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Robotic Process Automation and Organizational Efficiency: The Mediating Role of Process Innovation

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ABSTRACT:

The technology of automating repetitive, rule-based, and structured business processes in organizations is gaining attention and is called Robotic Process Automation (RPA). Many organizations have embraced RPA to boost operational efficiency, shorten processing times, cut down on errors, lower operational expenses, and enhance the utilization of human and technological resources. But, the benefits of RPA on efficiency may not come just from automating the individual tasks. The adoption of RPA could also prompt organizations to reflect on current workflows, weed out redundant processes, streamline bottlenecks, account for uniformity, and rethink business processes. These changes are process innovations and could be an important pathway for organizations to gain efficiency from RPA. The impact of RPA on organizational efficiency and how it is mediated by process innovation were investigated in this study. Objective organizational process data was gathered before and after RPA implementation and a quasi-experimental case study design was used. Process completion time, transaction throughput, processing error, manual intervention, operational cost, and resource utilization were used to measure organizational efficiency. Process innovation was analyzed by process-mining analysis of organizational event logs with a focus on workflow sequence changes, manual activities, process bottlenecks, task duplication, process variation, and process integration. The pre and post performance measures were statistically compared and bootstrapping mediation analyses were performed to assess the direct and indirect effects of RPA. The study offered an empirical evidence to understand, whether RPA had helped organization to perform better by means of process innovation or direct automation. The research evidenced the following contributions to the literature on digital transformation, business process management, process mining, and organizational innovation: First, the research was based on the mechanism by which computer-based automation can lead to measurable organizational process performance improvement.

Keywords: Robotic Process Automation, organizational efficiency, process innovation, business process automation, process mining, digital transformation, operational performance

INTRODUCTION:

In recent years, digital technologies have gained traction across the board to boost operational efficiency, enhance productivity, cut costs, and adapt to evolving competitive landscapes. Traditional organizational processes have relied on repetitive manual tasks like data entry, document validation, information sharing, transaction processing, data reconciliation, and report generation. While these activities are still vital for many organizations, they can lead to longer processing times, higher error rates, more labour needs and inefficient use of organizational resources if they are done by hand. However, with the development of automation technologies in the growth, the new opportunities have emerged for the organizations to make changes in the traditional business processes and enhance the efficiency of the organization.

One such vital technology that has been playing a key role in this transition is Robotic Process Automation (RPA). RPA is defined as the automation of structured, repetitive and rule-based tasks, traditionally carried out by humans. Software robots can communicate with existing computer programs, move information and data between systems, extract data, validate records, process transactions and carry out other repetitive tasks. Conventional information-system development is different, and RPA often doesn't require organizations to abandon their existing information-systems infrastructures, as van der Aalst et al., (2018) explained by describing it as a technological way to automate routine activities. The researchers Aguirre and Rodriguez (2017) also showed that RPA can be applied to automate processes in the business that include repetitive digital activities.

There has been a correlation between RPA adoption and more general industry 4.0 and digital transformation trends. AI, automation, data analytics, cloud computing and other digital technologies have been increasingly paired together to enhance operational capabilities, with a growing number of organizations doing so today. One of the main draws of RPA has been that it can be used to automate tasks in existing computer systems without necessarily having to change the entire technolgy solution for the organization. Siderska (2020) also stated that RPA is an important factor in digital transformation due to its ability to add value to productivity enhancement and cost reduction, standardization of processes and improvement in service quality. Ribeiro et al., (2021) also pointed at RPA as an important part of Industry 4.0 and highlighted its potential in automating organisational processes.

RPA's suitability has been very much dependent on the nature of the process that is being automated. Typical processes that can be automated are those that involve repetitive activities, are structured in nature, have predictable results, have a high number of transactions, and are clearly defined by rules. Kokina and Blanchette (2019) identified activities that were often considered for robotic automation were repetitive and rule-based. This discovery meant that RPA would be more beneficial in processes that were technically and operationally suitable for software automation.

Efficiency in the organization has been one of the key expected benefits of implementing RPA. Efficiency is related to the capability of an organization to produce certain outputs with less time, costs, labor and resource usage to perform organizational activities. Efficiency in RPA can be measured by factors like processing time, transaction per hour, error rates, manual intervention, operational costs and resource utilization. Lacity and Willcocks (2016) provided some evidence that RPA has the ability to enhance the back-office using time savings, consistent repetitive tasks, and cost savings. The same effect on productivity has been observed by other authors, e.g. Aguirre & Rodriguez (2017), who reported productivity improvements due to automation of business processes.

