Robotic Process Automation: A literature review on quantitative benefits

Mohammed Alfandi
Ph.D. student in Industrial Engineering
Graduate School of Natural & Applied Sciences
Gaziantep University
Gaziantep, Turkey
ma21101@mail2.gantep.edu.tr

Serap Ulusam Seçkiner
Full Professor of Industrial Engineering
Graduate School of Natural & Applied Sciences
Gaziantep University
Gaziantep, Turkey
seckiner@gantep.edu.tr

Abstract
Robotic Process Automation (RPA) comprises a set of emanating technologies that promise to automate business processes. This is achieved by simulating the way a human performs the target process. Although the time and cost savings advantages of RPA and other related performance metrics have been shown in various contexts, we found no literature review of the quantitative results. This requires an in-depth study to illustrate the quantitative benefits of RPA in various industry sectors. This paper presents a structured literature review based on various industry sectors. The aim was to analyze the quantitative benefits of Robotic Process Automation (RPA). We are presenting the potentials of RPA in each industry using case studies and prober RPA processes in each sector. The study concludes that although there are tremendous quantitative benefits of implementing RPA, only a few organizations in each sector reported their quantitative results.

Keywords
Robotic Process Automation; Financial Benefits; Business Process Automation; Business Improvement; RPA in various business sectors.

1. Introduction
Technological leaps accompanied by industrialization lead to what is known as “industrial revolutions.” these industrial revolutions have occupied the fore. Starting with the first industrial revolution that presented mechanisms, the second industrial revolution that presented electrical energy, and the third industrial revolution that presented digitalization (Lasi et al. 2014), there have always been efforts to enhance processes and achieve continuous improvements. Otherwise, it would not be possible to reach those peaks. Now a fourth industrial revolution is building on the third, the digital revolution occurring since the middle of the last century (Xu et al. 2018). These revolutions caused transformations of all sectors and made the necessity to keep up with this rapid change inevitable.

One technology that is expected to enhance organizations' processes and keep them competitive is Robotic Process Automation (RPA). Process Automation is not a recent concept since it has developed from using machines to perform physical tasks to include computers to perform service tasks later (Autor et al. 2003). Despite that RPA is the second-fastest-growing career category (Taulli 2020), it has received little academic attention than process automation, a mature research subject. However, the recent decade witnessed many case studies and applications of Robotic process automation.

In this study, we try to develop intuition and gain an in-depth understanding of the quantitative benefits of RPA in various industry sectors. Along with identifying the specific processes that are automated using RPA in each

mentioned industry. The aim is to check the real benefits of RPA in different industry sectors and make sure that its benefits are financially measurable.

The paper is structured as follows; Firstly, a brief explanation about RPA, its components, and the RPA project methodology has been given. In the second section of the paper, the research methodology has been presented. In the third section, the RPA implementation review in different industry sectors has been discussed. Lastly, the fourth part of the paper brings the results and conclusion.

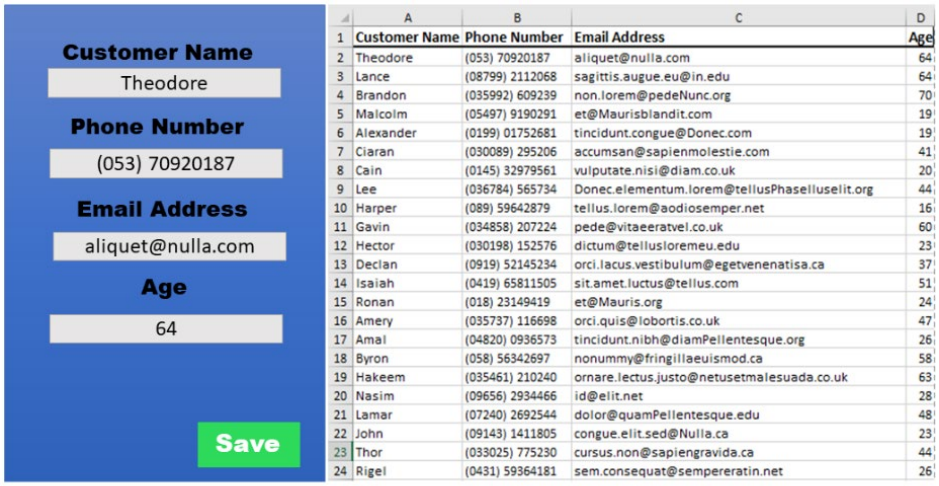
1.1 What is robotic process automation?

RPA is "a relatively new technology comprising software agents called 'bots' that mimic the manual path taken by a human through a range of computer applications when performing certain tasks in a business process" (Syed et al. 2020). Another definition claims that RPA goes even further and might even perform knowledgeable tasks like the Institute for Robotic Process Automation (IRPA), which defines RPA as "An application of technology that allows employees in a company to configure computer software, or a 'robot', to capture and interpret existing applications for processing a transaction, manipulating data, triggering responses and communicating with other digital systems." Other researchers like Aguirre and Rodriguez (2017) said that "Robotic Process Automation (RPA) emerges as a software-based solution to automate rules-based business processes that involve routine tasks, structured data, and deterministic outcomes.".

As inferred from the provided definitions, no hardware involvement includes "physical robots." Hence, Robotic Process Automation (RPA) is a form of digital process automation that uses robotic software that can do repetitive tasks usually done by humans. This is expected to allow employees to focus on more complicated tasks or tasks that might require decision-making instead of losing valuable time on performing mundane and tedious tasks. Besides, significant cost savings, quality improvement, and agility are associated with a successful RPA project (Asatiani and Penttinen 2016). Some examples of the typical tasks that were automated using RPA according to Jovanović et al. (2018) are: sending emails, opening applications, and copying and pasting information from one system to another. Lacity et al. (2015a) mentioned some suitable processes for RPA, for example, transferring data from email or spreadsheet software to ERP or CRM and vice versa. What is important to mention here is that RPA is useful when software does not have its application programming interfaces linked, and intra-software communication is possible only by front-end users, namely human workers or RPA (Asatiani and Penttinen 2016). Swedberg (2018) studied tens of papers that discussed process selection for RPA and created criteria and guidelines as a list of 49 criteria studied thoroughly process selection for RPA. Later on, more recent research by Syed et al. (2020) extracted the following characteristics of RPA-suitable tasks from thirty research papers:

- Highly rule-based
- High volume
- Mature
- Easy to achieve and show the impact
- Has digitized structured data input
- Highly manual
- Transactional
- Standardized
- Low levels of exception handling
- Highly repetitive
- Fewer complex processes
- Well-documented
- Interacts with many systems

When choosing the right tasks to be automated, many benefits can be achieved. A study made by Kroll et al. (2016) suggests that an RPA software license can cost between 1/3rd to 1/5th of the price of a Full-time Equivalent (FTE). The benefits of RPA will be studied thoroughly later on in this paper according to each industry sector. Figure 1 shows an example of a suitable RPA process, where there is a list of new registered customers (this is fake data just for illustration). We want to fill in all the information to update our customers' database. We can notice that even though the operation is easy and includes copy-paste actions, it needs much time to be accomplished. Such routines are perfect to be done with a simple robot using RPA technology.



	A	B	C	D
1	Customer Name	Phone Number	Email Address	Age
2	Theodore	(053) 70920187	aliquet@nulla.com	64
3	Lance	(08799) 2112068	sagittis.augue.eu@in.edu	64
4	Brandon	(035992) 609239	non.lorem@pedeNunc.org	70
5	Malcolm	(05497) 9190291	et@Maurisblandit.com	19
6	Alexander	(0199) 01752681	tincidunt.congue@Donec.com	19
7	Ciaran	(030089) 295206	accumsan@sapienmolestie.com	41
8	Cain	(0145) 32979561	vulputate.nisi@diam.co.uk	20
9	Lee	(036784) 565734	Donec.elementum.lorem@tellusPhaselluselit.org	44
10	Harper	(089) 59642879	tellus.lorem@aodiosemper.net	16
11	Gavin	(034858) 207224	pede@vitaeeratvel.co.uk	60
12	Hector	(030198) 152576	dictum@tellusloremeu.edu	23
13	Declan	(0919) 52145234	orci.lacus.vestibulum@egetvenenatisa.ca	37
14	Isaiah	(0419) 65811505	sit.amet.luctus@tellus.com	51
15	Ronan	(018) 23149419	et@Mauris.org	24
16	Amery	(035737) 116698	orci.quis@lobortis.co.uk	47
17	Amal	(04820) 0936573	tincidunt.nibh@diamPellentesque.org	26
18	Byron	(058) 56342697	nonummy@fringillaeuismod.ca	58
19	Hakeem	(035461) 210240	ornare.lectus.justo@netusetmalesuada.co.uk	63
20	Nasim	(09656) 2934466	id@elit.net	28
21	Lamar	(07240) 2692544	dolor@quamPellentesque.edu	48
22	John	(09143) 1411805	congue.elit.sed@Nulla.ca	23
23	Thor	(033025) 775230	cursus.non@sapiengravida.ca	44
24	Rigel	(0431) 59364181	sem.consequat@sempereratin.net	26

Figure 1. Fill customers data to a database app from Excel Sheet

1.2 Robotic process automation components

RPA is a relatively fresh field of study, as mentioned earlier in the introduction, and it lacks much theoretical background. So, for RPA components or RPA architecture, which is a technological perspective, it becomes hard to specify it because it varies from one RPA vendor to the other. It can be said that whatever the RPA architecture is, it will have either Stand-alone or Client-Server to manage those robots (Agostinelli et al. 2019). Besides, in all RPA solutions, we will have either attended or unattended bots (Tornbohm and Dunie 2017).

Attended RPA bots involve tasks that work with employee intervention, meaning that they work alongside a human controller who might input/take some to/from the robot while it is executing what it is designed for (an example would be in the call center, where a rep can have the RPA system handle looking up information while talking to a customer). Also, attended robots are suitable for many cases, like when there is a need for human decisions or entering data, or when there might be exceptions that are not expected.

Unattended RPA bots involve tasks with no human intervention at all, meaning that they execute the task they are designed for with no human involvement, and they do not take any input data. Unattended RPA bots are suitable for executing deterministic routines where all execution paths (including exceptions) are well understood and can be codified. Copying records from one system into another via their user interfaces through a series of copy-paste operations is an example of a routine that could be executed by an unattended bot (Leno et al. 2020).

1.3 Robotic process automation project methodology

A successful deployment of RPA technologies in an organization depends on a systematic approach to tackle the strategic level considerations surrounding the adoption of RPA and the technical considerations surrounding RPA implementations (Syed et al. 2020). Syed et al. (2020) concluded that many papers delivered reports and lessons learned from their RPA implementations within organizations. However, it is not vendor-neutral and is underpinned by rigorous academic research. Nonetheless, we can say that Willcocks et al. (2015) highlighted general eight steps the organizations can follow for RPA projects;

- Establish Business-RPA alignment: There must be a strategy the organization follows before thinking of RPA, so we should align this strategy and RPA's strategy.
- Define the organizational design and the role of the Head of RPA: The organization's structure must be defined and its responsibilities. This is very important to design the implementation process. The design must accord to the organization's needs. As organizations grow, they become more complex, meaning the need for more centralized RPA departments, while small size organizations have the advantages of a flexible light model.
- Form an RPA Governance board to manage the demand pipeline and assess RPA opportunities: To ensure the right delivery of RPA, it is recommended to have an RPA governance board that will be responsible for the demand pipeline for RPA. This RPA governance board prioritizes and assess the tasks and implement the most important ones first.

- Agree on the RPA delivery methodology and the tracking of its correct use: RPA delivery methodology is usually based on the RPA vendors who offer a standardized methodology that can be adapted in-house. When an unfamiliar process is added to the implementation plan, it is done using the selected RPA delivery methodology.
- Establish the RPA service engagement model required to support operational processes: With the correct support infrastructure in place, RPA optimizes the productivity of both human and virtual workforces. Operational support activities include referral and exception handling, business continuity, testing and deployment, systems support, process support, and product support. The roles and responsibilities for such tasks need to be assigned across a business unit, operational, RPA, IT teams, and the RPA software provider.
- Define the people, their roles, and responsibilities, and provide the training they need for operating efficiently in the existing organizational structure.
- Define a scalable, low-maintenance technical environment and associated growth strategy.
- Plan for Scaling.

