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The Future of Business Process Management: Robotic Process Automation

Masa Hadapan Pengurusan Proses Bisnes: Automasi Proses Robotik

Han Liao[1], Dalbir Singh[1], Jiqiao Ma[2], Xuting Hu[3]

[1]Faculty of Information Science and Technology, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor

[2]Anhui Business College, Anhui, China

[3]Anhui Technical College of Mechanical and Electrical Engineering, Anhui, China

Corresponding author: lh1362162033@gmail.com

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ABSTRACT

With increasing globalisation, organisations are confronted with intensifying market competition. Consequently, organisations continually implement novel technologies to address the challenges posed by market competition. In business process management (BPM), robotic process automation (RPA) is regarded as a tool or methodology that can automate specific tasks or activities within a business process. RPA is widely employed as a standard solution in various industries to assist enterprises in automating their processes, enhancing their operational efficiency, and reducing operational costs. Nevertheless, it is prudent to consider which processes can be automated by applying RPA and the most appropriate deployment methods for RPA. A literature review reveals that process identification is the optimal method for identifying processes suitable for automation, and three approaches - process mining, process quality-based and interview-based can be considered. There are three principal models for deploying RPA: local, cloud and hybrid. The RPA managers in an organisation are thus able to select the most appropriate deployment option based on the organisation's policies, requirements, and cost considerations. Furthermore, this study identifies the critical success factors (CSFs) and analyses their relationships using a 'why-why' diagram. This study could assist organisations in a more comprehensive understanding of RPA technology, which enables more effective utilisation of RPA for enhanced process management.

Keywords**:** BPM, RPA, Process Identification, Deployment Option, CSFs.

ABSTRAK

Dengan globalisasi yang semakin meningkat, organisasi berhadapan dengan persaingan pasaran yang semakin sengit. Akibatnya, organisasi sentiasa melaksanakan teknologi baru untuk menangani cabaran yang dibangkitkan akibat persaingan dalam pasaran. Dalam pengurusan proses perniagaan (BPM), automasi proses robotik (RPA) dianggap sebagai alat atau metodologi yang boleh digunakan untuk mengautomasikan tugas atau aktiviti tertentu

dalam proses perniagaan. RPA digunakan secara meluas sebagai penyelesaian standard dalam pelbagai industri untuk membantu perusahaan dalam mengautomasikan proses, meningkatkan kecekapan operasi, dan mengurangkan kos operasi. Namun begitu, adalah bijak untuk mempertimbangkan proses yang boleh diautomasikan dengan menggunakan RPA dan kaedah penggunaan yang paling sesuai untuk RPA. Kajian literatur mendedahkan bahawa pengenalpastian proses ialah kaedah optimum untuk mengenal pasti proses yang sesuai untuk automasi, dan tiga pendekatan - perlombongan proses, berasaskan kualiti proses dan berasaskan temu bual boleh boleh dipertimbangkan. Terdapat tiga model utama untuk menggunakan RPA: tempatan, awan dan hibrid. Oleh itu, pengurus RPA dalam organisasi boleh memilih pilihan penempatan yang paling sesuai berdasarkan dasar, keperluan dan pertimbangan kos organisasi. Tambahan pula, kajian ini mengenal pasti faktor kejayaan kritikal (CSFs) dan menganalisis hubungan mereka menggunakan gambar rajah 'why-why'. Kajian ini boleh membantu organisasi dalam pemahaman yang lebih komprehensif tentang teknologi RPA, yang membolehkan penggunaan RPA yang lebih berkesan untuk pengurusan proses yang dipertingkatkan.