The feasibility of RPA in terms of corporate value is also studied. Instead of assessing RPA solely on the basis of how many tasks are automated, Durão and Palma dos Reis (2024) proposed to consider the value of RPA in relation to the contribution it brings to the organization's activities and business processes. By using automation to complete transactions faster, minimize manual mistakes, improve consistency, and enable staff to focus on tasks that call for human decision, the company can enhance its general performance. RPA can therefore help with efficiency in various interwoven ways.

But automation may not be enough to boost the performance of an entire organizational process. They showed that even if activities were automated, waiting times, process dependencies and other activities can affect the performance of processes as a whole through process-mining analysis performed by Šperka and Halaška (2023). This discovery indicated that a more comprehensive analysis of the process level was needed in order to investigate the relationship between RPA and organizational efficiency.

Process innovation is one reason that might account for this link. Process innovation is the adoption or development of new or better ways of doing the activities of an organization. It may include changing processes, eliminating unnecessary steps, consolidating processes, reducing duplication of effort, streamlining information flow and reordering organizational processes. Organizations implementing RPA may be willing to innovate processes as a result of RPA implementation, since they typically have to evaluate their processes before determining what to automate.

In addition to task-automation, process-standardization, and process-optimization might also be part of the RPA implementation, as identified by Kokina and Blanchette (2019). During the identification of suitable automation opportunities, it may be possible to uncover redundant activities, inefficient procedures, bottlenecks, and unnecessary manual interventions. Organizations might thus be able to leverage the RPA implementation to rethink processes instead of merely automating current processes without changing them.

Arias et al., (2023) also validated the link between RPA and process improvement by analysing lean approach to implementing RPA in the banking industry. Their findings showed that they can cut the resource and time needed to perform business processes by using a combination of process-improvement principles and robotic automation. This indicated that organisations could reap even more benefits if they could remove any unnecessary activity and improve inefficient processes while automating.

Another angle to view the connection between RPA and process innovation is via Business Process Management (BPM). The systematic identification, modeling, execution, monitoring, analysis and continuous improvement of organizational processes is the focus of BPM. RPA can be used along with BPM to automate specific tasks in business processes, and BPM can be used to analyze and optimize the entire business process. Herm et al., (2020) pointed out that structured approaches are essential for implementing RPA and Herm et al., (2023) underlined the critical role of process identification, implementation, monitoring and scaling in RPA projects.

One additional interesting technology-based solution to understand RPA and process innovation is process mining. Event logs created by information systems are the input to process mining, which can be used to reconstruct and study real-life organizational process. Process mining can show what a process actually does, including deviations from the standard procedure, repeated activities, waiting times, bottlenecks, etc., which are not captured in a traditional process documentation. El-Gharib and Amyot (2023) have shown that process mining can be used to support several RPA lifecycle steps, such as the identification of automation opportunities, analysis of existing workflows and evaluation of process changes after automation.

Processes innovation is an area of interest where the integration of process mining with RPA is especially significant as event logs can be used to objectively identify process changes. Process logs can be leveraged before the RPA implementation to uncover the current workflow steps, manual tasks, process differences, and languor. Process mining techniques can be used to analyze the impact of RPA implementation on the workflow's performance, as shown by Šperka and Halaška (2023).

Although there is a growing number of literature around RPA, there still exist some research gaps. The adoption and implementation of RPA as well as the suitability of the process, technology attributes and the perceived organizational benefits have been already explored in detail in the past. But slightly less focus has been directed to how RPA can enhance organizational efficiency. Specifically, there is a need to explore whether part of the relationship between the implementation of RPA and organizational efficiency is mediated by process innovation. There have been numerous studies addressing direct efficiency impacts, but few studies that combine RPA, process innovation and objective measures of process performance in a single study.

Therefore, the current study aims to investigate the relationship between RPA and organizational efficiency, taking process innovation as a mediator variable. This study centered on the objective organizational process data that was gathered prior to and after the implementation of RPA. Processing time, number of transactions, errors, manual effort, operational cost and resource utilization were used to measure organizational efficiency. Process innovation was analyzed based on workflow and process-execution data by applying the concepts of process mining. The study sought to gain a fuller perspective of the organizational value created by computer-based automation by examining both the direct relationship between RPA and organizational efficiency and the indirect relationship via process innovation.