2. Research methodology

As a niche and emerging technology of business automation, the literature on RPA is insufficient. The results of previous literature reviews revealed the benefits of RPA implementation. However, there was a lack of presenting even the preliminary finding of quantitative benefits. Besides, the extempore analysis of recent RPA literature has shown that RPA is regarded in business activity as an opportunity to enhance processes. While many of the advantages and complexities of RPA implementation have been discussed, the need to have a literature review to exhibit the quantitative results of RPA implementation in various industry sectors emerges. Towards achieving this aim, we used the Systematic Literature Research (SLR) methodology, as it is used in similar research by (Ivančić et al. 2019). We studied carefully the reference “Guidelines for performing Systematic Literature Reviews in Software Engineering” (Kitchenham and Charters 2007) illustrates the various benefits of using SLR in software engineering. This methodology became very popular in the recent two decades in management and information technology (Ivančić et al. 2019). Our research will not build statistical results based on our search, so we will use the general theme of SLR in our method that complies with our goal.

According to these papers Mariano et al. (2017) and Boell and D (2015), which provide standard guidelines for SLR, our literature review was performed using a three-step method: (1) SLR protocol definition and literature search and selection; (2) quality appraisal and extraction of relevant articles; and (3) qualitative analysis and synthesis of the accepted articles. However, we had to add an extra step to make an additional search.

The first step was achieved by establishing a research protocol that started by constructing the queries to be executed in digital libraries and search engines. The main keywords for these queries are: “Robotic Process Automation, RPA case-study, RPA benefits." There were synonyms we used to make sure we got all possible related papers. These synonyms are "service automation, intelligent process automation, white-collar robot, routine task automation, repetitive, desktop automation, a virtual workforce, digital technology, business automation, RPA results.” These keywords were searched in multiple databases, namely Elsevier, Google Scholar, IEEEXplore, Web of Science, Scopus, and Springer Link. The search strategy is based on the following conditions: No publication date limit; no topic limit; search term contained anywhere in the articles; articles, theses, books, and conference papers only. As a result, 339 papers were found (after excluding duplicate papers) in the six mentioned databases and search engines.
For the second step, we established exclusion areas. The excluded papers were: Abstract-only; non-peer-reviewed articles; case studies from RPA vendors; articles with RPA in their content but with a different meaning; articles with no implementing example of RPA. After analyzing the abstract of the selected articles, not all of them achieve our research aims. So, they were excluded from our research to end up with 241 papers to move to our third step.

In the last step of our SLR protocol, we analyze the full text of the selected papers. After doing the full-text analysis, we did a backward search for additional papers cited in our reading papers. In the beginning, the only sources for our research were articles, conference papers, books, and theses. Later on, we found some studies by consultancy organizations that have been used extensively in the scientific literature (Capgemini, Gartner, and Deloitte, etc.). With reports by RPA vendors, we use them only if the same case study was mentioned in one of the peer-reviewed papers. Another source is reports published by the organization where the RPA implementation took place in. After downloading the new papers, we got 98 papers to be scrutinized for the quantitative results of implementing RPA in different sectors. Figure 2 shows the steps and procedures made to conduct this research.

