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Employees' perception of value-added activity increase of Robotic Process Automation with time and cost efficiency: a case study

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Abstract:
Implementation of Robotic Process Automation (RPA) is ubiquitous in the financial industry. However, the consequences are not clear enough in terms of strategic perspective. Drawing upon the theory of Task-Technology Fit, this study explores the emerging consequences with the exploratory sequential method. Data related to the time and cost of processes before and after the RPA implementation were collected and descriptively analyzed. Even though time and cost efficiency improvements occurred in 50 out of 54 of the processes, the results indicated no labor reduction after the RPA implementation and no cost reduction in some business units, contrary to reports in the literature. To investigate what happened to the human resource environment, we surveyed 106 employees who were affected by the implementation of RPA. No variance was found between the characteristics of the employees and the changes in the working environment. However, the descriptive results of the survey revealed that employees' perception of value-added activities increased. These results provided that considering RPA as a routine process without calculating the strategic value creates process-oriented transformation with a lack of time and cost-efficiency.

Keywords:
financial technologies; RPA (Robotic process automation); value-added activity; cost and time reduction; task-technology fit.

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1. Introduction

Efficiency and effectiveness are the main keywords for achieving sustainable development and competitive advantages in business environments. The elimination of unnecessary business processes and tasks is the main driver of efficiency and effectiveness. Thus, software-made robots are common in the financial industry to increase the productivity and efficiency of costs and labor [1]. A study related to Robotic Process Automation (RPA), conducted by Fortune Business Insights [2], claims that the global market size for robots might increase by $7.64 billion by 2028. Therefore, up to two-thirds of knowledge workers might be affected [3] and a noticeable switch in the distribution of responsibilities between labor and robots might occur. According to Scheppler and Weber [4], most European companies are planning to implement software robots in at least 10 of their processes. Even this statistical perspective would be enough to recognize the extensive disruption that RPA will produce in companies.

Software robots are intended to reduce routine tasks by automating the process and eliminating the jobs related to the tasks to intensify the decision-making results; this is called Robotic Process Automation [5], [6]. The RPA technology is based on the elimination of the repetitive environment to enhance the productivity of the business [7]. Banking and accounting industry leaders in particular are applying RPA projects to their business processes because of their risk aversion and regulation responsibilities [6].

Elimination of repetitive tasks and processes creates an expectation of a reduction in the number of laborers to achieve cost efficiency. Replacing employees with RPA, generating a prospect of reducing the need for human resources, or directing these resources to meet the other needs of businesses, is a common perception of technological disruption [1], [8], [9]. Likewise, when routine tasks in a company are automated, related employees' focus is expected to move to higher value-added activities. Human resource capability evolves to have a diverse and strategic nature with a new role in companies that implement RPA in their processes [10]. Task and RPA interaction requires to fit each other in order to see elimination or reduction which is a critical predictor conclusion for time, cost, and value-added activities to gain strategic value. Therefore, task and RPA interaction were evaluated by applying the Task-Technology Fit (TTF) theory [11].

Limited empirical studies and a lack of theoretical perspectives with the contradictory approach to RPA and labor reduction in the previous gray literature [12] created a motivation to investigate the unknown consequences of the implementation of RPA by applying the exploratory sequential method in a case study. Most organizations are failing to decide what to automate [13]. To evaluate the choice of the automation for the business units, TTF theory will be used to understand business units' tasks – RPA relations in terms of time and cost parameters to clarify the strategic value of the practical implementation of RPA with the combination of theoretical perspective and practical experience. Therefore, our case study, first, aims to investigate the time efficiency, cost efficiency, and human resource reduction after the implementation of RPA to perform tasks from secondary data that were collected from different business units in a financial institution. Its other contribution later is to evaluate whether human resource efforts can be transferred to value-added activities in this financial institution by implementing a quantitative survey method in the case study environment. Thus, this exploratory sequential design study first contributes to understanding the consequences of RPA implementation by evaluating the time and cost efficiency results with a descriptive case study and then investigating this exploratory outcome with a survey study to understand value-added activities among the participants who are the members of the business units that RPA was implemented with the task-technology fit theoretical lenses to observe strategic value.

The remainder of this paper is organized as follows. Section 2 provides the theoretical background and research proposal, while Section 3 presents the research methodology. Section 4 provides the primary and secondary data analyses and results. The final section contains a discussion of the results and concluding remarks.

2. Theoretical background and research proposal

Companies consider that carrying out business tasks efficiently and effectively ensures productivity, sustainability, and competitiveness. Operational performance can be leveraged through process optimization by reducing waste and errors, relocating high-cost destinations to low-cost ones, and adopting IT technology and automation with robots [14]. Automation is a powerful tool to reach these goals and to close the gaps between them. Robots are the main figure in the achievement of automation and better performance [15]. Among them, software types of automation create RPA, which is used for tasks to enhance the ability to operate in different applications and systems. The RPA technology operates with structural data, with which it connects to enterprise applications that interact with users in a client–server framework. In addition, the RPA application is executed with scripts that automate the users' workflows through dashboard-type interfaces [16]. Thus, RPA's technical ability has the capacity to change the nature of work by reducing the time, cost, and features and future of the labor [17]. In addition, the TTF theory explains that a good fit between task and technology brings better performance [18]. Therefore, task and technology characteristics need to fit each other to succeed in an intended time and cost performance from RPA implementation. There is always an interaction between task, technology, and individual perspectives of TTF, thus in our study the business units` each task is assessed in terms of time and cost to analyze strategic performance [11]. Considering the complicated environment of digital transformation, the vast literature on RPA explains its time and cost-effectiveness. Adaption of TTF is to analyze the literature perspective with a theoretical lens. Our study also includes a value-added activity perspective inside the financial institution with RPA whether a fit provides any positive performance on other tasks.

