

# The Rise of Robotic Process Automation in the Banking Sector: Streamlining Operations and Improving Efficiency

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**Abstract** – Robot Process Automation (RPA) is a type of business process automation that relies on software robots (bots) or artificial intelligence (AI) agents. This phenomenon is sometimes denoted as software robotics, which should not be conflated with robot software. This study investigates the increasing prevalence of RPA across several sectors, with a specific focus on its use in back-office functions. RPA software, exemplified by platforms like Blue Prism, Automation Anywhere, and UiPath, replicates human-computer interactions in order to automate operations that are repetitive and governed by predefined rules. This technology offers many advantages, including cost reduction, mistake minimization, and risk elimination. This research investigates many domains in which RPA may be used, including credible business transformation, content migrations, web crawling/OSINT, and IT department enablement. Additionally, it emphasizes the significant responsibilities within RPA operations, including process architects, technologists, and personnel involved in continuous support and maintenance. The study includes case studies conducted within the banking industry, which demonstrate the potential of RPA in augmenting both customer happiness and productivity. The market report anticipates substantial expansion in the market for RPA software, whereby industry leaders such as UiPath, Automation Anywhere, and Blue Prism are expected to play a dominant role.

**Keywords** – Robot Process Automation, Intelligent Process Automation, Customer Relationship Management, Enterprise Resource Planning, Automation Anywhere.

## I. INTRODUCTION

There is a growing trend among companies to seek comprehensive digital transformation, whereby their systems are capable of adaptive adaptation to the ever-changing dynamics of the business environment and the preferences of discerning consumers. In addition, consumers consistently express the need for business systems to possess adaptability and responsiveness, enabling them not only to fulfill their daily operational requirements but also to provide supplementary insights that facilitate informed and reliable decision-making. In light of the evolving global economy driven by technological advancements, it is essential for organizations to enhance their agility and promptly address the diverse needs, objectives, and demanding expectations of customers. Furthermore, firms are compelled by competitive and financial pressures to enhance their efficiency, prompting them to seek out novel technologies and techniques that may facilitate superior productivity compared to their rivals, reduce expenses, and provide value to their operations.

The application digital transformation within various business processes could be established by RPA, which is considered an intelligent and innovative approach. The technology proves to be significant in enhancing the human labor, especially in enhancing managerial duties within an organization. Various firms have started to employ the technology in fields such as supply chain management, information technology, accounting, and finance. The improved necessity for high-quality service provision, and effective business operations may be a stimulator for the adoption of this technology. The various advantages of integrating the technology into the firm's architecture have been widely studied in [1], [2], and [3]. However, a new technology called Intelligent Process Automation (IPA) was born out of the need to augment RPA with cognitive automation and AI in order to greatly increase its effectiveness.

Differences between RPA and IPA are inherent, mostly relating to the types of jobs that are encountered. RPA is more suited to mundane, repetitive jobs, while intelligent IPA is more suited to complex, decision-based operations. IPA is a system with the capacity to make judgments and draw conclusions, in contrast to RPA which functions by carrying out specified instructions. More applications and capabilities are under RPA's purview. IPA should be directed towards a clearly defined objective. The implementation of IPA incurs more costs and requires more time compared to RPA. Additionally, it is important to note that IPA is considered an emerging technology. Hence, the development and integration of intelligent

RPA technologies, coupled with AI-supported platforms, enhance the intelligence of business processes by enabling either complete automation without human involvement or partial human interaction.

AI and RPA are often regarded as distinct methodologies in the existing body of research [4]. However, the integration of expanding innovation possibilities and transformations has the potential to address issues arising from the abundance of judgment-related jobs and improve decision-making processes inside businesses. According to Siderska [5], it is projected that by the year 2021, more than four million Robotic Process Automations (RPAs) would be used for the automation of repetitive operations. However, there will be a change in emphasis towards the integration of AI and the advancement of RPA analytics. In a similar vein, Everest Group expounded upon the fact that the majority of purchasers expressed satisfaction with RPA solutions, although emphasized the need for the inclusion of cognitive capabilities and analytics. Hence, the main objective of this paper is to provide a fresh and innovative technology that elucidates the integration of artificial intelligence into robotic process automation.