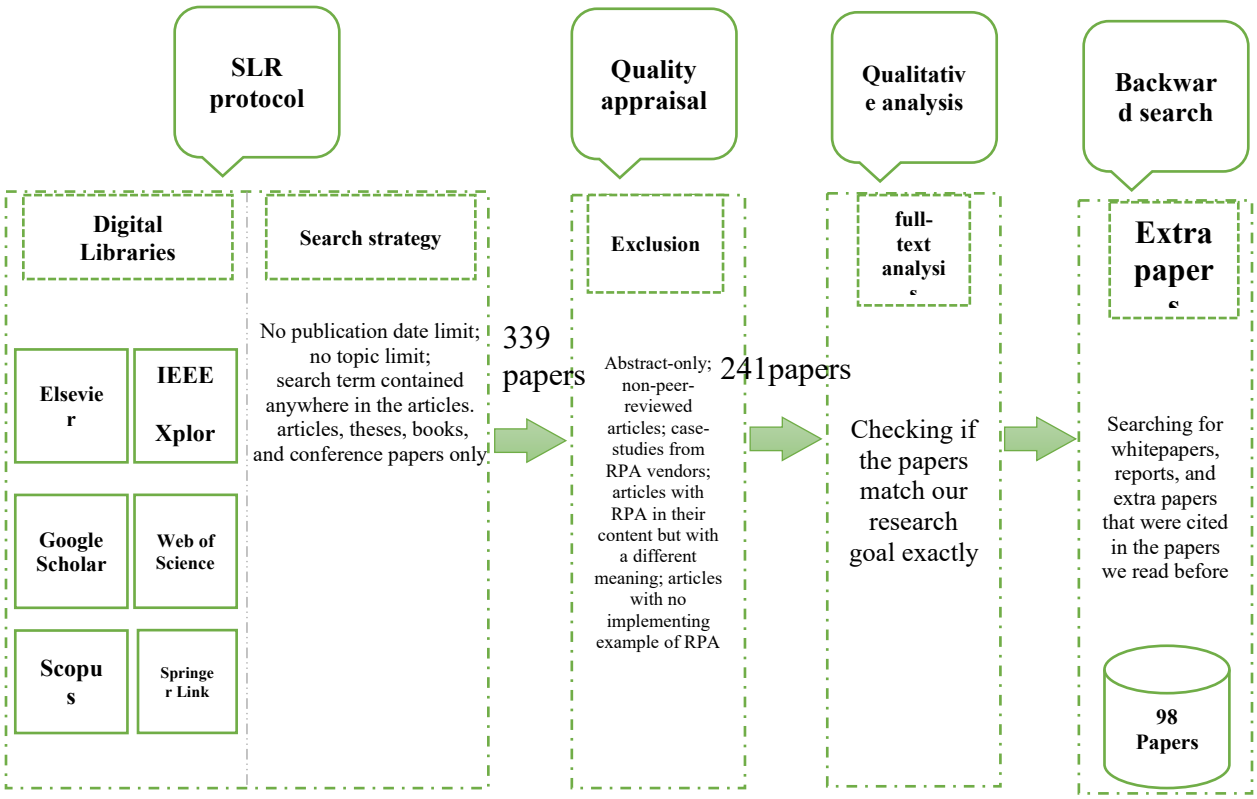


Figure 2. Research methodology

3. Related work

There are quite a few papers in the form of an RPA literature review Vitharanage et al. (2020) presented empirical study on RPA benefits gained by organizations. They classified the benefits into strategic, managerial, organizational, and operational benefits. Syed et al. (2020) presented a structured literature review that identifies several contemporary, RPA-related themes and challenges for future research. Ivančić et al. (2019) investigated how the academic community defines RPA and the extent to which research has been conducted in the literature on the state, trends, and application of RPA. Enriquez et al. (2020) presented a systematic mapping study to analyze the current state-of-the-art of RPA and identify existing gaps in scientific and industrial literature. Wewerka and Reichert (2020) Presented RPA using a Systematic Literature Review (SLR). In this SLR, 63 publications were identified, categorized, and analyzed along with well-defined research questions. Moreover, from the SLR findings, a framework for systematically analyzing, assessing, and comparing existing and upcoming RPA works was derived. In a more recent literature review paper, Ribeiro et al. (2021) presented a study of the RPA tools associated with AI that can improve the organizational processes business processes associated with Industry 4.0.

It is worth mentioning other research work done by (Valgaeren 2019) and (Vanhanen 2020); they both prepared master theses about RPA in banking and presented extensive literature review, but it was limited to RPA in the financial sector.

As far as we know, no study in the literature collected RPA benefits gained by organizations in a quantitative form besides qualitative. Above that, categorizing the results according to the different industry sectors does not exist. While mining for the quantitative results, we will introduce one or more case studies for each mentioned industry sector. The purpose of explaining the case studies is to illustrate some areas/processes suitable for RPA. By highlighting some application processes within each industry, we believe it would be easier to understand the potentials of RPA in the specified sector.

4. RPA at different industry sectors

As mentioned in the introduction, RPA can be an efficient solution for routine activities and businesses facing various transitions. Also, systemic improvements or changes to the system, since RPA is not a disruptive tool for deployment in an organization.

As a trend recently, RPA is being used by several Industry sectors have already recognized a range of benefits **[5, 20-25]**. This varies which of these advantages are more desirable to an organization, based on the organization's goals and vision.

In sections (4.1) to (4.4), we list what we could find of industry-specific benefits and results. Ivančić et al. (2019) found that 65% of RPA implementation projects, as mentioned by the researchers, come from two industries, services, and telecommunications, while the other implementations are related to finance and insurance, healthcare management, sales, and the oil & gas industry. Our research will do different categorizing according to what we found from our research method we followed. We will focus on the industry sectors that make up over 75% of RPA implementation projects concerned with quantitative results.

Figure three shows the results in percentages for different sectors in terms of reporting quantitative results of RPA implementation, noting that the "Other" category contains many sectors that will not be considered in the study since a very limited reporting of the quantitative benefits were found.

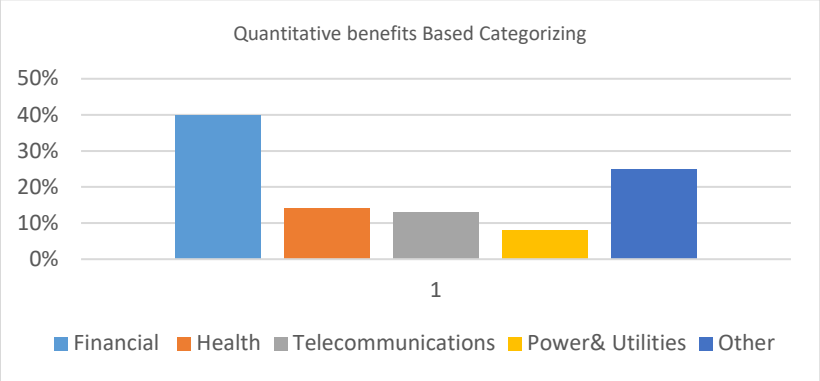


Figure 3. Categorizing per industry

4.1 Robotic Process Automation for the financial sector

The financial sector is heavily reliant upon digital operations in recent years. Digitization requires dealing with digital documents, information transactions, and many other tasks and processes. RPA, along with other technologies such as artificial intelligence, emerged to help achieve those tasks. RPA implementations in the literature included many case studies. We will talk about the financial sectors that got more implementations in the literature.

4.1.1 Robotic Process Automation at Banks

Manual financial frameworks cannot follow the quick-changing business condition any longer, and along these lines, banks need to focus on the digitalization of a few inside procedures (Daru 2015). Consequently, financial services are shifting towards a more systematic utilization of technology to decrease costs and maintain high consumer loyalty.
As seen in Table 1, we could find some published quantitative benefits of RPA implementation in different banks. Sometimes, we could not find enough information regarding the results. Meaning, it is not always the case where the organization announces the full results of implementing RPA. We choose the table contents to check whether the benefits of RPA implementation are general in the organization or just the result of applying on a specific process. As can be noticed in the table, sometimes the reference to these results mentions the overall enhancement of the organization. However, other times it is only process-specific enhancement results. An important point to mention is the existence of some other technologies at the same time as RPA implementation in most mentioned cases. According to Sibanda et al. (2020), some of these technologies are blockchains, big data, and cloud-based computing platforms. Other used technologies in the banking sector include AI and legacy systems (Met et al. 2020). Conclusion regarding RPA in the banking industry, there are significant benefits of implementing RPA in this sector