Kata kunci: Pengurusan Proses Perniagaan, Automasi Proses Robotik, Pengenalpastian Proses, Pilihan Pelaksanaan, Faktor Kejayaan Kritikal

INTRODUCTION

RPA is a technology that performs business processes by simulating human behaviour in interaction with digital systems and software. RPA is a virtual labour technology that automates repetitive manual work (Yadav & Panda 2022). In recent years, RPA has emerged as a significant area of research in BPM. BPM is a management methodology and technology designed to optimise and improve organisational flexibility and adaptability, increase efficiency, reduce costs, and improve business processes. BPM helps organisations identify, design and optimise their business processes, whereas RPA automates repetitive, rule-based tasks (Ketkar & Gawade 2021). RPA is a supplement to BPM, as it provides the means for BPM to perform the tasks within a process, thereby accelerating process improvement and increasing productivity.

RPA is a new technology that can quickly meet the needs of rapid deployment, increased efficiency, and low investment (Asatiani, Copeland & Penttinen 2023), but there are still some problems. Determining which processes can be automated (Yadav & Panda 2022). Users must answer two questions: "Which tasks should be automated and which should be performed by humans?" (Sharma & Guleria 2021). The second question is which deployment mode an enterprise should choose when deploying RPA, locally or in the cloud (Asatiani, Copeland & Penttinen 2023).

First, why is it essential to determine which processes need to be automated? The cost to an enterprise or organisation of RPA technology can be very high. Therefore, a new approach is needed to understand which processes need to be automated (Yadav & Panda 2022). Second, how should RPA be deployed? The robot in RPA is a type of software. Therefore, enterprises can refer to the deployment mode of some software in the company when choosing RPA deployment mode. There are usually three standard deployment modes: local, cloud, and hybrid. Therefore, the RPA manager must choose the appropriate mode to deploy RPA according to the company's situation (Asatiani, Copeland & Penttinen 2023).

For the first question, the easiest and most convenient way to find out which processes can be automated is to consult experts in RPA and developers or utilise a questionnaire. Alternatively, process mining can be used to determine which processes need to be automated, as process mining helps RPA managers to analyse and visualise the deviations and maturity of processes to select those processes with a high level of maturity and standardisation for automation. Regarding how RPA should be deployed, RPA managers can choose to deploy locally (On-Premises type), which installs and runs RPA software directly on the organisation's internal computers and servers, and it is a more expensive investment. Also, cloud-based RPA (SaaS) can be chosen, which deploys bots in a cloud environment by logging into an online cloud platform and automates web browser tasks to improve process efficiency. In contrast, cloud-based RPA is less costly to deploy. Of course, combining the two approaches and using a hybrid deployment method in specific cases is possible.

The principal objectives of this paper are as follows:

1. Process identification, process mining, process quality-based, and interview-based methods can be used to identify processes that can be automated during business process management.
2. The different deployment modes of RPA were then thoroughly summarised: local, cloud, and hybrid. Furthermore, the paper meticulously analyses the different application scenarios of the three modes.
3. To address the two issues of process automation identification and RPA deployment method selection, the respective CSFs are identified, and the relationship between different CSFs is analysed using Why-Why diagrams.

The rest of the paper is organised as follows: Section II focuses on the methodology, criteria, process and final results of the literature screening. Section III reviews the screened papers and summarises each paper's research content and methodology. Section IV mainly shows the research contribution of this paper. Next, in Section V, the two questions raised in the papers are analysed regarding CSFs, and the relationship between CSFs is illustrated using Why-Why diagrams. Finally, Section VI summarises the research in this paper, points out the problems and limitations of the research and provides directions for future research.

METHOD

This section will discuss the methods of literature review involved in this study. Systematic literature review (SLR) is one of the essential methods for conducting scientific research. It is primarily used to identify, evaluate, and synthesise all available literature on a particular research question or topic (Syed et al. 2020). This study uses the SLR approach to focus on the problems in applying RPA.

The review is centred on a selection of papers and studies about the utilisation of RPA technology between the years 2018 and 2023. Science Direct, IEEE Xplore, Web of Science, and Google Scholar are the academic databases utilised for this purpose. The search queries have been formulated focusing on the most recent advances, and specific keyword patterns related to RPA have been employed. Furthermore, to refine the search in Google Scholar, Boolean operators such as ‘OR’ and ‘AND’ were employed to more precisely define the keyword parameters, for example, ‘RPA’ AND ‘BPM’.