2.1 Time and cost effectiveness of RPA

There are always routine tasks and processes that companies want to minimize and reduce. If the requirement of task and the functionalities of technology are not close enough, then to reach the purpose of TTF gets harder [11]. The result of the reduction and minimization of these tasks and processes through the application of RPA generates time retrenchment for companies. It is claimed that RPA decreases the time required for high-frequency tasks [6]. In particular, RPA can operate at all times of the day, providing businesses with flexibility and scalability. Automating or decreasing the steps involved leads to tasks being completed within minutes/seconds instead of several days [10]. Thus, time efficiency is the expected result of the implementation of automation [10] which claims to have achieved a 30% to 70% reduction in the process cycles, waiting time, response time, and time taken to handle the processes. The duration of not only general business processes but also IT-related developments can be reduced with the implementation of RPA [14]. A study showed that also having the cognitive capability of RPA by using historical data saved employees millions of times to complete higher value tasks in a German financial institution [39]. Therefore, it is valuable to study this literature's task-technology fit expectations related to time reduction with practical hard data to compare the manual operations with the RPA-implemented processes and tasks. Our study investigates the time necessary for the processes to complete the specific tasks with RPA and without RPA and compares them to understand the fit between task and technology, leading to the following proposal:

> P1: The implementation of RPA reduces the time of the operation compared with the human resource who used to be responsible for that task, increasing the operational efficiency with the lens of TTF.

Cost reduction is a critical efficiency parameter for companies when they compare their performance. The majority of companies' operational cost is for the laborers who are employed to conduct the business processes. However, the adoption of automated systems enables a range of substitutions of labor in tasks. In particular, disruption occurs in the industry with the development of automated machinery [1]. Therefore, there is a high expectation of labor cost reduction when software-enabled automation is installed in companies. The past literature claims that the implementation of RPA tools also increases the product and service quality, which improves the operational performance with the elimination of human labor heavy tasks to robots while reducing the labor cost [1], [19], [20], [40].

A recent study by the World Economic Forum shows the transformation of tasks performed by humans to ones performed by machines, which shows to reduce the labor cost as well [3]. Huang and Vasarhelyi's [6] study corroborates the cost reduction through labor, showing a significant decrease in working hours and time of operation among accountants after the implementation of RPA. Furthermore, a prior study indicates that replacing full-time employees with robots allows labor-related expenses to be cut [10]. Therefore, the greatest concern among employees is losing their job due to RPA's cost promises and flawless operations compared to humans [6], [9]. A previous study's evidence indicates that managerial labor faces job losses because of average wage changes as a result of RPA implementation [19]. The notable difference between physical and software robots is that physical robots aim to reduce blue-collar labor costs and software robots aim to decrease white-collar labor costs [15]. Conversely, the RPA investment cost is critical for companies that plan to adopt this technology. The profit needs to exceed the cost of investment in RPA to motivate companies to install it for their processes [21]. The cost of RPA implementation is asserted to be less than the labor cost; however, inefficient processes and tasks that contain errors increase the cost of development and investment in RPA [4], [20]. Thus, the extent to which a cost reduction is achieved with the RPA adoption compared with human labor is not clear because of the additional costs for the maintenance of the RPA system after its implementation. Even though the cost reduction and the effect on the number of employees who are carrying out the processes seem to be clear, the cost of human resources and the RPA investment cost need to be investigated, especially among the business units, to compare the costs before and after the RPA implementation in a financial environment. Therefore, we unveil this gap by comparing the cost of labor for each business unit with the cost of RPA for specific units and their processes to identify the inconsistencies and propose that:

> P2: The implementation of RPA increases the cost-saving advantages over human resources for each process by decreasing the number of employees in business units that adopt RPA with the lens of TTF.

Since the processes transferred to RPA are repetitive, manual, and routine processes, the execution of the processes by the personnel or the robot does not create any change in the outcome. Since the quality of the process outcome was the same in both cases, only time and cost effectiveness were compared.

2.2 Value-added activity and RPA

Personal skills, creativity, and productivity are the main components of the development and adoption of high technologies in companies. RPA is a rule-based system that automates routine tasks and cannot mimic the actions and behaviors performed by humans [15], [20]. Eliminating the repetitive processes from tasks can change human resource activities in business units. Procedural human resource activities are transformed into value-added activities. Value-added activities are expected to happen, focusing more on decision making, problem solving, and interpersonal skills after the implementation of RPA [10]. Value-added activity transformation for employees shows that RPA implementation does not cut the total employment rate in business units [1]. Nevertheless, RPA tools improve employees' conditions, allowing them to perform multiple tasks with developed skills and strategic views on business tasks [20]. Implementing different algorithms to the business processes reshape human and algorithm relations over time without replacing human work. It is possible having new relations restructure existing roles into more accurate implementation of the technology [22]. Skillful and technology-friendly employees contribute to the success of RPA with their attainment. Non-routine processes and tasks are new roles for employees that generate value-added activities in businesses after the deployment of RPA [10], [23], [24]. Non-routine tasks and their consequences surge, allowing an innovative approach that forms a new type of labor perspective that engages with RPA [25]. RPA's promise of cutting labor costs seems to involve different approaches. Displacement of jobs does not occur; instead, RPA implementation creates new tasks and job opportunities and improves different labor activities, which increase the labor demand [1]. According to TTF, it is expected that technology assists individuals to improve their value-added skills with a new task engagement [11].

Our study investigates the amount of investment cost savings achieved through the use of robots instead of humans in operational tasks. These savings can be qualified as real savings if there is a real decrease in the number of human resources. If there is no decrease in human resources, the question of what kind of work is undertaken with the additional time obtained as a result of RPA will arise. Thus, we investigate employees in the business units of the financial institution that have adopted RPA, whose role has switched to more value-added activities with the lens of TTF, leading to the following proposal with the model Figure 1.