Table 1. Results of Robotic Process Automation implementation at Banks

Bank name	**Use of another Tech**	**No. of RPA processes**	**No. of bots used**	**Declared RPA Processes**	**Results**	**Reference**
Ziraat Bank	Yes	Not mentioned	c- For the Fleet traffic only over one bot	a- E-Notification Process b- Tax and Social Insurance Debt Collections c- Fleet Traffic Insurance Policies	a- Done eight times faster b- Much faster than before c- Hundreds of vehicles within a few hours 3240 FTEs saved	(Met et al. 2020)
The Co-operative Bank	Yes	Over 150	20 bots	a- Excess queue b- Complex CHAPs processing c- VISA chargeback processing d- Other back-office processes that support sales and general administration.	a- Consistency in following the excess queue procedure ensuring that the bank meets its customary requirements • Automatic customer account management • Automated outward customer calls • Fairness and consistency in customer treatment • Improvements in customer service provision which resulted in increased customer retention and satisfaction • 9 FTEs at least saved	(Barnett 2015) (Mungla 2019)
A bank in the UAE	Not mentioned	21	Not mentioned	a- Past due settlements b- Budget utilization c- Anti-money laundering payment screening	95% process automation 50% FTE	(Taulli 2020)
BNY Mellon (Bank of New York Mellon)	Yes	29 Projects 19 Business Functions across 147 individual business processes	178 Bots	a- Account Closure Automation b- Data Acquisition Group c- US Settlements Repair Automation d- USD Funds Transfer Exception e- Research; f- Trade Capture DE; g- Loans processing; h- Data Acquisition; i- ICSD Trade Input; j- ICSD Trade Input; k- Income Processing; l- Account Closures m- Institutional Investment Account (DAG, AST Accounting, & Investment Management Recon);	a- 70% automation; 30%Turnaround Time (TAT) improvement;88% reduction in time per transaction b- % Automation: 80% of client accounts from the top 10 investment manager websites (i.e. ~5000+ accounts); Productivity improvement: ~77% TAT improvement (~9 mins to ~ 2 mins); Benefits/Efficiency: Increased processing window for downstream reconciliation processing c- Automation: 86% to 100% automation depending on the work queue; Productivity improvement: 68% faster TAT improvement; Benefits/Efficiency: Annual run-rate savings $1.5M cumulative savings	(Theuerkauf et al. 2017)

Union Bank in the Philippines (UBP)	Not mentioned	400	Not mentioned	a- Processing of End-of-Day Reports for 250 CMS Billers	a- 18 FTEs saved; reduced the time per task from 120s to 18s; reduced total processing time from 8.33hr to 1.5hr • 97% digitization 300% processing time	(Taulli 2020) (Ortiz and Vera 2018)
Barclays Bank UK.	Not mentioned	Not mentioned	Not mentioned	a- Loan application processing	a- Quicker processing and does not have to take lunch, vacations, or time off wiped out. • 120 FTE annual reduction in bad debt provisions of $250 million	(Barclays Bank 2018) (Taulli 2020)
A full-service bank in India	Not mentioned	Not mentioned	Not mentioned	Not mentioned	• 55% productivity increase • 5% of common manual errors were eliminated.	(Taulli 2020)
A global fortune 1000 bank	Not mentioned	20 processes	150 bots	a- Credit card remediation b- PDF conversion: Logging into a statement repository and converting PDF-based unstructured data into structured data, using the power of natural language processing to identify key terms to inform claims assessment. c- Payment processing: Applying a tailored rule-set to transactional data and then feeding the results into a remediation calculator for processing and payment.	30% cost reduction	(Deloitte 2017) (Taulli 2020)
The Mashreq Bank UAE	Yes	Not mentioned	Not mentioned	a- multi-lingual human-robot interactivity	a- Productivity: 90% enhancement; 65% TAT reduction; 90% decrease in customers complaints. • 20000 cheques and 150,000 error-free and secure transactions processed daily	(Sibanda et al. 2020)
Standard Bank	Yes	Not mentioned	Not mentioned	a- Debit card maintenance b- The dormant debit card purge process c- Account opening d- Vehicle and Asset Finance Customer verification times	a- Reduced from an over 150 hours long manual process to an approximately 5 hours automatic one. b- Changed the dormant card's status to closed in about two seconds with no human intervention c- Reduced time from 23 days to under 5 minutes d- Cut in time about 60% • 1 M transactions processed / month	(Mungla 2019) (WorkFusion 2020)
Federal Bank-India	Not mentioned	15 processes 35 processes to be.	Not mentioned	a- Customer Identification	a- Merge around 250 records in one hour, while employees need a full day	(OSMAN 2019)

Note 1: When a result line in the" Results "column is labeled with letters (a-z) it means it results from a specific process in the" Declared RPA Processes" column.
Note 2: When there is "Not mentioned" in any place in the table, meaning that we could not find information about this issue.
Note 3: Having the symbol (●) next to a line in the" Results "column means that this result is mentioned in the reference as a benefit for the entire organization not for the specific process

4.1.2 Robotic Process Automation at insurance companies

Insurance companies across the globe are extensively monitoring orders and delivering feedback overloaded with manual back-office processes. This encourages insurance companies to simplify various procedures to satisfy the constantly growing demand and enhance their processing times. The complexity and number of tasks that must be managed in the insurance sector, from managing policies to filing and processing claims across multiple platforms, provides an ideal environment for the use of RPA technology (Tripathi 2018). TheLabConsulting (2018) addressed many benefits from adopting RPA compared to traditional automation; these benefits are: Faster claims processing; Easier policy cancellation; Simplified new business onboarding; Increased data accuracy; Standardized processes, Legacy-systems compatibility and new system implementation friendly, and Easy transition.

Table 2 shows the results we found related to the quantitative benefits of implementing RPA in the Insurance sector. As seen from Table 2, the quantitative benefits exist in a way or another. However, it is not well documented or published in a clear decisive manner. For instance, Generali CEE Holding reported over 50% of savings in their operations. Nevertheless, it is not clear whether it is only from RPA implementation. Another issue regarding CEE is the number of automated processes that reached 38 processes. No detailed process was found regarding implementing these processes or any clear financial benefits or FTEs savings. Other Insurance companies like the Australian company Taulli (2020) mentioned reported potentials of 7 million dollars of saving from RPA. While they mentioned, they saved over 80 FTEs. So, regarding the found results for Insurance companies, RPA is widely used and popular, and significant benefits can be achieved.