Once the academic databases were identified, the inclusion and exclusion criteria for the papers were developed, and the inclusion criteria were as follows: (1) papers involving the above

keywords. (2) Papers and new studies are written in English, peer-reviewed, and published in academic journals, conferences, or reports between 2018 and 2023. (3) Papers on applying RPA technology in the field of BPM. The exclusion criteria were mainly papers that did not use English, contained no keywords, and had low or no relevance to the research objectives. The paper selection process followed the standard steps of SLR, which consisted of searching for relevant studies, assessing their quality and relevance, extracting relevant information, and synthesising the results. Figure 1 is a flowchart showing the SLR process and the inclusion/exclusion of papers.

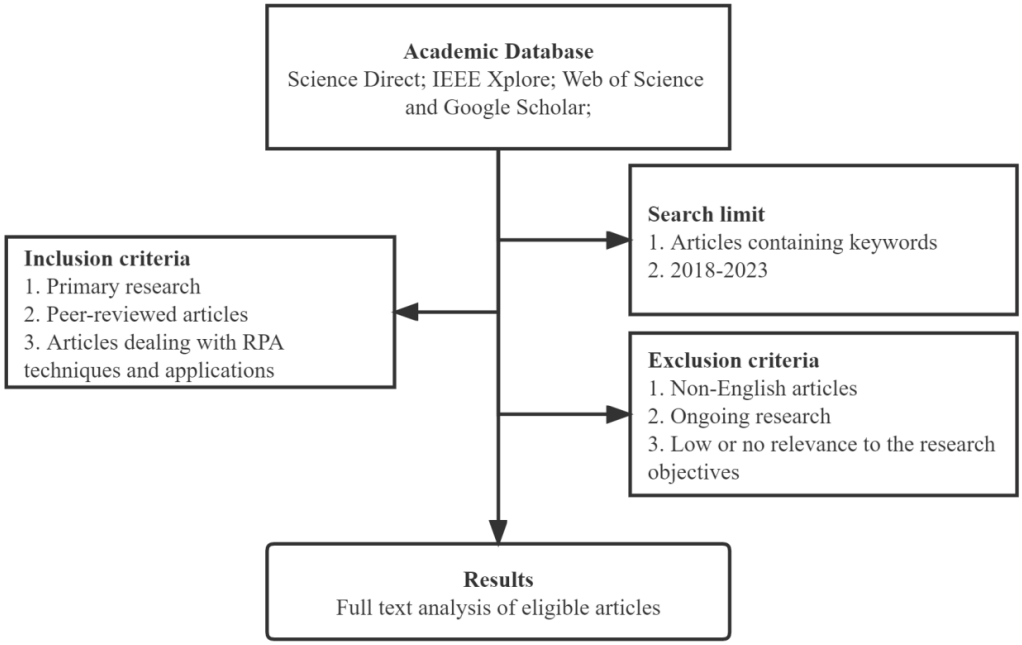

FIGURE 1. Flowchart Of SLR Process and Inclusion/Exclusion Criteria

Following the initial screening process, 22 relevant academic papers were ultimately selected. This paper will review and analyse the selected papers in the subsequent section, comparing their research content, methodology, and respective limitations. After that, the conclusions obtained will provide references for subsequent research.

LITERATURE REVIEW

RPA has been widely used in the BPM domain in the past six years because it can automate procedures with fixed rules or processes while ensuring accurate results. RPA is better at solving standardised, high-volume, and repetitive tasks. BPM aims to help companies better control, model and automate their business processes and optimise them to achieve their organisational goals (Yadav & Panda 2022).