The use of RPA in corporate activities has shown substantial growth in recent times. The primary objective of this study is to provide a thorough comprehension of RPA and its advantages in the operational processes optimization, enhancement of overall performance, and cost reduction. This research endeavors to underscore the potential of RPA in diverse businesses, with a specific focus on the banking industry, via an analysis of various aspects of RPA deployment and the presentation of real-world case studies. The objective of this study is to provide insights into the prominent participants in the market for RPA software, as well as their contributions to the overall expansion of the industry. The rest of the paper has been organized as follows: Section II introduces the concept of robot process automation. Section III further discusses RPA operations and designers. In Section IV, a case study application of RPA within the banking sector is provided. This section starts with describing the business RPA applications, before concentrating on the case study application of the automation technique within the banking sector. Lastly, Section V presents a conclusion to the research, describing the major concept of the research.

## II. ROBOTIC PROCESS AUTOMATION

The basic objective of RPA is to replicate human tasks and then replace them with automated processes. RPA is a classification of software designed to imitate and automate repetitive human-computer interactions. This suggests that software has the capacity to replace tasks that were formerly carried out by individuals, encompassing activities such as system login, data input, workflow execution, and any computer-based rule-driven operations, specifically those related to customer relationship management (CRM) platforms such as Hubspot or Salesforce, data systems like shared drives, email, and SAP, among other instances. RPA is a technological innovation that facilitates the emulation of human processes without necessitating direct human involvement.

The technology under consideration is classified as a robot owing to its capacity for autonomous driving. RPA has the capability to do a range of tasks, including reading emails, accessing attachments, transferring files, according to pre-established rules, extracting data, integrating information with Human Resources (HR), CRMs, and Enterprise Resource Planning (ERPs) systems, among other functionalities. The applications of the aforementioned fields are diverse and extensive, including areas such as business administration, finance, insurance, banking, capital markets, and several others [6]. This kind of automation facilitates the allocation of workers' attention towards jobs of greater significance, fosters innovation, and allows for the allocation of time towards the improvement of their knowledge and skillsets.

The name “Robotic Process Automation” evokes imagery of physical robots traversing office spaces to carry out operations often conducted by people. However, in actuality, this word refers to the automation of service jobs that were previously executed by human agents. Robotic automation refers to the use of specialized technology and approaches to employ a computer or a “virtualized FTE or robot” instead of a human being for the purpose of manipulating pre-existing application software. According to Umble, Haft, and Umble [7], Enterprise Resource Planning (ERP) systems function similarly to how individuals now handle transactions or carry out operations, including learning management systems, databases, and claims applications.

According to Gomes and Seruca [8], the use of RPA saw significant growth in shared service operations, back offices, and even among entrepreneurship process outsourcing service providers in the year 2016. The use of RPA is transitioning from experimental initiatives to a more widespread implementation. The Interactive Voice Response (IVR) development tools discussed by Corkrey and Parkinson [9] offers consumers essential information and facilitates their connection to a live contact center representative based on their specific needs. The individual or entity referred to as “M/s.” The phrase “Robotic Process Automation” was coined by the U.K.-based business Blue Prism®, which was established by David Moss and Alastair Bathgate [10]. The Blue Prism platform provides a sophisticated, interconnected, and user-friendly digital workforce, enhanced with the latest v6 capabilities and connectors. RPA refers to the implementation of software systems that are designed to carry out tasks that were traditionally performed by human operators. The program is seen as a robotic being due to its ability to replace human labor. When artificial intelligence is integrated with RPA, it may effectively aid in managing unstructured data to combat fraud and prevent money laundering activities.

Many organizations such as O2, The Shop Direct, the NHS, Co-operative Banking Group, RWE, and Fidelity Investments, are effectively adapting to business changes by implementing agile back-office operations. They are at the forefront of the outsourcing industry's significant transition by embracing Blue Prism's digital labor. An increasing number of Chief Information Officers (CIOs) are adopting RPA, an emerging technology, in order to enhance the efficiency of company operations and achieve cost reduction. According to Choi, R'bigui, and Cho [11], experts claim that the use of

RPA allows firms to automate repetitive and rule-based tasks, hence freeing up company people to allocate their time towards customer service or more valuable tasks. Organizations are attaining enhanced efficiency via the use of software robots to execute service procedures that are regular and governed by predefined rules. When effectively executed, the integration of automation may lead to the formation of proficient human-robot teams, characterized by the harmonious collaboration between software robots and human workers. These software programs are capable of emulating human user behaviors on computers, hence facilitating the completion of diverse corporate processes. Despite the first connotation of “Robotic Process Automation” implying the presence of real robots engaged in human-like activities inside office settings, it is important to note that RPA primarily operates as a software-driven solution.