> P3: Employees' value-added activities appear in companies that shift their labor from the routine processes in which RPA is implemented.

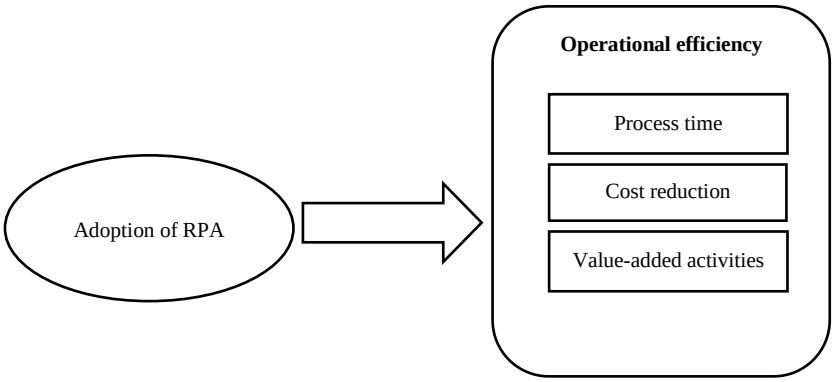

Figure 1: Model Proposal

These three models are tested separately and encompass all operational efficiency activities that RPA will add to an organization in the context of time, cost, and value-added activity increase in a single study.

3. Research methodology

The effects of the modeled RPA we created on time, cost and value-added activity are examined. The first two variables of these areas constitute the first part of the study, and the second variable is included as a continuation of the first analysis. These two sections proceed independently of each other, and the value-added activity section was included in the study by expanding the research, based on the fact that no real employee savings were observed as a result of the first analysis. Therefore, the survey analysis is the continuation and complement of the secondary data analysis as shown in Figure 2.

We applied an exploratory sequential approach in our study (Figure 2). First, a qualitative case study with a descriptive method was implemented by using secondary data. Second, a quantitative approach applied with survey design by using primary data. Secondary data analysis provided the necessary view to analyze primary data, and both were utilized to define the proposals with the theoretical lens of TTF. The following sections explain the secondary data collection and the survey settings with the primary data for our case study.

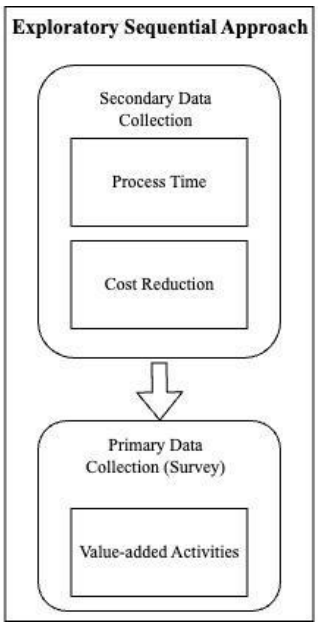

Figure 2: Data collection methodology

3.1 Secondary data collection

A comprehensive review of the RPA literature [4], [6], [7], [9], [10], [26], [27] directed us to choose time and cost data to answer the proposed research questions. We collected the data from a financial institution that operates in Turkey, as well as around the rest of the world. Its RPA implementation was chosen as a case for our study because it is the pioneer in the fintech industry related to RPA technologies.

While examining the gains from RPA, 54 processes in which the robot worked were considered over a 12-month period (May 2019–May 2020). These processes belong to 27 different sub-business services of seven different business units. With the transition to RPA, the changes in these processes were examined separately under the headings of time and cost to describe the conditions and the consequences in the financial industry.

3.1.1 Secondary data collection methodology for time

RPA implementation is expected to reduce the amount of time required for tasks to be completed. Therefore, the full-time employee (FTE) completion time for a specific process within a task is compared with the implemented RPA time frame that is used for the same process [24]. In line with this method, while calculating the gain in the time dimension, we calculated the number of seconds that an employee took to perform the same process on average in the year before the RPA was applied. The information systems used by the financial institution calculate the time elapsed between the assignment of each task to the personnel and the completion of the task. In this respect, the information of how long the tasks are completed by the personnel is an information that is automatically calculated by the system. Secondly, the average robotic time was found by calculating the average processing time of the robot per process. As a feature of the RPA product used, the information on how long it takes the robots to complete each task is data that is automatically calculated and reported by the system. Finally, the robot's time savings were compared on a business unit basis to analyze the differences in the processes of the units.

3.1.2 Secondary data collection methodology for costs

Similar to the methods reported in the literature, the investment in RPA, number of employees, and turnover rate calculations were applied to measure employees' procedures to investigate the cost reduction related to the labor in our secondary data collection from a financial institution [19].

The return on investment (ROI) is the main calculation to determine whether the investment benefits a company by reducing the costs. It is projected to improve efficiency because the ROI is better when RPA is implemented in processes, according to the literature [26]. The improvement is explained by the enhancement of productivity with the low-cost operation of robots compared with human resources [17]. Cost savings were not computed by Yetiz et al. [9] study, and no calculation method was defined to reach the cost-saving conclusion. Therefore, all the conclusions were speculations made by the authors. In addition, the RPA ROI perspective was compromised while explaining the cost savings in the paper. The main distinction in our approach is that we consider the RPA ROI perspective with the labor cost, which enables us to analyze the savings from the investment more realistically.