On the one hand, RPA plays a vital role across industries, helping organisations reduce costs, increase efficiency, and improve the competitiveness of their business. In financial services, RPA automates tasks such as data entry, account management and risk assessment, improving operational efficiency and customer experience. (Wang et al. 2022) apply RPA technology to university financial systems to solve the problem of expense reimbursement. The operational mechanism of RPA technology is also described, as well as the problems and future challenges of RPA technology. (Huang & Vasarhelyi 2019) applied RPA techniques to a specific audit assignment process, proposed a particular application framework, and validated its

effectiveness through specific pilot projects. (Flechsig, Anslinger & Lasch 2022) provide insights into the potential, barriers, appropriate process management and the best practices and components of RPA implementation. (Kokina & Blanchette 2019) conducted semi-structured interviews with adopters of RPA from organisations of different industries and sizes to study and analyse the applicability of RPA to accounting and finance business, the problems encountered in implementing RPA, and the impact of RPA on the performance of future innovation in the accounting industry. To reduce the cost of using the RPA, (Séguin et al. 2021) studied the minimum number of robots needed to complete multiple financial transactions simultaneously based on the trading environment of financial institutions and introduced four different heuristic methods to calculate the upper limit of the total number of robots needed. (do Rosário Cabrita, Pargana & Costa 2021) conducted a literature review of this research topic and proposed a framework for assessing critical factors in successfully implementing RPA technology.

RPA automates repetitive tasks on production lines in the manufacturing industry, reducing human error and improving line stability and productivity. (Ribeiro et al. 2021) describe research on AI-related RPA tools that can help improve organisational processes related to Industry 4.0. (George, Ali & Papakostas 2021) propose a framework for applying RPA technology to the design workflow to improve product design efficiency.

In the retail services industry, RPA can be used for inventory management, order processing, and customer service. (Sharma & Guleria 2021) propose a business process framework for an inventory control system using RPA based on a study and analysis of various existing business process models for online travel agencies (OTAs). (Kobayashi et al. 2019) studied the application of RPA in consumer services for older people, verified the feasibility of RPA in consumer services for older adults by citing several examples of the use of communication robots, and used this analysis to clarify the application model of RPA in consumer services. (Mehta & Chaher 2022) analysed the problems in digital marketing, proposed applying RPA technology to the digital marketing field to improve work efficiency and ensure work quality, and finally implemented specific programs using the RPA tool UiPath.

In addition to this, the RPA also plays a vital role in other areas. (Asquith & Horsman 2019) discussed the application of RPA in digital forensics (DF), objectively assessed its value in the DF process, and presented two case studies demonstrating the functionality of RPA and its integration with mainstream forensics tools. (Gradim & Teixeira 2022) eliminate the problem of talent waste by reviewing how an enterprise implements RPA, arguing that processes that will not add value and waste talent can be automated using RPA. (Mora & Sánchez 2020) combined with different research theories and findings in the past, the subject of BPM based on RPA is proposed to solve the pressure of digital transformation faced by higher education institutions.

On the other hand, the research and development of RPA technology and related tools is also a research area of great interest. As RPA technology matures and gains popularity, researchers and developers are committed to improving existing RPA tools to address changing business needs and technical challenges. (Yadav & Panda 2022) understand which processes might need to be automated in an RPA project, they proposed three different approaches - robotic process mining, process quantifiability and survey-based - to address which processes could be automated in business process management using RPA and how to prioritise processes for RPA deployment. (Asatiani, Copeland & Penttinen 2023) identify three critical issues for RPA managers deploying RPA through a study of seven organisations deploying RPA and suggest

solutions and recommendations accordingly. (Issac, Muni & Desai 2018) studied and analysed the advantages, disadvantages, and best-use places of mainstream RPA development tools in the current market and pointed out that UiPath is the best of all RPA tools in the current market on the premise of meeting the needs of different business management processes. To solve the incompatibility problem between the system and API in automatic software data acquisition, (Ketkar & Gawade 2021) proposed using RPA technology for data mining and acquisition. (Yatskiv et al. 2019) studied the application of RPA technology to software test automation, compared and analysed two main software test methods based on programming and RPA, and proposed a new test method based on RPA. (Ma et al. 2019) studied the development process of RPA and proposed a method to judge whether it can produce benefits and help managers quickly find what they need. Because of the inadequacies and deficiencies in the theoretical foundation of RPA, (Syed et al. 2020) conducted a structured literature review to identify some of the current topics related to RPA and challenges for future research.