Table 2. Results of RPA implementation at the insurance companies

Company name	Use of another Tech	No. of RPA processes	No. of bots used	Declared RPA Processes	Results	Reference
Generali CEE Holding	Yes	38	Not mentioned	All their policy cancellation processes.	• >50% cost savings Increased quality, productivity, error reduction, and employee satisfaction	(Marek et al. 2019)
Leading Global Insurer	Yes	Not mentioned	Not mentioned	a- Policy Renewal Process (General Liability and Financial Lines; Non-Standardized process between three original locations worldwide; Process involved over 25 applications and many documents, forms, and emails; Part of the process involved an offshore Business Services provider)	a- Reduction of FTEs by approximately 50%; 30-40% increase in efficiency; Elimination of overtime, including peak cycles; Increased customer satisfaction because of faster response times; Increased quality and accuracy output.	(Capgemini 2017)
Insurance company in Australia	Yes	>100 identified (not declared whether they automated all of them)	Not mentioned	Not mentioned	• Potential for $7 million in net savings >80 FTEs saved	(Taulli 2020)
Xchanging	Yes	14 core processes	27	a- Insurance premiums Insurance-related processes	a- Reduced time to process 500 notes by many humans in several days to only 30 minutes. • Saved an average of 30% on each automated process	(Lacity and Willcocks 2016a)
Global Insurance Brokerage Firm	Yes	Not mentioned	Not mentioned	a- Robotics Center of Excellence (Identify business processes for automation; Establish and show RPA capabilities within the context of the business; Illustrate expected benefits and get business	a- 50% reduction in FTEs; Reduced cycle time of targeted processes by 75%; Reductions in error rates; Ease of scalability to extend RPA; Reduced operational cost	(Capgemini 2017)

				user acceptance on automated results)		
Zurich Insurance	Yes	48	Not mentioned	a- Issue policies	• 51% cost reduction • 25% of operational team capacity • 1 billion dollars cost savings	

Note 1: When a result line in the "Results" column is labeled with letters (a-z) it means it results from a specific process in the "Declared RPA Processes" column.
Note 2: When there is "Not mentioned" in any place on the table, meaning that we could not find information about this issue.
Note 3: Having the symbol (●) next to a line in the "Results" column means that this result is mentioned in the reference as a benefit for the entire organization, not for the specific process

4.2 Robotic Process Automation at the power & utilities

Since energy demand remains flat, switching to technologies proved to be effective in cost-saving, increasing efficiency, and enhancing processes as RPA does. RPA is one technology that aims to increase the operational performance of Utilities by automating activities (ANAGNOSTE 2018). Many RPA implementations have already taken place, which have different applications across this sector.

As can be noticed from Table 3, which shows the results of RPA implementation at the Power & Utilities. There is a significant opportunity to implement RPA in many processes in this sector. For example, the results of implementing at UTILITY are very motivating. Achieving a 200% ROI in a year is an excellent financial result. It is necessary to mention here that Artificial Intelligence exists in all the case study companies we reported. Also, we can say it is vague results, cannot be judged whether it is pure RPA results or mixed for the overall quantitative results on the organization.

Table 3. Results of Robotic Process Automation implementation at the Power & Utilities

Company name	**Use of another Tech**	**No. of bots used**	**Declared RPA Processes**	**No. of RPA processes**	**Results**	**Reference**
DTE energy	Yes	Not mentioned	a- Customer Service: High Bills b- Qualification Evaluations	35	a- 40-50%. Reduced bill number that needs manual review. 250,000 annualized hours were given back to business	(Taulli 2020) (BluePrism 2020)
UTILITY	Yes	300	a- Resolving infeasible customer meter readings	20-25% of back-office processes	a- 60% FTE; improved the quality, consistency, and speed of resolutions • 200% ROI in one year	(Lacity et al. 2015b)
a Top 500 company in Power & Utilities	Yes	>100	a- Handling Intercompany reconciliation • Finance (e.g. Procure to Pay, Order to Cash, Record to Report, Intercompany transactions, and General Ledger). • Client operations (e.g. Hardware change requests, Credit payments, and Credit requests, Plan renewals, and Tariff upgrades). • Human Resources (e.g. Employees boarding, • Employees training requests, New employee registration, Annually Employee Promotion Letters) and Network Operations.	>120	a- 25% processing time on normal processes and 45% on complex processes 35% processing time; The responding time to external parties (i.e. vendors or clients) has improved by approximately 25%.	(ANAGNOSTE 2018)

Note 1: When a result line in the "Results" column is labeled with letters (A-Z) it means it results from a specific process in the "Declared RPA Processes" column.
Note 2: When there is "Not mentioned" in any place on the table, meaning that we could not find information about this issue.
Note 3: Having the symbol (●) next to a line in the "Results" column means that this result is mentioned in the reference as a benefit for the entire organization, not for the specific process

4.3 Robotic Process Automation in the healthcare sector

Delivering high-quality, affordable healthcare is probably the goal for every healthcare facility. To accomplish this, many forms, other documentation, and details have to be worked with. The patient's records, billing and payment, and other information are collected to be processed and then stored in the system.
Tripathi (2018) suggests that the Healthcare industry would benefit from RPA in the following processes: Data entry, patient scheduling, and, more importantly, billing and claims processing. RPA would help optimize patient appointments, send them automatic reminders of their appointments, and eliminate human error in patient records. This leaves workers to focus more on the patients' needs and leads to an improved patient experience.
Several RPA projects have been implemented recently in the health sector; we will show two examples to motivate the facilities within this sector to take steps towards robotic process automation.
Table 4 summarizes some results of RPA implementation in the health sector. It can be noticed that Catholic Health Initiatives achieved great annual savings of 0.5 million dollars. More significant savings were achieved in Blue Cross Blue Shield North Carolina (BCBSNC) regarding money savings and FTEs. The Healthcare sector, as we can see, has great potentials for savings and other quantitative results. Due to the lack of information regarding the case studies, we included only three columns and the organization name.