According to Gao, Van Zelst, Lu, and Van Der Aalst [12], within the context of RPA, the term “robot” is used to refer to a single software license. According to Kregel, Koch, and Plattfaut [13], Gartner places RPA technologies in the phase of the Hype Cycle known as the “peak of inflated expectations.” Software systems for automated performance monitoring and automated regression testing, which use virtual users from various geographical areas, have been in existence for around 10 to 15 years. These tools have the capacity to imitate human workers and execute repetitive duties such as regression monitoring and testing of diverse web apps and front-end desktop. According to Lubis and Sembiring [14], RPA represents a logical advancement of these capabilities. A variety of companies provide RPA products, as identified by Van Der Aalst, Bichler, and Heinzl [15]. These providers include UiPath, Automation Edge, Softomotive, Automation Anywhere, Pegasystems, Blue Prism, Kryon systems, Cognizant, Kofax, Conduent. The proliferation of physical robots has led to a rapid displacement of industrial, manual labor positions, while software robots are anticipated to supplant a significant proportion of professional, office-based occupations.

It is imperative for Robotic Process Automation specialists to possess a comprehensive understanding of various aspects related to RPA software. This includes familiarity with the installation process, comprehension of the software's structure (such as Flowchart vs. Sequence), understanding of control flow mechanisms (such as Decisions, Loops, and Switches), proficiency in error handling techniques using Try/Catch, ability to automate interactions with applications like Portable Document Files, Word, and Excel, competence in automating email communication and managing attachments, aptitude for decomposing complex processes and proficiency in debugging skills. Robotics has the capability to provide replies of superior quality to inquiries that are more intricate and extend beyond standard procedures. Artificial intelligence (AI) approaches enable software to process vast quantities of research across a wide range of subjects, beyond the capacity of any individual to consume such a volume of information. When responding to a client's inquiry on the future prospects of the Chinese stock market, a “Chatbot” may have consolidated pertinent information and conveyed that there was a prevailing consensus suggesting a positive trajectory for the Chinese stock market. Financial advisers are under increasing pressure from computerized rivals known as “Robo-Advisors”.

According to Eikebrokk and Olsen [16], the utilization of RPA offers several benefits. These advantages encompass enhanced operational accuracy, improved employee morale, increased productivity, reduced technical obstacles, compliance adherence, consistent performance resulting in reliability, and the implementation of non-invasive technology. One notable advantage of robot process automation technology is its accessibility to those without technical expertise, since it provides them with the necessary resources to design software robots and address their automation needs. Additionally, he stated that RPA has the capability to give immediate advantages to various essential entrepreneurship processes. These processes encompass onboarding and recruitment of new hires, employee status modifications, and payroll management, handling accounts payable and receivable, onboarding vendors, processing invoices, migrating information, managing inventory, installing software, and generating reports, among others.

### III. ROBOTIC PROCESS AUTOMATION OPERATIONS AND DESIGNERS

Until now, no standardized operational models have been produced for RPA activities. Mr. Kristina Romero and his technical team from M/s. InfoCap Networks LLC (InfoCap), based in San Diego, present a proposed demonstration of RPA processes [17], as seen in **Fig 1**. According to Flechsig, Anslinger, and Lasch [18], this technology approach has the potential to revolutionize entrepreneurship operations by automating manual tasks. This shift would reduce reliance on human labor, decrease time consumption, and address the issue of error-prone content in business processes. From this perspective, the primary benefit is in the use of “Digital Labour” to achieve cost reduction, error minimization, and risk elimination. The use of RPA offers several operational benefits within diverse and interdisciplinary organizational contexts.

#### *RPA Operations*

##### *Credible Business Transformation*

The use of the new RPA technology is expected to have a profound impact on corporate operations, resulting in significant changes. Companies have the potential to significantly enhance their labor efficiency by incorporating RPA, therefore supplementing their workforce with dependable, efficient, and cost-effective modern labor. This enables organizations to decrease expenses, mitigate inaccuracies, and eradicate potential hazards.

##### *Content Migrations*

A significant volume of material is being generated inside various organizations. The acquisition of human resources may be necessary in order to gather, evaluate, and produce a report, as the complexity of insights in normal operations increases.

RPA exclusively facilitates the acceleration of application consolidation and integration of legacy applications inside organizations and corporate enterprises. This is achieved by the expeditious migration of information or establishment of connections with legacy systems, requiring little exertion.