TABLE 1. Review Relevancy Between Similar Studies in RPA

References	Purpose	Methodology	Contribution	Limitation
(Yadav & Panda 2022)	Find out what processes need to be automated in an RPA project	The paper presents a research analysis of the last five years of research papers on RPA and then proposes three different approaches to finding automated processes based on the results of the analysis	(i) Robotic Process Mining (RPM) (ii)Process Quality (iii)Interviews, surveys & discussion	Three strategies were not tested and validated.
(Asatiani, Copeland & Penttinen 2023)	Although RPA is deployed on a large scale in different industries, the choice of its operating model is tricky.	Studied seven organisations that have deployed RPA, identified three critical issues for RPA managers when operating RPA, and suggested solutions and recommendations accordingly	The study mainly helps RPA managers address how to choose the RPA model that is in the company's interest.	Changes in the internal and external environments affect the choice of the RPA model, and the solution lacks adaptability.
(Gradim & Teixeira 2022)	Solve the problems of not adding value and wasting talent due to repetitive tasks.	Practical examples to demonstrate that RPA can solve the problem of wasted talent	With RPA, processes that do not generate value and waste talent can be automated.	Lack of thinking about which processes can be automated in business process management and the effectiveness of the corresponding tools.
(Flechsig, Anslinger & Lasch 2022)	RPA is too little used in purchasing and supply management (PSM) to explore the application of RPA in PSM	A qualitative approach is used to review, research, and analyse multiple cases, to make initial recommendations and observations, and to further refine recommendations supported by more evidence.	Findings show that adopting RPA depends on an organisation's digital procurement readiness and maturity.	The limitations of the number of study participants, the scope of the study, and the limitation of focusing only on early RPAs and non-intelligent RPAs.
(Ma et al. 2019)	Research the development and process design of RPA	RPA development using an agile development approach	Applying agile development methods to the RPA development and design process	Lack of validation of the findings and limitations of the research methodology.

A review of previous research papers reveals that the current main research directions in the field of RPA focus on the utilisation of RPA tools, the application of RPA technology in different industries, and the challenges encountered while applying RPA technology. Undoubtedly, the use of RPA can achieve the automation of business processes, significantly enhance the efficiency of work, improve the quality of work, and liberate the labour force. Nevertheless, it is crucial to direct greater attention to the challenges inherent in implementing RPA. These include identifying the specific processes within a business that require automation and determining which processes should be automated to enhance the business's and the organisation's profitability. Additionally, it is essential to consider the optimal deployment strategy for organisations that have adopted RPA. Table 1 shows how different papers compare these issues regarding purpose, methodology, contribution and limitation.

RESEARCH CONTRIBUTION

In the previous section, research papers on RPA in recent years were reviewed, and the problems of applying RPA and the contributions of these studies were discussed. In this section, the contributions of the research papers will be further analysed and discussed before identifying the critical success factors and how they relate to each other.

Previous studies have summarised in their research three methods that can be used to identify automated processes (Yadav & Panda 2022). The first one is based on the RPM approach, where the process mining approach is based on the analysis of the UI. Firstly, the UI usage logs are collected to obtain what happened in the business process management process, when it happened and the case ID of the event or activity that occurred. Finally, the UI usage logs are analysed to check whether they match the correct process and whether there are precise tasks and specific patterns or regularities. (Yadav & Panda 2022) believe that RPM is the best way to identify processes that can help organisations maximise the benefits of RPA and, more importantly, help them better understand the maturity of different processes by analysing and visualising them. The second method to identify automated processes is to automate many highly automated, standardised processes with high-quality input data and high maturity. A final method is to summarise which processes can be automated by conducting interviews, surveys, and discussions with experts in RPA, developers of RPA software and workers before implementing RPA.