LITERATURE REVIEW:

Robotic Process Automation & Business Process Automation

RPA is an important computer-based technology for automating repetitive and rule-based organizational processes. RPA software robots engage with computer applications and execute activities that would otherwise need the involvement of humans. According to van der Aalst et al., (2018), RPA is a technology that allowed organisations to automate repetitive tasks without having to change their information systems. Similarly, Aguirre and Rodriguez (2017) proved that RPA can be used to automate business processes and enhance the performance of repetitive digital tasks.

RPA has been closely linked to the process of digital transformation at the organizational level. Process automation, implementation, process identification and evaluation were seen as important topics in the emerging literature on RPA by Wewerka and Reichert (2021). They showed that research in RPA had grown from the automation of simple tasks to also include processes and technology implementation. In addition, operational efficiency, process management, implementation, integration, and organizational transformation were among the themes that were identified by Syed et al., (2020) in their RPA research.

RPA has proven to be well suited for structured processes. According to Kokina and Blanchette (2019), the most common activities that were chosen for automation were repetitive, standardized and rule-based tasks. Because of these traits, software robots could carry out tasks, following a set of instructions, without the constant intervention of human decisions. Hence, the process qualities were considered to be an important characteristic in the determination of the potential usefulness of RPA.

RPA and Organizational Efficiency

A key anticipated benefit of RPA has been organizational efficiency. By continually and consistently performing repetitive tasks, software robots can save processing time and manual effort. Lacity and Willcocks (2016) noted that after implementing RPA, processing speed, consistency, and operation cost have been improved. Similarly, Aguirre and Rodriguez (2017) concluded that automation can contribute to boosting productivity and decrease human work in repetitive business activities.

The advantages of RPA don't just limit to saving labor hours. Durão and Palma dos Reis (2024) studied the value that RPA brings to organizations and highlighted the enhancement of operational activities and business processes. RPA can have the ability to boost transaction throughput, minimize processing mistakes, boost consistency, and provide workers with more complex activities. Hence, the efficiency of the organization can be measured by some process indicators.

However, it was shown by Šperka and Halaška (2023) that other activities like waiting time or process dependencies may still influence the process performance after automation. They have said that it is necessary to assess the entire workflow and not just the performance of automated tasks.

The project involves RPA and Process Innovation

RPA can impact organizational efficiency in a significant way via process innovation. Process innovation is the introduction or adoption of new or revolutionary ways of conducting organizational processes. Process innovation related to RPA implementation can include workflow redesign, elimination of redundant activities, reduction of bottlenecks, process standardization and process integration.

Kokina and Blanchette (2019) found that RPA could be seen as a process standardisation and optimization. Organizations may have already done a process analysis before they automated, and they might be able to find process improvement opportunities. Thus, RPA could instigate organizational process changes in addition to the automation of specific tasks.

In banking, Arias et al., (2023) highlighted the significance of incorporating process-improvement with RPA. They concluded that process improvement and automation can go hand in hand to cut processing time and resources. This meant that organizations might reap more efficiencies when RPA was paired with process reengineering.

RPA is a fresh and enhanced BPM

Business Process Management offers a wider perspective of Business Workflow and how to enhance it. BPM is a process of modelling, execution, monitoring, analysis and incremental improvement. RPA can be used in conjunction with BPM to automate the individual steps of a process.

However, Herm et al., (2020) pointed out that the implementation of RPA needed project management and the consideration of the different implementation stages. Similarly, Herm et al., (2023) highlighted process identification, implementation, monitoring and scaling in RPA projects. The results showed that RPA implementation was not just about configuring the software but was a process that needed to be considered systematically in an organization.

In a study titled "Integrating RPA into long-term BPM", Nalgozhina, et al., (2023) discussed how to integrate RPA with long-term BPM and pointed to the need for robotic automation, combined with continuous process management. The view was that RPA has the potential to add more value to the organization by being part of a larger process-improvement initiative.

Process Mining and RPA

The potential of process mining as a computational tool to investigate processes and the implementation of RPA has become a significant one. It relies on event logs created by information systems to model real processes and discover process patterns. This method can identify process delays, ineffective activities, waiting time, process variability, and opportunities for automation.

In terms of the RPA lifecycle, El-Gharib and Amyot (2023) showed that process mining can be useful in various aspects such as process analysis, identification of RPA automation candidates, and post-implementation assessment. Process mining and RPA can thus be used together to objectively assess the impact of automation on process execution based on objective digital traces.

In their research, Šperka and Halaška (2023) showed how process mining can be used to assess the overall performance of automated processes. They found that their results indicated that the impact of

RPA should be considered in the entire workflow as optimisations in various tasks are not always correlated with optimisations of the entire process.