Table 4. Results of Robotic Process Automation implementation in the Healthcare sector

Organization name	RPA process	Results	Reference
Catholic Health Initiatives	accounts payable (A/P)	$0.5 million in annual recurring savings	(Bruno et al. 2017)
Blue Cross Blue Shield North Carolina (BCBSNC)	the claim automation engine	savings of $11 million by the end of 2010; reduce FTEs from 425 to 300; reduce supervisors from 30 to 20	(Dunlap and Lacity 2017)
A leading global pharma company in Switzerland	Pricing process in the Finance and Controlling department.	reduction 76% in time (from 25 minutes to 6 minutes); >1 million Euro in savings, while achieved 100% automation.	(Anagnoste 2018)
Swiftqueue (patient registration platform in Ireland for NHS)	• real-time appointment scheduling post-emergency room discharge • schedule set up via a chatbot and auto recommends another clinic if one has a significant delay	With 20,000 hours saved and an average waiting room time of fewer than 10 minutes	(Jolt Advantage 2019)

4.4 Robotic Process Automation in the telecommunication sector

For the telecommunication sector, the first case study that comes to mind is Telefónica O2, an example of a successful RPA adoption. O2 outsourced most of its back-office processes and nearly 90% of its staff before they adopted RPA. They removed some processes before RPA, e.g., legacy order verification process, because the error rate was 0.01%. Robotics involved the use of a variety of software applications to do the first processes. Specifically, the first two processes were highly standardized and high-volume processes. The first one was the SIM swaps, which involves replacing customers' SIM cards while not changing his/her current number. The second one involved applying a pre-defined credit to a clients' account. At first, RPA vendor specialists worked on-site to introduce these processes, but after three months, O2's employees, ultimately three individuals, performed process automation themselves. They expected the RPA to repay in 10 months with ten processes, while the IT-based BPM would have taken three years to break. In the following five years, 15 processes were robotized, accounting for 35% of back-office transactions, including credit checks and request handling. Another finding made by O2 was that RPA needs intensive directions to forestall certain types of "common sense" related errors. O2 reports that its 75 robots handle up to 500 000 transactions per month, and 250 FTEs more without RPA would be required to handle the respective transactions. The ROI is calculated to be at least 650% (Lacity and Willcocks 2016b).

Table 5 summarizes the quantitative results we could find in the literature. As we mentioned before, there are many case studies and implementations in the literature, but we are concerned only with papers that published quantitative results of its RPA implementation. Implementing RPA in Deutsche Telekom (DT) is a very recent case study. They claimed to robotize 50 processes and used over 1000 bots to do their automation. This number of bots used reflects that there must be tremendous benefits from this implementation. Because of this high number of bots, it is not surprising to see that they saved 800 FTEs.

Table 5. Results of RPA implementation in the Telecommunications sector

Company name	Results	No. of bots used	Declared RPA Processes	No. of RPA processes	Reference
Telefónica O2	Between 650 and 800% ROI in 3 years	>160 and growing	a- SIM swaps b- applying a pre-defined credit to a clients' account	15	(Lacity and Willcocks 2016b)
Deutsche Telekom (DT)	• 30% to 60% cost saving • 80% Automation • 800 FTEs • They observed benefits in the three areas of customer satisfaction, financial performance, and process compliance.	>1000	a- Field Service App b- Proactive Problem Solving	50	(Schmitz et al. 2019)

Note 1: When a result line in the "Results" column is labeled with letters (A-Z), it means it results from a specific process in the "Declared RPA Processes" column.
Note 2: When there is "Not mentioned" in any place on the table, meaning that we could not find information about this issue.
Note 3: Having the symbol (●) next to a line in the "Results" column means that this result is mentioned in the reference as a benefit for the entire organization, not for the specific process

5. Threats to validity

It is important to emphasize that we took into consideration while preparing this study the different aspects recommended by (Kitchenham et al. 2009) and (Petersen et al. 2015). However, our search was for some unique papers that contained the quantitative benefits, which was our main research question. These benefits might not be used as a keyword in the published papers or are most likely not used in the title. This fact made it very difficult to judge the paper's validity to our research and made the statistical categorizing of the industry categories with reporting the benefits extremely time-consuming. For the context of this research, SLR was conducted as generally as possible in terms of publications and dates. In this way, the study was carried out as thoroughly as possible since it does not privilege certain publications.

The examination of aspects that may affect the study created tendentious or unrepresentative is known as publication bias. In this regard, it is vital to keep in mind that, as a study project progresses, researchers may be tempted to stress the good outcomes in connection to the performance of the technique they suggest, which implies that the experimental data may not be properly transparent. To prevent bias, several of the researchers' colleagues who are experts in the topic have thoroughly examined the work to ensure that the planning requirements are satisfied.

The risk to the credibility of data synthesis and outcomes is addressed to the greatest extent feasible by establishing filters and sector categorization schemes in figures 2&3.

Finally, as previously stated, these risks are mitigated by doing the research filtering as mentioned in the research methodology and excluding the papers, not from renowned resources.

6. Results and conclusion

In this paper, we investigated the quantitative and qualitative results of RPA implementation in different industry sectors. Therefore, organizations from different industry sectors or Academia can check the benefits of RPA implementation in the same/similar sector. The measurement of investing in IT technologies has always been troublesome. At the same time, having the correct metric method was a crucial factor for business success (Willcocks and Lester 1999). Ordinarily, we found that organizations that used ROI as a measure reported positive results. This means that they could overcome the actual costs, which include technical costs plus managerial costs. However, we found that the quantitative results were found in various sectors and declared in the different metric methods. Some of these methods were:

- Return on Investment (ROI)
- Productivity improvement is measured sometimes by Turnaround Time (TAT)
- Full-Time Equivalent (FTE)
- Cost-saving (sometimes in numbers representing saved money of the budget and sometimes in percentages of the cost)
- Automation percentage
- Time-saving (sometimes in terms of hours reduction in the process).

Although all the found case studies declared benefits of RPA implementation in at least one of the above measures. However, in some studies, it was vague results. For example, in the banking industry, Met et al. (2020), in their case study, it is unclear if the 3420 FTEs saving resulted from RPA implementation only. Perhaps this is because organizations used other technologies along with RPA like (legacy systems or AI). It, therefore, makes determining whether the overall results in an organization are RPA alone tricky. Furthermore, we could not find enough quantitative results in the literature in some industries. Even though those cases were mentioned and success stories were published in the literature, we ignored them.