**Fig 1.** RPA Operations- Kristina Romero (2017) [10]

#### *Web Crawling / OSINT*

RPA facilitates the automated extraction of material from diverse sources and formats, using a range of devices. The forms used may include several mediums such as text, images, audio, and video. The data may exist in organized, semi-structured, or unstructured formats. Robotic Process Automation system is able to successfully retrieve data from the deep web by using deep learning algorithms. In addition, the mining process may be completed more easily with the use of web analytics, artificial intelligence, and big data analytics.

#### *IT Department Enabler*

The term “Robots” is defined and discussed by Albu-Schäffer et al. [19] in relation to RPA. These robots are described as computer programs that follow a set of rules to carry out repetitive activities and simulate interactions between humans and computers. Among these responsibilities are the following: collecting and comparing datasets from numerous sources; writing and reading activities with different databases; and reformatting and extracting data for use in reports and dashboards. In order to keep operations running smoothly and respond to any issues that may arise, the organization employs monitoring procedures to keep an eye on its software, networking, and hardware systems.

#### *RPA Designers*

RPA is an emerging technology that automates business activities using software robots or AI agents. In [20], Stolpe, Steinsund, Iden, and Bygstad assert the increasing prominence of Robotic Process Automation technology. It has been accurately observed that the implementation of RPA is transitioning from pilot projects to actuality. Therefore, it is essential for enterprises to establish their own RPA models in order to save costs and enhance operational efficiency. In [21] assert that there is a variation in the operational models of RPA across different enterprises and industries. According to their perspective, the operational models for Robotic Process Automation are not universally applicable. However, a successful RPA operational architecture primarily revolves around three essential functions.

#### *Process Architects*

The designers assist in the development of future state procedures enhanced by Robotic Process Automation. The process may be seen as the act of accomplishing a certain job. There are several aspects in software, such as Interactive Voice Response, as well as hardware, including robots, with few human inputs. There are several process types, such as Last In First Out (LIFO), long-term and short-term processes, First Come First Served (FCFS), priority scheduling, and round robin. The responsibility of process architects include the definition of procedures in both decentralized and centralized process systems. Initially, it is vital to comprehend the current system flow and discern any deficiencies within the system's components, task management, time constraints, and potential avenues for cost reduction and enhanced system efficiency. Entrepreneurship analysts are accountable for automation process in one manner. The architects are responsible for designing the cohesive approach, standards, and process of the RPA system.

*Technologists*

These professionals are responsible for the development of the code, which allows for business logic translation into workflows, which could be performed by robotic systems. It is understood that a technologist refers to a someone who has expertise in a certain technology or utilizes technology within a specific domain, including scientists and engineers. Currently, there is an increase in the number of enterprises operating in the industry. The individuals referred to as coders and programmers are responsible for receiving input from functionalists and designers, and then executing the development of code in accordance with the Software Requirement Specifications (SRS). The aforementioned programmed software has the capability to autonomously handle regular tasks without requiring human interaction to a certain extent. The authors further highlight that an RPA Centre of Excellence often involves the deployment of a specialized team of developers in a cost-effective location, with the aim of expanding RPA initiative. The technical proficiency necessary for using RPA solutions is somewhat less complex in comparison to conventional application advancement.