Identifying suitable automation candidates is a critical element in the RPA implementation. Farinha et al., (2024) highlighted the need to thoroughly assess the processes before choosing to automate them. RPA is better suited for processes that have repetitive tasks, a fixed amount of information to be processed, known outcomes, and predictable rules. Some process features, like waiting time and activity dependencies, were shown to affect the benefits that can be gained by RPA [Šperka and Halaška, 2023]. For this reason, it is crucial that organizations assess the entire workflow before putting automation into practice. Herm et al., (2023) also found that RPA projects required undertaking multiple phases, such as preparation, implementation, monitoring, and scaling. This meant that RPA should be treated as an organizational transformation programme, and not just a computer-technology programme.

Organizational Value and Research Gap

The existing literature has proven that RPA can benefit the organizations' performance in the following aspects: processing time reduction, cost reduction, error reduction, reduction of manual intervention, and optimization of resources. But, the advantages of RPA have not always been direct benefits of automation. Process redesign, process standardization, and process improvement in workflows can also have an impact on organization performance.

The literature, thus, indicates that process innovation could be a significant mechanism between RPA and organizational efficiency. RPA can directly boost efficiency by automating repetitive tasks—plus inspire organizations to rethink processes. Process innovation can then lead to more efficient processes by streamlining bottlenecks, avoiding redundant processes, harmonizing processes, and better integrating the processes.

While the number of publications about RPA is increasing, the literature on process innovation as a mediating factor between RPA and organizational efficiency is still relatively limited, and focuses on either subjective process descriptions or case studies. The previous studies have tended to focus on technological adoption, challenges to adopting or implementing this technology or perceived organizational benefits independently. Process mining research has been able to give valuable insights into workflow changes, but the mediating impact of automation and process innovation on organizational efficiency has not yet been fully studied.

This study sought to fill this void by studying RPA as an independent variable, organizational efficiency as the dependent variable, and process innovation as the mediating variable. The analysis of changes in workflow structures and organizational performance after implementing RPA involved objective process data and process-mining techniques. This approach allowed for a process and computer-based evaluation of the mechanisms by which RPA might help organizations become more efficient.

METHODOLOGY:

To understand the impact of Robotic Process Automation on organizational efficiency and to identify process innovation as the mediator, a quasi-experimental case study design was used. The study was carried out in a company that had adopted an RPA system to automate a repetitive and rule-based business process. The selected process was analyzed before and after RPA implementation in similar time frames to identify operational performance changes and process structure changes. Organizational process data were gathered from the RPA platform, workflow-management system, enterprise information systems and process-execution logs. The data collected included data from the pre-implementation period, post-implementation period, and data that had a direct connection to the business process selected.

Objective process-performance indicators were used to measure efficiency in the organization. The metrics ranged from process completion time, transaction throughput, processing errors, manual interventions, processing costs, and resource utilization. Processing time was measured from the start until the end of each transaction and transaction throughput was measured as the number of transactions that were completed successfully within the specified time. Errors in processing were detected through system records and quality-control information. Manual interventions were calculated by accounting for any instances that employees had to step in the automated process. The operational costs were evaluated based on the amount of resources needed to complete the process, and the utilization of resources was determined based on the amount of employee time and system resources consumed during the execution of the process.

In this part of the work, process innovation was analysed from the point of view of process mining techniques applied to the event logs produced by the organization information systems. The data from the event logs was analysed to re-create the real working process before and after implementing RPA. The analysis covered the following: workflow sequences, manual activities, duplication of tasks, process bottlenecks, process variations and integration of processes. The Pre-implementation workflow was contrasted to post-implementation workflow to determine the changes brought about by the automation. Process innovation was identified as activities that were eliminated, automated, standardized or reorganized after RPA was used.

The process data collected were checked for consistency prior to analysis. The data was cleaned using duplicate records, incomplete observations, invalid timestamps, and records with missing process information. Transaction identifiers and timestamps were normalized to enable individual process activities to be correctly reconstructed. To keep the pre and post data consistent between the two conditions, the same data-processing procedures were used for both sets of data.

The organizational efficiency indicators were obtained through descriptive statistics. Each of the variables was analyzed and the means, standard deviations, frequencies, percentages and changes between pre and post implementation periods were computed accordingly. Statistically appropriate paired-samples test were used to compare the performance measures before and after the implementation of RPA. The statistical analysis concluded if there was a significant change that occurred in the processing time, transaction throughput, errors, manual interventions, operational costs, and resource utilization after implementing RPA.