The fact that sometimes none of these measures is used requires suggesting standardizing the measures in the organizations that adopted RPA. We recommend in future research that the quantitative results should be documented. Qualitative results exist, but the fact that these results are not measurable does not necessarily encourage the future implementation of RPA.

It was evident after making this study that not all the companies declare the number of the automated process with complete absence in the Healthcare sector and even the number of bots used, as we can see in figures 4&5 below:

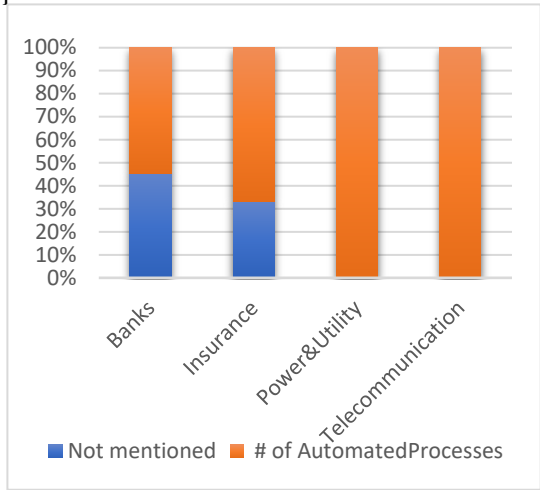


Figure 4. percentage of mentioning # of automated processes

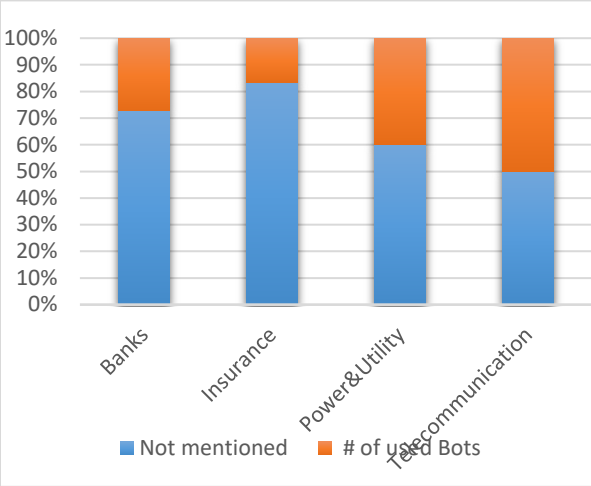


Figure 5. Percentage of mentioning # of used Bots

We tried in this research to connect the number of automated processes with the number of used bots where declared (see figure 6 below). Since this might give a conclusion regarding cost against benefit. However, it is not easy to come up with a clear conclusion. There are very few cases where the companies declared both the number of automated processes and the number of bots used. In general, the number of Bots outweighed the number of processes, yet the financial benefits reported in those companies were very high. So, connecting these two factors cannot be considered an indicator of financial benefits.

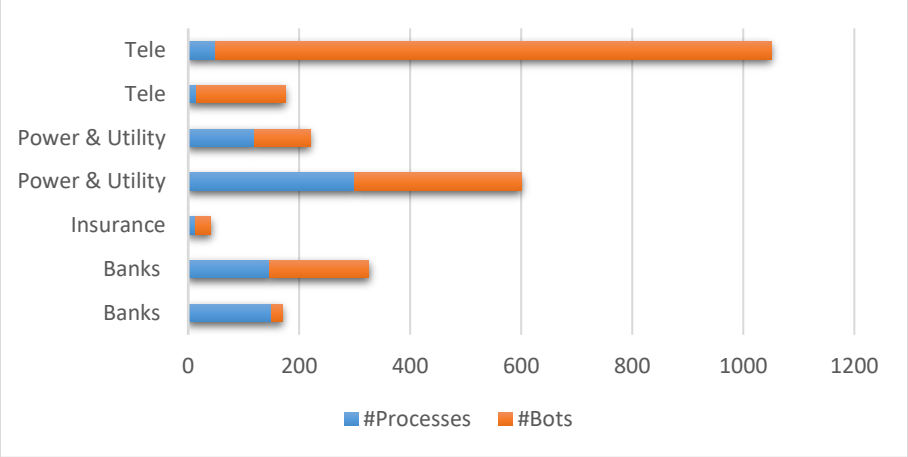


Figure 6. Number of Processes vs. Number of used Bots

7. Challenges, limitations, and Future research

The research depended on the core of SLR methodology; however, it was very challenging to formulate the search results since our search cannot be found in most cases in the keywords, title, or even the abstract of the papers we are searching.

As Vom Brocke et al. (2015) mentioned, there is no One-Size-Fits-All Approach to searching the literature. We had to search our method of SLR, reading hundreds of papers to filter the mand reach the research goals.

The research is done in a specific time frame and might be published after taking some time in the review stage. This limits the research and conclusion to the period before submitting the paper, so the results might change if the exact search is done later (this is a hot topic, and we have new publications).

In the future, other methods to conduct the research might be considered, such as conducting interviews or a survey of RPA users so the findings could be more standardized and comparable. Maybe instead of documenting broad quantitative benefits, a question would be how organizations decide to measure/quantify and communicate those benefits – costs saved, employee time saved, customer time saved, return on investment, or other specific KPIs (key performance indicators).

Doing the previously suggested research in future research might lead us to better data collection methods, thus having more apparent results of the research.

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Biographies

Mohammed Alfandi is a Ph.D. student at Gaziantep University, department of industrial engineering. Mohammed earned her B.Sc. and M.Sc. in Industrial Engineering from Aleppo University. He has several years of work experience in Industrial engineering and management in addition to CNC engineering. He is currently working as a project manager at IHR. He is interested in Machine learning, Artificial Intelligence, Artificial Neural Networks, Data Science, Robotic Process Automation, Mathematical Modeling, Decision Support Systems and would like to influence both the academic and industrial worlds.

Serap Ulusam Seçkiner received the BS, degrees industrial engineering from University of Çukurova, Adana. MS and Ph.D. degrees Industrial Enginering from the University of Gazi, Ankara. Currently, She is a full time Professor at the University of Gaziantep, Gaziantep involved in teaching operations research and human factors engineering.

7.1.1