*Ongoing Support and Maintenance Staff*

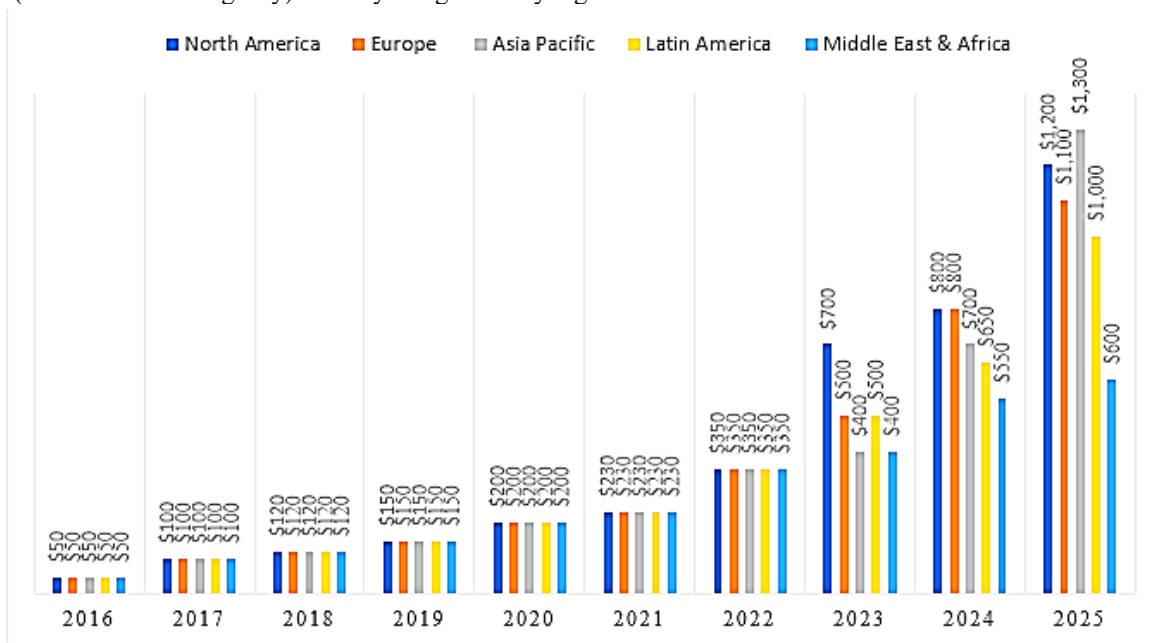
The personnel in question carry out recently automated duties and do necessary code modifications as needed. Typically, this procedure occurs via an annual maintenance contract (AMC) established between the software provider or and the relevant party. The identification and resolution of defects, faults, and failures inside the system software and applications are accomplished with ease. If the AMC is valid, technical help is given 7 days a week, in a whole year. The provision of such technical help significantly decreases the expenses and duration associated with the recruitment of in-house technical personnel. Additionally, there would be no associated expenses for training. The continuous support packages provided by corporations are customized to align with the specific requirements of individual client businesses, rather than catering to the demands of a broader audience. Whether customers want help with a specific issue or seek regular guidance and evaluations, our comprehensive package is designed to cater to their unique requirements, ensuring complete assurance and tranquility.

IV. CASE STUDY APPLICATION IN THE BANKING SECTOR

*Business RPA Application*

*Market Size for RPA*

The fast development of RPA in recent years may be attributed to the motivation of firms to enhance customer experience and streamline their company processes. Based on the most recent prediction by Gartner, Inc., it is anticipated that the revenue generated by PRA software will reach \$1.89 billion in 2025, reflecting a growth rate of 19.5% compared to the previous year. According to Gartner's projections [22], the market for RPA is expected to have significant growth rates in the double digits by the year 2024, notwithstanding the impact of the COVID-19 disease. **Fig 2** presents the market size of the PRA (Public Relations Agency) industry categorized by region.



**Fig 2.** Global RPA Software Revenue

*RPA Industry top-performing key players*

The prominent professional RPA businesses emerged between the years 2001 and 2005. Certain RPA vendors have been created by manufacturers specializing in Artificial Intelligence (AI) or prominent Internet corporations. Currently, there is a notable surge in the growth of RPA firms. Several prominent RPA organizations have achieved significant financial success, with operational revenues exceeding \$100 million and values reaching as high as \$7 billion. The RPA market is expected to

see more development and maturation in the next three-year period. Based on the findings of Gartner, it is observed that the top 10 suppliers of RPA software together own a market share above 70% within the RPA industry [23]. The organizations that have been identified as leaders in the 2020 Gartner Magic Quadrant for RPA are Blue Prism, Automation Anywhere, and UiPath.

#### *UiPath*

UiPath, a company established in Romania in 2005, now has a dominant position in the industry for RPA. The organization has branches in a total of 19 nations and sustains a workforce of over 3100 individuals. UiPath, on December 17, 2020 [24], confidentially filed a draft registration statement with the United States Securities and Exchange Commission, expressing its intention to proceed with an initial public offering. The estimated value for this offering is said to be in excess of \$20 billion. UiPath said on February 1, 2021, that it had secured \$750 million in Series F fundraising, resulting in a post-money value of \$35 billion. UiPath offers a range of technological characteristics, including integration capabilities, an automated desktop, robust customization options, online application, cloud environment hosting mechanism, and flexible virtual terminal capabilities.