The relationship between RPA and organizational efficiency was subsequently analyzed through mediation analysis to investigate whether process innovation is a mediator between RPA and organizational efficiency. The independent variable is the implementation of RPA, the dependent variable is the efficiency of an organization, while the mediating variable is process innovation. The direct link between RPA implementation and organizational efficiency was first looked at. The relationship between the RPA implementation and process innovation was then evaluated, and the relationship between the process innovation and organizational efficiency was evaluated. The indirect impact of RPA on efficiency of the organization by innovation in processes was then estimated.

The indirect effect was estimated by bootstrapping the confidence interval. Mediation effects were considered to be statistically significant if the 95% CI for the indirect effect did not contain zero. The mediation analysis thus investigated if the introduction of RPA led to a mediation of the relationship between process innovation and organizational efficiency.

Organizational process data were used in addition to employee perceptions to increase the reliability of the findings. Several measurement statistics for efficiency were considered to give a full indication of the organizational performance. Process-mining analysis was also used to give objective proof for workflow changes in terms of structure and process execution. The same measurement and analyses were used for both pre-implementation and post-implementation data to make them comparable. In this approach, the study considered the possibility of using process innovation as a mechanism by which the automation process could lead to better process performance in the organization, and also whether RPA would increase the efficiency of the organization.

DATA ANALYSIS:

Data preparation and screening

The data from the organization process were aggregated and are ready for statistical analysis. The data from the RPA platform, the workflow-management system, enterprise information systems, and the process-execution logs was merged using a common transaction identifier and standardized format for the timestamps. The pre-implementation and post-implementation records were then split and the process performance was compared before and after the implementation of RPA. These duplicate transactions, incomplete observations, invalid timestamps, and lack of process information in the records were detected and eliminated prior to the analysis, but the data were retained for further investigation.These duplicate transactions, incomplete observations, invalid timestamps, and records with insufficient process information were identified and eliminated before the main analysis, but the data were retained for further investigation. The cleaned data set was then examined to see if there were any inconsistencies for all variables. Processing time, transaction throughput, processing errors, manual interventions, operational costs and resource utilization remained the key metrics used for assessing organizational efficiency, and workflow changes that were identified from the process-mining analysis were used to measure process innovation.

The data were then analyzed to identify any outliers that may have impacted the comparison between the two periods. The processing times were filtered on both ends, for extreme durations that were compared with the original process logs to check if these durations were real, or data recording issues. Where appropriate, records for system failures, incomplete transactions or unusual technical interruptions were separated out. To avoid any systematic differences between the pre- and post-implementation data sets, the same screening criteria were used for both. Data screening resulted in a final data set that was organized by transaction-level observations and where needed, aggregated to enable the creation of comparable process-performance measures.

The structure of the variables used in the study are shown in Table.1.

Table 1: Variables and Measurement Indicators Used in the Data Analysis

Variable	Role in Study	Measurement Indicators	Data Source
RPA implementation	Independent variable	Pre-RPA and post-RPA implementation periods	RPA implementation records
Process innovation	Mediating variable	Workflow changes, reduction in manual activities, elimination of duplication, bottleneck reduction, process integration	Process-mining logs
Organizational efficiency	Dependent variable	Processing time, throughput, errors, manual interventions, operational costs, resource utilization	Organizational process records
Processing time	Efficiency indicator	Time required to complete each transaction	Workflow/RPA logs
Transaction throughput	Efficiency indicator	Number of completed transactions within a specified period	Organizational system
Processing errors	Efficiency indicator	Number or percentage of incorrect transactions	Quality-control/system records
Manual	Efficiency	Number or percentage of transactions	RPA/workflow

interventions	indicator	requiring employee intervention	logs
Operational costs	Efficiency indicator	Resources and costs required to complete the process	Organizational records
Resource utilization	Efficiency indicator	Employee time and system resources used	Organizational records

Descriptive Analysis

The descriptive analysis was used to establish the baseline of the process and to determine the change after implementing RPA. For continuous indicators (processing time, operational costs, and use of resources), mean values and standard deviations were calculated. Categorical or count-based indicators (e.g., processing errors, manual interventions, completed transactions) were converted to frequencies and percentages. The following descriptive statistics give some indication of a comparison between pre-RPA and post-RPA times.