According to Aleksandre Asatiani et al., there are three main options for organisations to deploy RPA: administrators can choose to deploy RPA directly locally, or they can choose to deploy RPA quickly in the cloud, or they can combine the two in a hybrid deployment. Organisations found that most enterprises use cloud-based RPA deployments because of the advantages of rapid RPA deployment and low cost. In contrast, local deployments, where the RPA software is installed and run directly on the organisation's in-house computers and servers, are a more expensive investment and can impose a significant cost burden on the organisation. In addition, before choosing to deploy an RPA solution, the RPA manager must first understand whether the organisation has any rules or policies regarding IT deployment. For mission-critical systems that will continue to operate even in the event of a shutdown, the organisation will have policies that require these mission-critical systems to be deployed in-house, so a local RPA deployment solution is required. As mentioned earlier, the organisation needs to have direct control over all mission-critical systems and be able to keep them up and running in the event of failure. However, for non-critical tasks, there is an option to deploy RPA in the cloud, so in this case, organisations can use a hybrid deployment solution. Finally, as a qualified RPA manager, one needs to be able to determine in advance whether it is necessary to rapidly

increase or decrease the number of robots during the execution of a task. In this case, there is an option to enter a minute-based contract (paying for one bot for every minute used) when adopting a cloud-deployed RPA model. Both the RaaS and SaaS cloud deployment models allow for the rapid deployment of additional robots. At the same time, minute-based contracts help companies address the extra costs associated with idle robots.

IDENTIFY CRITICAL SUCCESS FACTORS IN RPA FOR PROCESS AUTOMATION AND DEPLOYMENT APPROACHES

CSF is the critical area that organisations, projects, and technologies need to get right to be successful. It is designed to identify the critical business activities that make an organisation successful. CSF has always been a hot research topic, but there is still a lack of research on CSFs in RPA and even less research on the specific operational processes of RPA (Plattfaut et al. 2022). Therefore, this study focuses on the analysis and determination of CSFs for the two questions posed above, which are how to identify processes that can be automated and select the deployment method for RPA.

Previous studies also point out that to better automate processes, the first thing to do is process identification and that visualisation of processes provides a better understanding of process maturity, which can be used to identify processes that can be automated and thus further utilise RPA technology (Yadav & Panda 2022). They argue that process visualisation is one of the critical success factors in determining which processes can be automated and that process visualisation can be further enhanced thanks to the development of disciplines such as artificial intelligence techniques, machine learning and deep learning.

In addition, previous studies also argue that the standardisation of processes is a critical factor in whether the identification process can be automated (Gradim & Teixeira 2022). A standardised process should be based on simple rules, reducing the influence of external factors. The standardised process should also have characteristics such as high maturity stability and predictability, in which case, when a process contains a large amount of data, it can reduce the error rate, ensure the quality of the process, and improve efficiency.

As RPA technology becomes increasingly widely used across industries, RPA managers are often faced with how to deploy RPA, which is essentially a piece of software, so organisations can refer to other software deployments when deploying RPA. In terms of how to successfully choose the suitable RPA deployment method, (Asatiani, Copeland & Penttinen 2023) argue that before an organisation deploys RPA, it has to confirm its own IT deployment policies, which means that if the organisation has policies such as critical systems that need to be internal to the organisation or privacy and security, local deployment of RPA is the best way for the organisation.

Secondly, cost is also critical in determining the successful selection of the right approach when choosing an RPA deployment method. A study by Aleksandre Asatiani et al. clearly states that the number of robots and the ability to scale quickly can significantly impact the cost to the organisation. In their view, the control method determines the number of robots deployed. In comparison, direct control of robots dramatically increases the speed of control and avoids the problem of redundancy and waste associated with idle robots. On the other hand, the organisation's infrastructure and support staff can also profoundly impact its scalability (Asatiani, Copeland & Penttinen 2023).

As demonstrated in Figure 2, there are two main CSFs for identifying automatable processes: process virtualisation and standardisation. Artificial intelligence techniques, such as machine learning and deep learning, play a significant role in enabling virtualised processes. Processes with simple rules, high maturity, and stable and predictable characteristics can significantly improve the standardisation of process management.

