and impact on project objectives.

Table 7. Audit criteria RPA projects - Design / Project Development.

3. Design / Project Development	
8.	**Solution architecture:** Evaluate the proposed solution in terms of its technical architecture and its suitability for requirements.
9.	**Good development practices:** Check that best software development and automation practices are being followed.
10.	**Security:** Evaluate security measures implemented to protect data and automated processes.

Table 8. Audit criteria RPA projects - Testing Phase.

4. Testing Phase	
11.	**Test planning:** Ensure that a comprehensive test plan has been created that covers all aspects of the project.
12.	**Integration testing:** Ensure integrated systems are being tested for interoperability and functionality.
13.	**Performance testing:** Evaluate automation performance under simulated realistic usage conditions.

Table 9. Audit criteria RPA projects - Deployment & Hypercare.

5. Deployment & Hypercare
14. **Deployment plan:** Check whether there is a detailed deployment plan that minimizes the impact on business processes.
15. **Post-deployment support:** Evaluate the support and troubleshooting mechanisms made available during the initial phase of operation.
16. **Performance monitoring:** Ensure automated systems are being monitored to identify and correct any issues.

Table 10. Audit criteria RPA projects - Go-live and Support.

6. Go-live and Support
17. **Smooth transition:** Verify that the transition to normal operation is carried out smoothly and without significant interruptions.
18. **Continuous quality assurance:** Ensure quality assurance processes are in place to keep automation running.
19. **Continuous improvement:** Promote a culture of continuous improvement by identifying opportunities to optimize and improve automated processes over time.

4. Results and Discussion

The proposed structure for auditing RPA projects is based on the analysis of criteria identified for each phase of the RPA life cycle. This framework aims to provide accurate guidance for evaluating and ensuring the effectiveness, compliance, and operational efficiency of RPA projects. The proposed framework for auditing RPA projects is based on the analysis of the criteria identified for each phase of the RPA life cycle. This framework aims to provide precise guidance to evaluate and ensure the effectiveness, compliance and operational efficiency of RPA projects.

When considering the Analysis phase, it is essential to assess the strategic alignment of the project with organizational objectives. Furthermore, technical feasibility and adequate identification of candidate processes for automation are crucial to ensuring project success from the beginning.

During the Requirements Development phase, accurate and comprehensive documentation of requirements, along with their validation and prioritization, are essential to effectively direct project development.

At the Project Development stage, the solution architecture and the implementation of solid and secure development practices are key aspects that must be evaluated to ensure the robustness and security of the implementation.

During the Testing phase, it is crucial to carry out comprehensive planning, including integration and performance testing, to ensure that the solution meets established functional and performance requirements.

The Deployment and Post-Deployment Support phase requires a detailed deployment plan and ongoing support to ensure a smooth transition to normal operation and rapid resolution of issues that may arise.

Benefits of the Proposed Model:

- **Strategic Alignment:** Ensures that RPA projects are aligned with organizational objectives, maximizing return on investment and driving innovation.
- **Technical Feasibility:** Ensures that RPA projects are achievable within the available resources and technological infrastructure, minimizing implementation risks.
- **Operational Efficiency:** Through accurate documentation of requirements and good development practices, the proposed model aims to optimize operational processes through automation.

- **Security and Robustness:** By evaluating the solution architecture and implementing secure development practices, the model seeks to ensure the integrity and security of automated systems.

- **Rapid Problem Resolution:** Comprehensive test planning and post-deployment support ensure rapid identification and resolution of problems, minimizing impact on operations.

- **Continuous Improvement:** By promoting a structured and iterative approach, the model facilitates the identification of opportunities for continuous improvement in automated processes.

The criteria identified for the auditing framework of RPA projects play a crucial role in ensuring the effectiveness and efficiency of these initiatives. The inclusion of criteria such as strategic alignment, technical feasibility, and comprehensive documentation of requirements ensures that the project not only meets organisational expectations but also operates effectively in a complex technological environment. These criteria contribute to a systematic approach in the execution of RPA projects, enabling organisations to mitigate risks and achieve desirable outcomes. Furthermore, by continuously assessing the development and implementation processes, organisations can make timely adjustments, thereby enhancing the agility and resilience of their operations.

The proposed auditing framework offers significant practical implications for the implementation of RPA projects in real-world scenarios. In dynamic business environments, the need to ensure compliance and operational efficiency is critical. The framework guides project teams in identifying critical issues at each stage of the RPA lifecycle, enabling corrective actions to be taken before problems escalate. This not only enhances the likelihood of project success but also fosters trust among stakeholders, as a well-founded audit ensures that automation processes are managed responsibly and aligned with the organization's strategic goals.

While the proposed auditing framework provides a comprehensive model for assessing RPA projects, certain limitations must be acknowledged. In particular, the framework may not account for the specificities of different sectors or organizations, as needs and challenges can vary significantly. Furthermore, the rapid evolution of automation technology may render some criteria obsolete. Therefore, future research should explore how to adapt the framework for various contexts and how to integrate it with emerging technologies, such as artificial intelligence and machine learning, to further strengthen the governance of RPA projects.

It is essential to emphasize that the proposed auditing framework distinguishes itself from other existing frameworks through its holistic and specific approach to the RPA lifecycle. While other approaches may focus solely on financial or compliance audits, this framework integrates technical and operational aspects, providing a comprehensive view that spans from the initial analysis to the ongoing maintenance of the system. This integrated approach enables organizations not only to meet regulatory requirements but also to continuously improve their automation processes, thereby ensuring better operational efficiency and strategic alignment.

5. Conclusions

Developing an audit framework is crucial to effectively managing Robotic Process Automation (RPA) projects. In response to the central research question, we found that developing an effective audit framework to manage Robotic Process Automation (RPA) projects) involves carefully analyzing the different phases of the RPA lifecycle and identifying relevant criteria for each of these phases. This framework must cover everything from initial project analysis to implementation and ongoing support, ensuring compliance, effectiveness and operational efficiency throughout the entire RPA implementation process. The proposed framework offers a solid structure to evaluate and ensure the effectiveness, compliance and operational efficiency of RPA projects in all their phases. By aligning RPA projects with the organization's strategic objectives and ensuring thorough requirements analysis, secure development practices, and comprehensive testing, organizations can maximize the benefits of process automation.

The development of this framework contributes significantly to the field of process automation by providing a structured and comprehensive approach to ensuring the success and sustainability of RPA projects. However, it is important to recognize that there are limitations to be considered, such as the need to adapt the framework to different organizational and technological contexts. Additionally, new challenges may arise as RPA technology

continues to evolve. Future research could focus on exploring these limitations and further improving the proposed audit framework, ensuring its continued relevance and effectiveness in the field of process automation.

Acknowledgements

This work has been supported by FCT – Fundação para a Ciência e Tecnologia within the R&D Units Project Scope: UIDB/00319/2020, and EXPL/EME-SIS/1224/2021.

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