Currently, the primary offerings consist of the UiPath Studio, which encompasses both code programming and visual programming capabilities, and the UiPath Robot, which serves as the execution platform. The primary application scenarios of RPA offered by UiPath pertain to several domains such as customer support, finance, human resources, SCM, and other related areas. The primary operational strategy is on the sale of software authorization, which is tailored to the specific needs of clients. This is achieved via partnerships and agents that facilitate the delivery and implementation process. UiPath has a robust training community as well. The platform offers a range of courses from various colleges, produces pertinent publications, and has been recognized as the leading entity in Deloitte's 2019 North American high tech 500 ranking [25].

#### *Automation Anywhere*

Automation Anywhere (AA) was established in the year 2003. In the year 2018, the company secured a cumulative investment amounting to \$550 million from Softbank Vision Fund. The company's sales for that year was \$130 million, resulting in a post-investment value of \$2.6 billion [26]. In the year 2019, AA employed a global workforce of 2400 individuals. The organization has a presence in over 40 nations and has expanded its operations to include prominent urban centers like as Hong Kong, Taiwan, Beijing, Shanghai, and Shenzhen. In the year 2020, AA developed the Automation Anywhere Robotic Interface as a modern assistant with the purpose of automating its internal duties.

AA introduced a cloud-native RPA platform that is accessible via a web-based interface. The internet platform facilitates the delivery, operation, and maintenance of items. Enterprises have the capability to implement a hybrid deployment model that combines both local and cloud infrastructure based on their specific requirements. Within the organizational context, personnel have the capability to initiate RPA robots via various web browsers, operating systems, and devices, hence facilitating the attainment of the “RPA-as-a-Service” stage. As of November 2019, AA provided services to over 3500 corporate organizations with a client base spanning over more than 90 countries [27]. The company has a diverse clientele consisting of prominent leaders in several industries such as human resource management, retail, healthcare, manufacturing, banking and financial services.

#### *Blue Prism*

Blue Prism (BP), a company established in 2001, had an initial public offering (IPO) on the London Stock Exchange in 2016. During this IPO, Blue Prism successfully generated £100 million (equivalent to around \$130 million) by issuing additional shares [28]. In the year 2020, BP provided services to a total of 2,031 firms on a global scale. According to Jason Kingdon, the chairman and CEO of BP, the company achieved a 46% increase in revenue, obtained £180 million in client commitments, maintained 98% of customers by revenue, and decreased the adjusted EBITDA loss by 47% [29]. Blue Prism is marketed as a tool designed for business use, offering a centralized platform for managing and controlling digital labor in large-scale organizations. Enterprise managers utilize information technology (IT) as a means to efficiently deploy labor resources and improve the basic efficiency of critical processes of production.

#### *RPA Adoption in Major Industries*

The use of RPA spans across several sectors, including businesses such as banking and utilities. Currently, the concentration of this phenomenon is mostly seen within the back-office and middle divisions of many industries, including customer support, finance, human resources, manufacturing, SCM, and retail. The application criteria are divided into many categories, including analysis, reporting and administration, data transfer, customer assistance, and other factors. The report provides a concise overview of the process inside a prominent sector that is now seeing advantageous outcomes as a result of adopting RPA. **Table 1** presents the adoption rates of RPA across several sectors, categorized by segment.

**Table 1.** The Utilization of RPA across Several Industry Sectors

<i>Manufacturing</i>	<b>Telecom</b>	<b>Insurance</b>	<b>Banking</b>	<b>Retail</b>
<i>Administration and reporting</i>	Simple query forwarding	Regulatory Compliance	Validating and processing	Inventory monitoring
<i>ERP Automation</i>	Report generation	Premium renewals	Account Closure	Online sales
<i>Data Migration</i>	Porting customer numbers	Form Registration	Same day funds transfers:	Supply chain management
<i>Proof of Delivery</i>	Customer dispute resolution	Responding to customer queries	Trade execution	Trade promotions
<i>Inventory Control</i>	SIM swapping	Appeals processing	Loan processing	Automated returns
<i>Bill of Material (BOM) processing</i>	Credit checks	Claims processing	Know Your Customer	Product categorization
		Risk management	Audits	

*RPA Adoption in Banking*

In 2019, the banking and financial services sectors emerged as frontrunners in the implementation of RPA, constituting a significant portion of the worldwide revenue at 29% [30]. This is due to the fact that several banking business operations include the execution of repetitive, rule-based, and labor-intensive activities that lend themselves well to automation. The optimal business process should possess the following attributes: (1) The use of low-cost resources enables the achievement of high production, resulting in time and cost savings. (2) The selected business process for implementing RPA exhibits stability and is not subject to frequent changes, hence reducing the need for frequent updates to the associated RPA processes. (3) The business process is not characterized by a significant use of obsolete technology. It is possible that RPA software may exhibit incompatibility with older infrastructure. Furthermore, it is important to ensure that the on-premise infrastructure is regularly updated in real-time to facilitate the successful implementation of RPA system. This thesis provides an overview of three bank business areas that are suitable for the implementation of RPA, based on the characteristics of their respective business processes. The subsequent parts will provide further description of these areas.