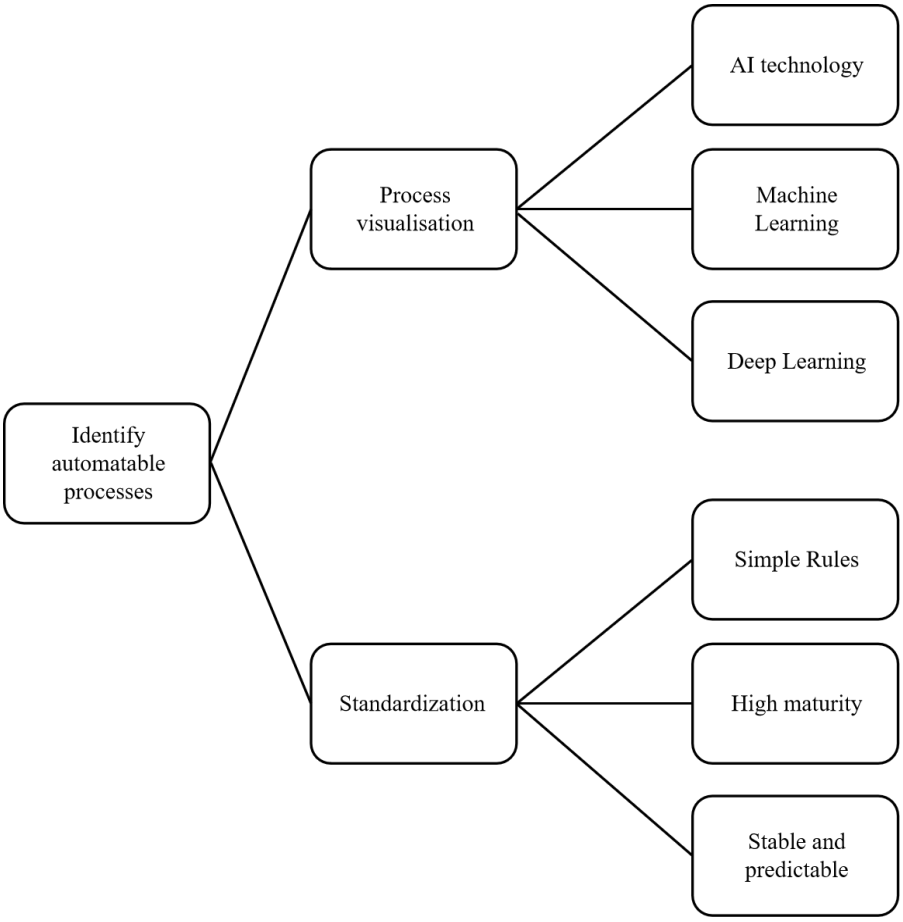

FIGURE 2. The List of Critical Success Factors That Identify Automatable Processes

Figure 3 shows that the IT deployment policy and the cost of the enterprise or organisation are the two essential CSFs that affect the choice of RPA deployment method. The organisation can specify the deployment policy according to the location of the critical systems and the need for privacy and security. The number of robots deployed and the ability to scale quickly affect RPA deployment costs, where controlling the robots, constructing infrastructure, and supporting employees are important CSFs.