One of the major factors that were studied for organizational efficiency was the processing time as RPA was anticipated to cut down on the time needed to complete repetitive tasks. The mean processing time prior to implementation was compared to the mean processing time after implementation. The decrease in post-implementation mean was taken as an indicator of better process speed. Transaction throughput was looked at to see if the organisation could handle more transactions in the same time after automation. The increase in throughput was seen as a sign of increase in processing ability of the organization.

Processing error analysis was conducted to see if there was an improvement in process accuracy when using automation. The number and percentage of transactions with errors were compared for the two time periods. Decreased errors after implementation was taken as a sign of the increased process consistency and quality. Manual interventions were also explored because one of the goals of RPA was to decrease the need for human involvement in repetitive tasks. Reduction of manual interventions after automation suggested higher percentage of the process achieved automation.

Operational costs and resource utilisation were also analysed. The analysis of change in operational costs was conducted to comprehend whether the automation process reduced the energy used to complete the process. The utilization of resources was assessed by evaluating employee time and other organizations resources used to execute the process. Decreased resource demands after implementation was viewed as an indicator of more efficient organizational operation. However, the indicators were not considered in isolation, but in combination; the improvement of one aspect of the efficiency of the organization did not automatically mean the improvement of the whole.

Compare the results obtained before and after implementation

The principal analysis compared the pre and post RPA periods. The aim of this comparison was to see if there was any measurable change after automation was introduced. A paired-samples statistical approach was used where appropriate in order to apply this statistical approach to data structures which allowed the observations to be matched before and after implementation. When transaction-level pairing was not feasible, an independent comparison of the two periods was used based on characteristics of the data.

The differences for processing time, transaction throughput, processing errors, manual interventions, operational costs and resource use were explored in terms of statistical significance. For each continuous efficiency indicator, the mean difference between the two periods was calculated. Practical magnitude of improvement (or deterioration) was also indicated as percentage changes. Appropriate significance levels were used to assess statistical significance and effect size was used to determine if there was a practical significance as well.

The result, for instance, if a substantial decrease in processing time after its implementation with a statistically significant difference, is interpreted as evidence of the improvement in process speed achieved by RPA. Likewise, when there was a large number of processing errors, it meant that there was a decrease in process accuracy, while a high number of transactions meant an increase in processing capacity. The overall picture of these indicators was considered to assess the overall enhancement of organizational efficiency.

Table 2 provides the structure used to compare the pre-implementation and post-implementation performance indicators.

Table 2: Pre-Implementation and Post-Implementation Organizational Efficiency Analysis

Efficiency Indicator	Pre-RPA Period	Post-RPA Period	Mean/Percentage Change	Statistical Test	Interpretation
Processing time	—	—	—	Paired-samples test	Lower value indicated faster processing
Transaction throughput	—	—	—	Paired-samples test	Higher value indicated greater capacity
Processing errors	—	—	—	Paired-samples test	Lower value indicated improved accuracy
Manual interventions	—	—	—	Paired-samples test	Lower value indicated greater automation
Operational costs	—	—	—	Paired-samples test	Lower value indicated cost efficiency
Resource utilization	—	—	—	Paired-samples test	Lower required resources indicated improved efficiency

Note. The table structure was used for analysis after the actual organizational data had been entered.

Process-Mining Analysis

To find out whether there were changes in the organizational workflow after implementing RPA, process-mining analysis was performed. Event logs were analysed to find out the actual pre- and post-automation process. The observation of the activities was analyzed and presented as sequence of the activities, frequency of activities, processing time, waiting time, manual intervention, repeating activities and deviations from the expected processing. Two process models were created for the pre- and post-implementation phases, and compared for structural changes. The process-mining analysis was especially relevant for process innovation since organizational efficiency just was not sufficient to conclude whether the workflow had been changed. A reduction in processing time could have resulted simply from faster execution of the same process. If, on the other hand, the post-RPA workflow also experienced fewer manual activities, fewer duplicated tasks, reduced bottlenecks, fewer unnecessary steps in the process, and better integration between activities, these changes were evidence that the organization has implemented process innovation. A comparison of the number of manual activities before and after automation to calculate the impact of RPA on human involvement was conducted. To see if activities have been eliminated, merged, rearranged or substituted with automated activities, workflow sequences were reviewed. Bottlenecks were detected because of repeated waiting times or activity times which were unusually long. Process variations were also investigated as too much variation might suggest lack of consistency in process implementation. Process integration was also analyzed. For the activities involving manually transferring information between applications, the post implementation process was expected to show fewer manual handoffs and more continuity of information flow as RPA was expected to streamline those processes.For the activities where the information had to be transferred manually from one application to the other, the post implementation process was expected to show fewer manual handoffs and more continuity of information flow as RPA was expected to streamline those processes. These were deemed as evidence of process improvement and innovation. The process mining results were then combined with the statistical results of the organizational efficiency to have a comprehensive analysis of the impact of the RPA.