In calculating the cost savings obtained with RPA, the total cost for robotic investment and the human resource cost that would be spent if this development was not undertaken were compared. For the 54 processes in which RPA was implemented, the processing time of the employees (PTE) in hours to perform each transaction was calculated, and then the total time spent (TTS) by employees on these transactions was found by multiplying the PTE by the number of transactions (NoT).

$$TTS = PTE * NoT \tag{1}$$

The average daily effective working time of an employee in this workplace is 6.5 hours, according to the research made by the human resources (HR) of the financial institution. Using this figure, it was determined how many FTEs correspond to the total time spent by the employees on the transactions transferred to the robot. With the transition to the robotic process, the employee time spent on that process completely disappears, so the number of employees corresponding to the total time spent annually is saved.

$$FTE\ Saving = TTS/6.5 \tag{2}$$

FTE Saving is the number of employees needed to perform the same number of transactions in the scenario in which RPA has not been implemented. Therefore, FTE Saving was multiplied by the average human resource cost (AHRC) in each work group to calculate the total cost of an employee (TCE) in the scenario in which no robotic development was undertaken.

$$TCE = (FTE\ Saving) * AHRC \tag{3}$$

Some important aspects should not be overlooked in the cost calculation of robotic process automation investment. First, the employment of a team of robotic experts, separate from the relevant business units, for coding robotic processes stands out as an additional cost. In each case of robotic process development, it is necessary to calculate how many person days the central RPA team spends and the effort that this team exerts in following the process, updating it, and eliminating the related errors during the period after the related process is transferred to the robot. A more realistic approach is to include in the calculation the time required for the RPA team to be trained to code the process and the cost of the time that the RPA team spends without process coding because it is not working at full capacity. In the analysis method, the cost of the RPA team, the time spent writing the code, and the total cost of the time spent on all the above monitoring and control activities are included in the calculation.

Second, since the robots do not work at full capacity, when calculating the robotic cost (RC) for each business unit, a value should be obtained by dividing the total robotic investment cost (TRIC) by the total active working time (WT).

$$RC = \frac{TRIC}{WT} \tag{4}$$

This means that the cost of robots' downtime is distributed to active robotic processes. For example, the capacity utilization rate of robots never exceeded 40% in the period examined within the scope of this study. Although full capacity operation was never targeted in terms of business continuity in robotic process automation, it can be said that 40% is a very low rate. In this sense, it may seem unfair that the total cost of robots with the ability to work 24/7 is charged only to the time that they work actively. On the other hand, no matter how inefficiently they are used, considering that all the robotic investment costs made by the financial institution in the analyzed period are for activated robotic processes, the method used is viewed as more realistic.

Finally, the cost reduction obtained by comparing the robotic cost (RC) and the total cost of employees (TCE) for each business unit is examined. The number of processes transferred to robots in each business unit to achieve the cost reduction is different. In this respect, the cost reduction per process is obtained by dividing the savings by the number of processes.

3.2 Primary data collection and survey measurement

3.2.1 Survey setting and data collection

The data were collected through an online survey tool that was designed in Google Forms. The survey link was shared through e-mail circulation with the employees who are affected by RPA and work in the treasury, human resources, legal affairs, risk follow-up, call center, operations, financial affairs, and marketing business units in the chosen financial institution. To establish content validity, in-depth interviews were held with executive managers who work at similar financial institutions. Likewise, the questionnaires were discussed with several academics in the field of financial technologies and revised based on the feedback. Eventually, clear, understandable, and well-structured survey questions were developed. The targeted respondents who would complete the surveys were the affected employees and the managers in the units in which RPA was implemented.

The survey questionnaire was originally prepared in English, then the final version was translated to Turkish. The survey was back translated to English to increase the accuracy of the questions. The translated English text was controlled by several academics again to preserve the original meaning of the survey questions for the study. Approval was obtained from the university's research ethics committee before the dissemination of the survey. We randomly sampled 200 respondents throughout the units of the institution who are affected by the RPA implementation. A total of 106 questionnaires were returned. All the responses were usable, and the response rate was 53%. The business units are organized into four groups according to their process characteristics. A summary of the characteristics of the sample is presented in Table 1.

Table 1. Characteristics of the sample

Characteristics		**N=106**	**%**
Respondent's position	Business unit employee	77	72.6
	Business unit manager	29	27.4
Work duration in the institution	< 5 years	40	37.7
	5 and > 5 years	66	62.3
Work experience	< 5 years	34	32.1
	5 and > 5 years	72	67.9
Business unit	Reporting-based processes (treasury, human resources, financial affairs)	28	26.4
	Operational processes (operation, risk monitoring)	50	47.2
	Call center processes	16	15.1
	Marketing processes	12	11.3

3.2.2 Measurement of the variables

In the survey, closed-ended questions and the Likert scale were used [28]. The survey was measured through a five-point Likert scale ranging from 1 = "strongly disagree" to 5 = "strongly agree." The reason for using a five-point Likert scale is that it is less confusing than other scales and better quality responses are received from the respondents, according to the literature [29], [30].

Based on a comprehensive review of the relevant literature, the survey instrument was prepared to measure the employees' perception of value-added activity change after the implementation of RPA. During the literature review, we compiled our question sets based on the context of keywords such as "routine, repetitive, and manual work," "soft skills," "analytical work," and "job diversity," which are used in RPA articles that indicate value-added jobs after the implementation of robotic process automation. The survey questions that were asked to measure the rate of repetitive and manual work were adapted from earlier studies [17], [31], [32]. The questions examining soft skills after the implementation of RPA were also drawn from earlier studies [17], [33], and the questions regarding the necessity of technological capabilities before and after the implementation of robotic process automation were adapted from earlier studies [27], [31], [34]. All the questions that define Value-Added Activity (VAA) were combined into one set of questionnaires that constitutes the VAA construct.

4. Data analysis and results

In our descriptive case study, hard data were collected from the systems that belong to a Turkish financial institution, and the necessary calculation was performed to analyze the time and cost results. According to the results of hard data, primary data collected from the survey were also analyzed descriptively to explore the value-added activities of employees after the implementation of RPA.