*The basic repetitive manual work*

The fundamental tasks involving repeated manual labor include straightforward data entry, filing of documents, identification of information, and transfer of data. As an example, it is mandatory for personnel to manually transcribe all client handwritten data into the system of the bank. The process of verifying, extracting, editing, and converting handwritten material into electronic form may be automated via the use of RPA, smart Optical Character Recognition (OCR) systems and tasks in **Table 2**.

**Table 2.** Repetitive Tasks Involved in Verifying, Extracting, Editing, and Converting Handwritten Materials

<b>Tasks</b>	<b>Description</b>
<i>Loan processing</i>	In order to fulfill the requirements set out by the bank, customers are expected to provide a series of documents, including tax payment certifications, printed financial statements, employment verification, and credit checks. RPA possesses the inherent capacity to authenticate and validate data, therefore enabling the system to make a conclusion regarding loan acceptance based on pre-established criteria.
<i>Credit card approval</i>	The use of RPA by the bank facilitates the efficient entry of diverse client application data, while also enabling the assessment of creditworthiness, collateral evaluation, and risk analysis. Following the completion of the condition evaluation, the use of RPA enables a streamlined execution of tasks such as card customization, distribution, and activation.
<i>Customer service response</i>	RPA has the capability to gather client complaints via various channels such as email, telephone, and internet, subsequently offering automated real-time remedies. This process significantly minimizes the turnaround time to a matter of seconds.

*Cross-system check process*

The financial institution retrieves information from an external system and then verifies the legitimacy and precision of the data submitted by clients. Cross-system checks include fundamental client identity verifications as well as the detection of potentially illicit financial operations. The primary objective of this business process is to address the issue of money laundering and mitigate the risk of corruption. Financial institutions are required to undertake the task of customer identification, verification of the legitimacy of money, and enhancement of account monitoring for their clientele. Additionally, the bank has the capability to establish a connection with the national tax system, enabling the provision of account holders' transaction information to the tax bureau. Furthermore, the bank may retrieve tax payment data from the system in order to assess the veracity of tax deductions and declarations.



*Stable and frequently used operation management system*

In light of the expenses associated with the creation and subsequent updates of the RPA platform, it is advisable for banks to prioritize its implementation within a well-established and reliable business process. In the event that the application technology or process undergoes rapid changes in response to market dynamics, it becomes imperative to regularly upgrade the RPA software. The bank's operation management systems that are often used and exhibit high levels of stability include document management system, CRM, internal audit system, and ERP system. Operating systems of this kind exhibit a reduced susceptibility to market fluctuations, hence warranting a higher level of consideration when implementing RPA.

*Case Study of RPA in Banking*

*Banking RPA use case examples*

In contemporary times, financial institutions have increasingly used RPA as a means to streamline various routine operations, yielding very favorable outcomes in terms of implementation efficacy. RPA offers banks across many nations the opportunity to alleviate the burden on their workforce, so enabling staff to redirect their attention onto more intellectually demanding roles that need human decision-making. **Table 3** presents an examination of several banks operating in China, United States, South Korea, and Netherlands, which have included RPA technology. The objective is to analyze the implementation of RPA within the banking sector.

**Table 3.** Example of country using Banking RPA

<i>Country</i>	<i>Name of the Bank</i>	<i>Year of RPA application</i>	<i>Details of Application</i>
<i>United States</i>	Bank of New York Mellon	2016	According to the bank's study, the use of RPA yielded remarkable outcomes. Specifically, the verification process for closing accounts in a typical company, spanning many systems, attained a level of correctness of 100%.
<i>Netherlands</i>	ING Bank	2016	ING Bank of the Netherlands recently unveiled its strategic initiative, known as the RPA system, with the aim of preserving its staff via the establishment of a digital banking platform.
<i>Korea</i>	Shinhan Bank	2018	The RPA system was implemented by Shinhan Bank, including a total of 44 subprojects and involving 21 different departments. The RPA system effectively manages a daily workload of over 6000 processes for Shinhan Bank.
<i>China</i>	Bank of Nanjing	2018	A collaborative effort with Alibaba cloud resulted in the successful implementation of over 30 RPA applications. These apps have been deployed across several entrepreneurship lines within the bank, including both post-loan and pre-loan procedures.