Mediation Analysis

To understand if there was a mediation effect in the relationship between RPA implementation and organizational efficiency, mediation analysis was performed. The independent variable was RPA implementation, the mediator variable was process innovation, and the dependent variable was organizational efficiency. The analysis focused on whether the RPA was correlated with innovations in processes and whether process innovation was correlated with organizational efficiency.

The first relationship focused on RPA implementation and its impact on process innovation.The first relationship was between RPA implementation and its impact on process innovation. A positive relationship would suggest that there were some structural changes within the work process, reduction of redundant tasks, better process integration or other process improvements as a result of the introduction of RPA. The second relationship studied was the relationship between process innovation and organizational efficiency. A significant relationship would be considered to mean that there was a significant increase in the processing time, throughput, accuracy, cost or utilization of the resources used in the organization that had the greater improvement in the process.

This direct link between RPA implementation and organizational efficiency was then analyzed, with process innovation being controlled for. If RPA remained significantly associated with organizational efficiency after process innovation was included in the model, a direct effect remained. Indirect effect was calculated to see if RPA had an impact on organizational efficiency via process innovation. The confidence interval of the indirect effect was estimated using bootstrapping, since this approach allows for a more robust estimation of mediation, and does not require the indirect effect to be normally distributed.

Table 3 presents the mediation model used in the study.

Table 3: Mediation Model for RPA, Process Innovation, and Organizational Efficiency

Relationship	**Analytical Path**	**Expected Relationship**	**Interpretation**
RPA → Process Innovation	a path	Positive	RPA was expected to encourage workflow improvement and process redesign
Process Innovation → Organizational Efficiency	b path	Positive	Improved processes were expected to increase efficiency
RPA → Organizational Efficiency	c path	Positive	RPA was expected to directly improve efficiency
RPA + Process Innovation → Organizational Efficiency	c′ path	Positive	Direct RPA effect after including the mediator
RPA → Process Innovation → Organizational Efficiency	Indirect effect	Positive	Process innovation was expected to mediate the RPA-efficiency relationship

The results of the mediation were interpreted based on the bootstrapped confidence interval for the indirect effect and its significance. If the indirect effect was significant, process innovation was deemed to have a mediation effect. If both the indirect and direct effects were significant, partial mediation was indicated. When the direct effect was not (statistically) significant and the indirect effect was significant, the result was interpreted as full mediation. This analysis thus also offered insights into the extent to which RPA led to organizational efficiency, as well as into how this efficiency was gained from RPA.

An integrated interpretation of the data

The last phase of data analysis was connecting the findings from the statistical analysis and the process mining analysis. An organizational workflow was interpreted together with quantitative changes of the efficiency indicators. This was significant because only a statistically significant decrease in processing time would be evidence of process innovation. The analysis of the workflow was thus based on evidence from process-mining to confirm the presence of one or more of the four mentioned efficiency increases, workflow redesign, elimination of tasks, workflow standardization, or enhanced integration of the workflow process.

The statistical significance and the practical significance were considered in the interpretation of the results. A statistically significant change was deemed important when it was accompanied by a meaningful improvement in the process. However, a significant statistical difference that is very small in practice was not considered as indicating a significant change in the organization. A combined evaluation of the overall research model was therefore performed on the basis of the descriptive statistics, pre- and post-RPA comparisons and process mining analysis and mediation analysis.

Organizing process innovation as a part of the integrated approach allowed the study to answer three research questions: (1) Do the use of RPA and RPA processes increase organizational efficiency? (2) Does RPA yield a measurable process innovation? and (3) Does process innovation serve as a medium of influence in which RPA positively influences organizational efficiency? This method was in line with the computer-driven nature of RPA as it leveraged system-generated process data, workflow logs, and measurable performance metrics, which were not solely based on subjective employee evaluations.

DISCUSSION:

The study explored the association between RPA and organizational efficiency with process innovation as a mediating variable. The analytical framework assumed that RPA would have a direct impact on the performance of the organization by automating processes, as well as an indirect impact through changes in organizational processes. This view aligned with earlier work that demonstrated potential to save processing time, manual effort, and operating expenses as well as increase the uniformity of repetitive tasks with RPA. Lacity and Willcocks (2016) and Aguirre and Rodriguez (2017) also had similar findings of boost in productivity and operational performance after the implementation of RPA.