4.1 Secondary data analysis and results for time

One of the most important added values of RPA is the increase in the transaction processing speed. Table 2 indicates that, in 50 of the 54 processes followed during the analysis period, the robot worked faster than an employee and performed the operations in an average of 63% less time.

Table 2. Results for processing time

Business unit	No. of processes	No. of processes in which the robot is faster	Average employee processing time (Sec.)	Average robot processing time (Sec.)	Average robot processing time efficiency
Treasury	7	7	2143	299	86%
Human resources	3	3	400	58	85%
Legal affairs and risk follow-up	3	3	160	40	75%
Call center	5	5	1392	424	70%
Operations	16	16	491	170	65%
Financial affairs	17	13	2241	831	63%
Marketing	3	3	68300	26533	61%
Grand Total	**54**	**50**	**5083**	**1870**	**63%**

Through a detailed analysis performed on a process basis, it is apparent that robotic time efficiency is higher in processes that currently have low automation rates and require the use of multiple screens. The more IT automation is

done in the related processes, the easier it is for the personnel to perform that operation and the personnel processing time is reduced. Likewise, if there is a need to operate from more than one screen in the process, this slows down the personnel and causes a waste of time to switch between screens. When the robotic process is started, the transition between the relevant screens is much faster and the use of too many screens does not affect the robot as much as the personnel. This is the main reason for the robot achieving much greater time efficiency in the treasury and human resources business units. Conversely, it is evident that the time efficiency of robotic process automation is relatively low for operations processes, in which there are routine and very repetitive tasks, since the employees' ability to perform these tasks is high. The high automation rate of the screens used by the employees because of the high level of IT capability is also a factor that affects the time efficiency in the operations business unit.

While the robot completed the process faster in 50 of the 54 processes in which RPA was applied, the robot was slower than the personnel in the following 4 processes belonging to the Financial Affairs business unit. These processes are presented in Table 3.

Table 3. Financial affairs business unit results for time

Business unit	**Process**	**Employee processing time (Sec.)**	**Robot processing time (Sec.)**
Financial affairs	Official reporting—daily public deposit—treasury	600	600
Financial affairs	Official reporting—spot foreign exchange—CBRT	900	1800
Financial affairs	Official reporting—TL101G CBRT	900	1800
Financial affairs	Official reporting—daily participation fund CBRT	1800	3600

The preparation time of the relevant reports by robots is equal to or longer than the preparation time by the employees. The main reason for this situation is that these reports are made with a very high degree of IT capability support when they are prepared by the employees. Although the IT improvements made on the screens where the employees make transactions do not fully automate the preparation of the relevant reports, they have facilitated the transactions by the personnel. With the transition to RPA, these IT improvements on the screens became useless and the previously spent IT resources were wasted. Therefore, some of the related IT support capability is lost when the robotic process is started, which may cause inefficient results.

4.2 Secondary data analysis and results for cost

While performing the cost comparison analysis, the 12-month total expenses covering the period of May 2020–May 2021 were considered and compared with the person–day cost to be spent in the scenario in which no RPA was undertaken. Thus, the aim was to achieve annual net cost savings with RPA.

One of the important expected outputs of RPA is employee savings. The full-time employee (FTE) savings field in Table 4 is the theoretical number of employees thought to have been saved in business units over the employee time eliminated. A total workload of 12.4 FTEs was transferred to robots. When the FTE savings per process with RPA are analyzed, the operations and call center areas are prominent. Savings of 6.8 FTEs were achieved in the operations business unit and 2.1 FTEs in the call center. Although the same workload savings were not achieved in all 27 sub-business units, it is apparent that an average workload of 0.5 FTEs is transferred to the robot in each sub-business unit.

The total cost of employees (TCE) in Table 5 is the total employee cost obtained due to not using manpower after RPA in the relevant processes. Conversely, during this period, it was observed that relevant processes were transferred to the robot by an average of 4.3 robotic process developers and an average of 5 robots. Table 5 shows the comparative results of these two costs.

Table 4. Employee savings

Business unit	No. of sub-business units	No. of processes	FTE savings	FTE savings per process	FTE savings per sub-business unit
Call center	2	5	2.1	0.4	1.0
Treasury	4	7	0.9	0.1	0.2
Legal affairs and risk follow-up	2	3	0.5	0.2	0.2
Human resources	1	3	0.5	0.2	0.5
Financial affairs	3	17	1.2	0.1	0.4
Operations	12	16	6.8	0.4	0.6
Marketing	3	3	0.5	0.2	0.2
Grand Total	**27**	**54**	**12.4**		

According to the analysis results shown in Table 5, savings of 1,145,004 Turkish lira (TL) can be made annually by switching to robots in 54 processes. The highest earnings were obtained in operations.

In the analysis of savings percentages, the highest savings efficiency was achieved in the treasury and human resources. It is apparent that the employee expenses in these business units were reduced by 81% and 73%. In contrast, the financial affairs business unit had the lowest savings rate, with 23% of employee expenses. The factors that caused the savings to differ for different business units are the annual number of transactions in the processes, the difference in the processing times of robots and employees, and the average human resource cost in those areas.

Even though financial affairs is the area in which the most processes are undertaken, it is evident that this business group ranks second from last in total savings. Therefore, the financial affairs unit ranks last in savings per process and savings percentages. Considering that the robotic development time is the same for all processes, the fact that the RPA team performs the most processes in the business unit with the least savings per process shows that it is not the right choice (Table 5).