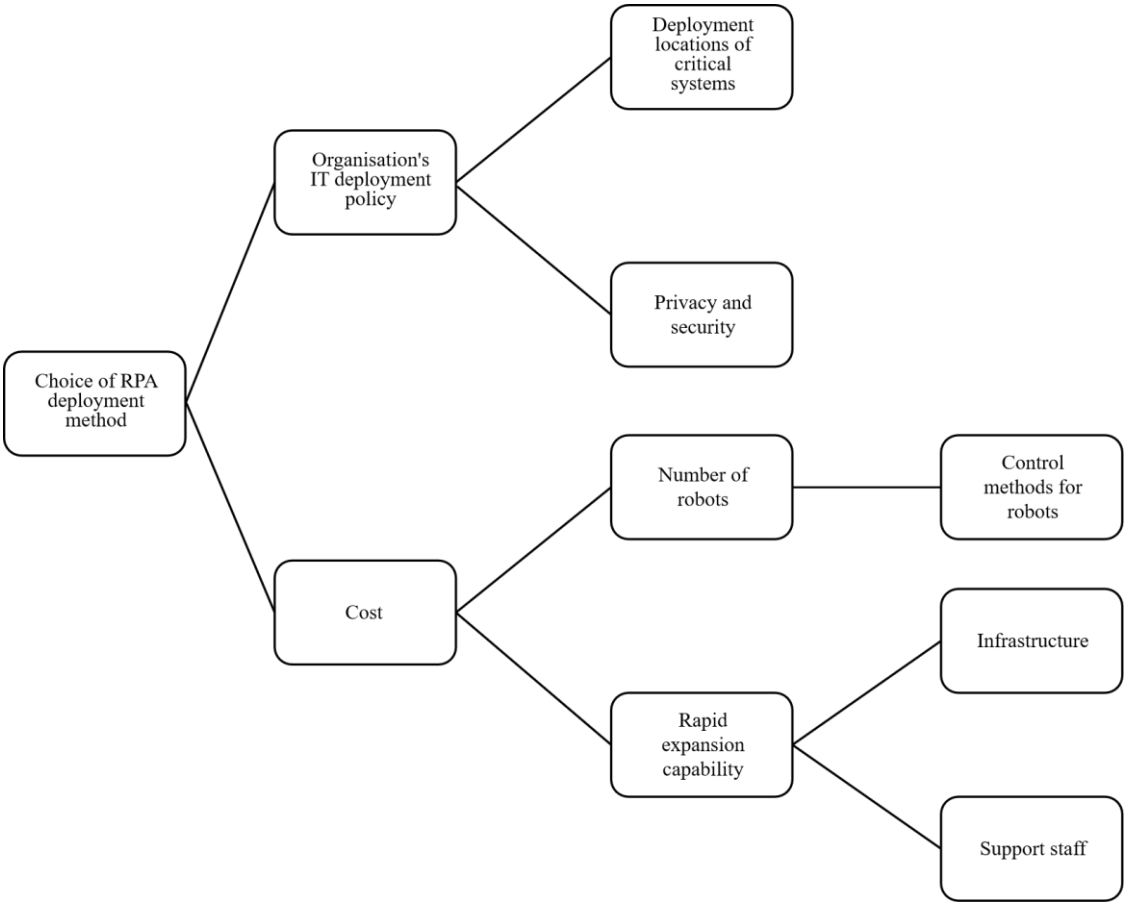

FIGURE 3. The List of Critical Success Factors in That Choice of RPA Deployment Method

CONCLUSION

This study examines the problems or difficulties in applying RPA technology in the context of its widespread use. The literature review focuses on the two main issues organisations face when using RPA: identifying which processes need to be automated with RPA technology, how to choose to deploy RPA and suggesting solutions and recommendations. In addition, critical success factors for these two issues and a Why-Why diagram showing the relationship between these CSFs were identified. This research will help companies or organisations better understand RPA technology and utilise RPA for better business process management. Clarifying the CSFs and their relationship will also help further advance the RPA technology.

Although this study has contributed to issues such as RPA deployment, there are limitations in the study itself. Firstly, in clarifying the CSFs for these issues and the relationships between them, this study does not analyse in depth what impact these CSFs will have on the future development of RPA technology. Secondly, the scope of this study for RPA technology is still relatively narrow, focusing mainly on the key issues and deployment problems in RPA applications. Further research could investigate additional challenges associated with the implementation of RPA. For instance, examining the methodologies employed in developing RPA software would be beneficial. Additionally, the characteristics of various RPA techniques could be delineated, along with their respective advantages and disadvantages. Ultimately, a comprehensive understanding of RPA technology through in-depth research will facilitate the optimal utilisation of RPA, resulting in enhanced returns on investment for enterprises.

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