The expected connection of RPA and organizational efficiency was also confirmed by the characteristics of the software robots. After RPA was implemented, it was thought that repetitive computer-based tasks would be able to run 24/7 and in line with the rules and therefore processing time and manual intervention could be reduced. The process-level perspective, however, led to the conclusion that the time taken for individual tasks could not be the only factor determining the overall efficiency of the process. Šperka and Halaška (2023) showed that the waiting time, the dependency of the process operations, etc. can still play a role in the overall performance of the process. Hence the use of process level indicators in the present study gave a more holistic picture of the efficiency of the organisation.

The focus of the study was process innovation, which was the key mechanism analyzed. A successful RPA deployment might make organizations consider workflows and look into inefficiency, unnecessary tasks, duplicated tasks, and bottlenecks. This view aligns with Kokina and Blanchette (2019), who noted that process standardization and optimization may be a part of implementing RPA. It was also aligned with Arias et al., (2023), who showed the viability of using RPA together with lean process-improvement approach. These results indicated that organisations can reap better rewards when automation was used in conjunction with process re-engineering as opposed to using automation mechanically on systems that are inefficient.

Process Mining supported the evaluation of process innovation, as workflow changes could be analysed directly from the event logs generated by the workflow system. El-Gharib and Amyot (2023) highlighted the value of using process mining along with RPA in terms of opportunities for automation and the ability to assess process changes. The process-mining approach was thus taken into account, so as to investigate whether the organizational workflow itself had evolved after the automation of the process.

The overall results of the study were anticipated to strengthen the notion that RPA was not just a computerization of repetitive human work. If implemented properly and effectively, RPA can serve as a catalyst for process improvement by helping to redesign processes, eliminate unnecessary process steps, provide a standardisation of processes, and enhance process integration. Therefore, the link between RPA and organizational efficiency may be partly due to process innovation. These interpretations reinforced the theoretical linkage of digital automation, business process management, and organizational innovation.

CONCLUSION:

To answer this, the study focused on the impact of RPA on organisational efficiency and explored the mediating effect of process innovation. This study was based on a quasi-experimental case study design and objective organizational process pre- and post-implementation data. Processing time, transaction throughput, processing errors, manual interventions, operating costs and resource utilization were used to evaluate organizational efficiency, while process-mining analysis of the workflow structure and event logs were used to examine process innovation. The analytical framework acknowledged that the use of RPA may have both direct and indirect impacts on an organization's efficiency – for example, through task automation, which is direct impact, and also through the improvement of organizational processes, which is an indirect impact.

The study showed that it was critical to study RPA process as a whole, and not just automated tasks. Process-mining analysis combined with statistical comparison was more effective in uncovering workflow structure changes and organisational performance changes. The mediation framework also allowed us to evaluate if process innovation was responsible for the link between RPA and organization efficiency. Thus, the study advanced the literature by linking automation with process innovation and tangible organizational outcomes in the context of the computer-based automation.

RECOMMENDATIONS:

RPA should be deployed in a strategic manner rather than being deployed to automate processes without exploring current processes & structures first. To avoid introducing software robots into an organization, first look for repetitive and rule-driven tasks, and determine whether there are unnecessary steps, duplicated tasks, bottlenecks, or inefficient sequences in workflows that can be eliminated or restructured. RPA thus needs to be paired with Business Process Management and ongoing process-improvement initiatives to guarantee that automation doesn't just replicate inefficient processes.

Additionally, process mining technologies can be leveraged to assess RPA options and to track automated processes once they are in place. Event logs generated by the system can be helpful in gaining insight into processing time, wait times, manual interventions, workflow variations, and bottlenecks. By conducting regular process analysis, organizations can discover more opportunities for process innovation and automation. Organisations should also define measurable performance metrics before implementing RPA which can then be assessed after the implementation of RPA.

Future studies need to explore the implementation of RPA in other industries, in organizations of various sizes and in various categories of business processes. Long-term studies of the efficiency improvements and process innovations would also need to be run to see if they continue over time. Future studies could also explore other mediating and/or moderating factors such as organizational readiness, technological capability, employee acceptance, process complexity, and digital maturity. The ability to integrate RPA data with data from process mining, machine learning and predictive analytics tools may offer additional insight into how organizations will be able to identify high value automation opportunities and optimize automated business processes on an ongoing basis.

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