Table 5. Results of the cost comparison

Business unit	No. of processes	Total cost of employees (TCE) (TL/Annual)	Robotic cost (RC) (TL/Annual)	Savings (TL/Annual)	Savings per process (TL)	% of savings
Operations	16	1,100,899	505,186	595,713	37,232	54%
Call center	5	337,342	155,655	181,687	36,337	54%
Treasury	7	188,595	35,307	153,288	21,898	81%
Human resources	3	86,275	22,936	63,339	21,113	73%
Legal affairs and risk follow-up	3	92,507	36,501	56,007	18,669	61%
Financial affairs	17	226,365	174,625	51,739	3,043	23%
Marketing	3	95,329	52,098	43,231	14,410	45%
Grand Total	**54**	**2,127,311**	**982,307**	**1,145,004**		

The main reason for the financial affairs and marketing business units appearing in the last place in both total savings and savings per process is their negative differentiation from other groups in the number of transactions per process (Table 6). Thus, the higher the number of transactions in the selected process during the analysis period, the greater the total savings from the process.

Table 6. Transactions per process

Business unit	**No. of transaction**	**No. of processes**	**Transactions per process**
Operations	441,682	16	27,605
Legal affairs and risk follow-up	17,130	3	5,710
Human resources	7,248	3	2,416
Call center	11,174	5	2,235
Treasury	7,478	7	1,068
Financial affairs	4,538	17	267
Marketing	74	3	25
Grand Total	**489,324**	**54**	**30,583**

Another reason for the low level of savings per process in financial affairs is that, in the above four processes (Table 7), in which the robot works more slowly than the employees, no savings could be obtained from robotic process automation and the RPA investment was lost.

Table 7. Financial affairs processes

Process	**Robot annual cost**	**Employee annual cost**	**Annual net saving**
Official reporting—daily public deposit—Treasury	7,351	4,892	-2,459
Official reporting—spot foreign exchange—CBRT	22,054	7,338	-14,715
Official reporting—TL101G CBRT	22,054	7,338	-14,715
Official reporting—daily participation fund CBRT	44,108	4,677	-29,431

The actual number of employees in all the business units was examined after RPA. It is remarkable that no real reduction in the total number of employees was achieved in any of the business units. One of the main reasons for this situation is that the workload savings is less than one person in all the business units except the call center (Table 8).

Even though the workload was transferred to robots, each unit kept its current employees, which posed a question about what happened to the effectiveness that was gained from the implementation of RPA. Thus, we investigated the employees' perception of value-added activities to explore the real cost-saving tendency related to the labor cost. The third part of our research investigated whether employees perceive that these savings are directed to VAA.

Table 8. Employee savings

Business unit	No. of employees before robotics	No. of employees after robotics	Real employee savings
Call center	23	23	0
Treasury	17	17	0
Legal affairs and risk follow-up	9	9	0
Human resources	12	12	0
Financial affairs	14	14	0
Operations	48	48	0
Marketing	18	18	0
Grand Total	**141**	**141**	**0**

4.3 Primary (survey) data analysis and results for Value-Added Activity (VAA)

The unchanged number of employees after the implementation of RPA captured our attention and directed us to investigate the value-added activity presence among employees to see how the efficiency and effectiveness of RPA appear in the financial institution. The quantitative survey results were analyzed with descriptive statistics to understand employees' perception of value-added activities within the business units in which they operate.

4.3.1 Measurement method and results

Our research proposal was to investigate value-added activity appearance in business units that had implemented RPA. We decided to perform a factor analysis of our sample and compare the differences according to the characteristics of the sample to determine how VAA changes accordingly. The first step was to conduct a factor analysis, forcing us to eliminate four questions out of 14 because of reliability issues and the internal consistency of the questions. A repeated factor analysis test with the remaining questions created one factor that explains 55.2% of the total variance and was defined as the VAA construct in line with the literature [1], [17], [35]. The reliability of the construct was measured with a Cronbach's alpha of 0.904, which is above the necessary threshold of 0.70 [36]. In addition, each question's factor loadings are above the accepted minimum level of 0.50, which ensures the content validity of the survey (Table 9).

A normality test is necessary to decide whether the samples are distributed normally and thus whether to choose a parametric test or a non-parametric test for the variance analysis. The skewness and kurtosis values were checked and shown to be between -1.5 and +1.5, which indicates that our sample is normally distributed [37]. Therefore, to test the variance analysis between the VAA construct and the characteristics of the sample, we decided to perform an independent t-test that includes two groups in the characteristics variables, respondent position, work duration at the institution, and work experience. A one-way ANOVA test was performed to measure business units' characteristic variable, which contains more than two groups — reporting-based, operational-based, call center, and marketing business units — to examine the variance between the VAA construct and the characteristics.

Table 9. Descriptive analysis of value-added activity (VAA)

	Items	Mean	Std Deviation	Variance	Factor loading	α
Value-added activities						**0.904**
After the implementation of Robotic Process Automation (RPA), the time allocated to manual and routine tasks/work performed by the employee decreased.	Q1	4.02	0.84	0.71	0.633	
After the implementation of Robotic Process Automation (RPA), creative work emerged.	Q2	3.62	0.86	0.75	0.793	
After the implementation of Robotic Process Automation (RPA), knowledge-based jobs increased.	Q3	3.48	1.00	1.01	0.651	
After the implementation of Robotic Process Automation (RPA), problem-solving skills are used effectively in the work.	Q4	3.69	0.84	0.70	0.789	
After the implementation of Robotic Process Automation (RPA), technological competence is required for the work.	Q5	3.81	1.03	1.06	0.647	
After the implementation of Robotic Process Automation (RPA), a proactive approach can be adopted in the work.	Q6	3.77	0.83	0.69	0.803	
After the implementation of Robotic Process Automation (RPA), employees can focus on the analytical side of the work.	Q7	3.85	0.92	0.84	0.805	
After the implementation of Robotic Process Automation (RPA), innovative approaches can be introduced into the work.	Q8	4.02	0.78	0.61	0.809	
After the implementation of Robotic Process Automation (RPA), job diversity increased.	Q9	3.34	1.04	1.08	0.739	
After the implementation of Robotic Process Automation (RPA), business processes in which decision-making skills are used increased.	Q10	3.54	1.00	1.01	0.724	

Notes: 5-point Likert scale: 1 (strongly disagree) to 5 (strongly agree); ⟨ = Cronbach alpha.

4.3.2 Analysis results

The survey results show the variance between specific characteristics of the employees and their VAA in the business units in which robots currently operate. The t-test was conducted between the respondent position, the work duration at the institution, the work experience, and the VAA of employees. The results show that none of the characteristics' values of the two groups vary with the VAA of employees ($p > 0.05$). Thus, the VAA is not changed by the institution's specific characteristics. The business units of the institution, according to the ANOVA test results, are also not significant ($p > 0.05$), indicating that none of the business units' values make any difference to the VAA perspective among the employees with the implementation of RPA. These results explain that the VAA of the employees does not vary with the institution's measured characteristics. In addition, the descriptive statistics of the survey, presented in Table 10, indicate that RPA implementation helps the institution's business units only in the completion of routine tasks which fit with the technology.

Table 10. Descriptive statistics of the questionnaires

Survey questions	Strongly disagree (1) %	Disagree (2) %	Neither agree nor disagree (3) %	Agree (4) %	Strongly agree (5) %	Mean	Std. deviation
After the implementation of Robotic Process Automation (RPA), the time allocated to manual and routine tasks/work performed by the employee decreased.	1.9	4.7	8.5	**58.5**	**26.4**	**4.03**	0.84
After the implementation of Robotic Process Automation (RPA), creative work emerged.	0.9	11.3	**23.6**	**52.8**	11.3	**3.62**	0.86
After the implementation of Robotic Process Automation (RPA), knowledge-based jobs increased.	1.9	17.9	**24.5**	**41.5**	14.2	3.48	1.00
After the implementation of Robotic Process Automation (RPA), problem-solving skills are used effectively in the work.	0	10.4	**23.6**	**51.9**	14.2	**3.70**	0.84
After the implementation of Robotic Process Automation (RPA), technological competence is required for the work.	1.9	14.2	10.4	**48.1**	**25.5**	**3.81**	1.03
After the implementation Robotic Process Automation (RPA), a proactive approach can be adopted in the work.	0.9	7.5	**19.8**	**56.6**	15.1	**3.77**	0.83
After the implementation of Robotic Process Automation (RPA), employees can focus on the analytical side of the work.	1.9	9.4	10.4	**57.5**	**20.8**	**3.86**	0.92
After the implementation of Robotic Process Automation (RPA), innovative approaches can be introduced into the work.	1.9	2.8	9.4	**62.3**	**23.6**	**4.03**	0.78
After the implementation of Robotic Process Automation (RPA), job diversity increased.	1.9	**24.5**	23.6	**37.7**	12.3	3.34	1.04
After the implementation of Robotic Process Automation (RPA), business processes in which decision-making skills are used increased.	2.8	16	**17.9**	**50**	13.2	**3.55**	1.06

5. Discussion and conclusion

In the first part of the exploratory sequential approach of the study, secondary data collected from various units of a financial institution were used and the effects of RPA on time and cost efficiency were examined. In the second part, according to the information extracted from the initial descriptive case study, the effect of RPA on the VAA of employees was analyzed by interpreting the primary data obtained through the questionnaire, and it was determined whether the time and cost savings obtained from RPA allowed the related units' employees to focus more on value-added activities to see the strategic value.

The analysis of the secondary data showed that robots completed the process faster than employees in 93% of the processes (50 of 54 processes). When all the processes are considered, it is apparent that robots work on average 63% faster than humans, which supports the literature in general [6]. The use of multiple screens in RPA-applied processes, staff members' experience with screens, IT automation, and the business alignment rate came to the fore as the main factors affecting the relative speed of the robot compared with the staff. Therefore, a remarkable result is that, in four

out of 17 processes in the financial affairs business unit, the robot works slower than the employees and the RPA application cannot be exploited in terms of speed; this result is not in line with the literature. According to the literature, while RPA should save time, it was observed that the robot did not work faster than the personnel in some of the processes examined. [6]. It is believed that robots are more efficient in routine work; therefore, the IT capacity and capability can be improved in business units that require a high level of knowledge, and transactions can be carried out faster. Also, it is possible that the tasks in the financial affairs business unit may have non-routine characteristics, thus the relationships between tasks and technology may construct a low fit presence to produce necessary strategic value related to timesaving [11].

The second analysis using secondary data focused on cost savings. The results show that a total of 12.4 full-time employee (FTE) jobs were transferred to the robot. When the number of processes transferred to the robot is evaluated, the units with the highest FTE savings per process were operations and the call center. As a result of the comparison of the total employee cost, which corresponds to the FTE savings obtained, and the cost of the robot, it can be seen that the financial institution has saved 1.1 million TL in a year. This amount of savings shows that cost efficiency of 54% has been achieved. The annual number of transactions in the relevant processes, the difference in the processing speed of the robot and the employees, and the average human resource cost are important factors explaining the differences in the amount of savings in business units. For example, although the financial affairs department is the unit where most processes are transferred to the robot, it ranks second from last in total savings and last in savings per process. This situation shows that financial institutions that implement RPA should make more rational choices to achieve the highest level of efficiency when choosing a process. This result supports that one of the most important challenges in the banking and financial industry is to select the right process to use RPA [41]. To achieve more rational choices in business process management at the beginning of RPA project, a combination of human intelligence, process mining by extracting event data from Information Systems, and artificial intelligence by generating a standard classification on deviated, failed, or delayed processes can be implemented to discover most logical business processes [13]. Since RPA deals with structured data, AI implementation with RPA would solve the gap in capturing unstructured data by having capabilities such as Optical Character Recognition (OCR) and Natural Language Processing (NLP). Transforming traditional RPA into Cognitive RPA with these technologies creates human-like capabilities that help to improve a better understanding of the processes of the organizations [39]. This way task-technology fit can be achieved. Also, RPA may create risk and weakness in a more controlled environment which needs to be addressed in the financial affairs department to align with TFF theoretical perspective [38].

One of the most striking results of the study, contrary to the literature [9], [10], [15], [19] is the fact that no real employee reduction was observed in any business unit, although 12.4 FTE of work was transferred to a robot through robotic process automation. This situation raises the question of whether the reduction in workload and time savings as a result of the RPA implementation in the relevant units led to an increase in value-added activities.

To answer this question, the integration of both qualitative and quantitative analysis in a descriptive case study was applied, and the primary data obtained through the survey were examined. The results reveal that there was no statistically significant difference between the views of the employees based on their position, work duration at the institution, and work experience. Conversely, when the questions with which the employee agreed most (evaluating the sum of the agree and strongly agree responses) were examined, it was apparent that the rate of employees who think that innovative approaches have increased in their work is 85.9%. In addition, it was observed that the rate of employees who believe that the analytical focus has increased is 78.3%, while the number of employees who think that there has been a decrease in routine and manual work is 84.9%. The subject on which the employees agree least is the thesis that job diversity has increased. While the rate of the employees' agreement with this opinion was 50%, the percentage of respondents expressing disagreement and strong disagreement was 26.4%.

In the 10 questions asked about the increase in value-added activities, the average agreement rate of the employees was 69.4%. This shows that the employees think that there has been an increase in value-added activities in the business unit in which they work since the RPA implementation. This result supports our last proposal and some of the literature related to employee effort in value-added activity [10], [17], [23], [24]. On the other hand, our results contradicted the

studies that were evaluating RPA implementation in the public sector in which the employees were not focused on value-added activities without giving education [42]. This indicates that financial sector employees` capability on adaption of RPA and business analytical capability is high, but additional educational support could increase employees` innovative approaches. In the evaluations made based on the survey results, it is seen that the time allocated to develop the digital and analytical competencies of the employees and to obtain insights about the areas they are responsible for by using their business analytics competencies has increased. It is also seen that they interact more with other units and do more collaborative work and focus more on design-oriented product and process development activities for the development of business processes.

It can be concluded that the reason for the increase in job diversity is relatively low is that robots can only undertake routine work in the institution; therefore, the institution can benefit from RPA only within the framework of descriptive applications. In addition, the results indicate that the basic level of RPA implementation is not enough to capture necessary strategic output; instead the RPA implementation should be either cognitive or artificial intelligence level to eliminate the task-technology fit problems in some units [12]. When evaluating the institution in terms of process analytical capability, it is understood that it cannot switch to automatic decision-making mechanisms, which we can call full automation, which is the predictive level. Likewise, instead of focusing on directly the individual processes, RPA strategy needs to consider a holistic approach with customer-oriented solutions in financial institutions [39]. As a result, since it still needs human capital, real cost savings cannot be realized from the perspective of the number of employees. The result also revealed how task-technology fit impacts the performance of overall expected efficiency results with strategic value. Therefore, task and technology alignments are necessary to get the predictive level benefits of the RPA technology.

Limitations and future research directions

Although the fact that our study examined only one financial institution's use case prevents us from generalizing the results to all financial institutions, in practice, this study suggests that similar companies should benefit from this experience and implement RPA for more routine processes. Another conclusion to be drawn for these companies is that the use of predictive data, the capabilities of which have been improved with AI, and the development of IT competencies in complex jobs can yield more successful results than RPA. The low number of processes transferred to robots in the financial institution is another major limitation of the study as it resulted in insufficient sampling. The study was carried out two years after the financial institution started the RPA application and only 54 of the 757 processes in the financial institution were included in the RPA application studies to be carried out in institutions where the maturity level of RPA implementation is higher will provide more efficient results in terms of a larger sample. Conversely, the fact that RPA has not yet been implemented in any process that requires optical character recognition (OCR) is the biggest obstacle to reaching higher levels of technological efficiency. OCR increases the potential number of processes that RPA can run effectively. In this respect, it is estimated that RPA can produce very effective results in studies to be carried out in organizations with a high level of OCR usage. The third limitation is that the RPA application does not contain artificial intelligence. The inability of RPA to be applied to processes that require artificial intelligence has caused many high-value-added processes with robotic potential to be excluded from the application. With the development of RPA applications with these features in the coming period, it is expected that time and cost efficiency will reach much higher levels and that the value-added activity increase will be at a much higher level in the units in which RPA is applied. Finally, the use of an employee questionnaire as a measurement method of the increase in value-added activities is also considered as a limitation. The lack of data on how much of the total time distribution of the employees in terms of workload is spent on value-added work resulted in the inability to make a statistical measurement in this regard. Test of the first and second proposals is quite reliable in that it is derived entirely from the financial institution's information system's data. On the other hand, making the third proposal based on the bank's workforce distribution data rather than the personnel survey data will provide a much more reliable environment to validate the value-added activity increase thesis. The fact that the financial institution did not keep these data led to the necessity of testing the third thesis with the survey method. In future studies, analyzing the employees' workload distribution before and after the RPA application, considering the nature of the job, will be a step toward overcoming

this limitation. In addition, by measuring IT performance in the future, the performance difference between the processes in which IT automation is applied and the processes in which RPA is applied will provide a clearer perspective on the selection of applications.

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