*A detailed use case of RPA in banking operations*

RPA has emerged as a significant technology in the domain of credit card processing. RPA pertains to the utilization of software robots or bots for the purpose of automating repetitive and rule-based activities associated with the processing of credit cards. This technology has gained China Minsheng Banking Corporation Limited, often referred to as China Minsheng Bank, was founded in the year 1996. The bank in question is the first national joint-stock commercial bank of China, primarily established and spearheaded by non-state-owned businesses (NSOEs) [31]. At the conclusion of the fiscal year 2020, the organization's assets were recorded at a value of \$1,064 billion. As of June 2020, the organization has a network of 42 branches situated in 41 cities around China.

Additionally, it maintained a total of 2,427 banking outlets and employed over 55 thousand individuals. The adoption of RPA commenced in the year 2020, with the establishment of a dedicated unit under its subsidiary, Mingsheng Fintech Corporation Limited (“Mingsheng Fintech”), aimed at facilitating the use of RPA technology in the banking sector. The conventional method of credit card processing often entails a prolonged duration of several weeks for the verification and human approval of client information. The extended duration of processing results in significant financial expenses for the bank and leads to consumer dissatisfaction. Robotic operation Automation (RPA) has the potential to improve the efficiency and profitability of this particular operation.

*Credit card business volume*

Based on the 2020 annual report of Mingsheng Banks, the total number of credit cards issued by the bank stands at 61.67 million. In the year 2020, the quantity of newly issued credit cards amounted to 4.21 million. Approximately 70% of newly issued credit cards are obtained by in-person applications at the front desk, while the remaining percentage is acquired using internet platforms or mobile devices. In the year 2020, a total of around 2.95 million credit cards were issued using manual processes.



*Time saved after applying RPA*

Based on the calculations shown in Fig 3, it can be seen that the use of RPA in conjunction with Artificial Intelligence (AI) technology enables the bank to achieve automated validation and approval of applications in a time frame of 7 minutes. According to the findings, there is a potential time-saving of 43 minutes per application when comparing automated processes with manual staff involvement.

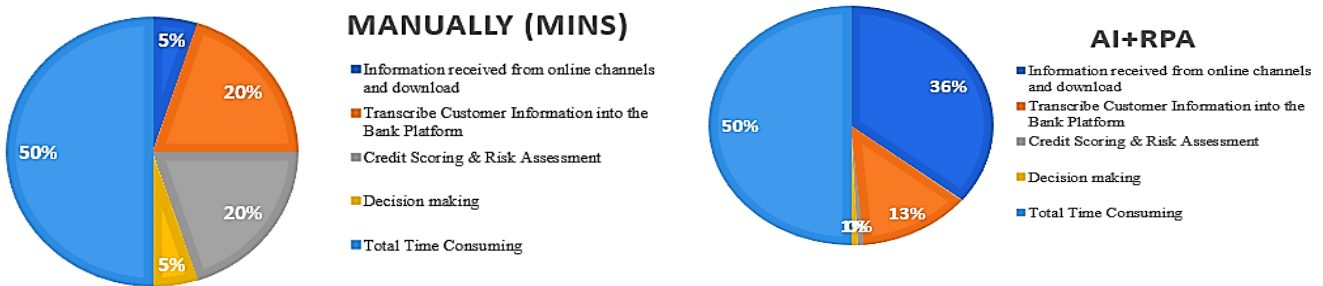


Fig 3. The Duration Required for Each Individual Procedure

*Total cost saved after RPA application*

The mean monthly compensation of workers at the credit card center of Minsheng Bank is \$2000. On average, employees work for 22 days per month, with each working day consisting of 8 hours. Consequently, the hourly labor cost may be computed as \$12. Based on the performance statistics of Minsheng Bank, the use of RPA and AI technology in credit card processing has the potential to provide cost savings of \$36 million. The computation may be expressed in the following manner:

$$\begin{aligned}
 CS &= BV \times TS \times \frac{ES}{\text{minute}} \\
 &= 4,215,300 \times 43 \times \frac{\$12}{60 \text{ minutes}} \\
 &= \$36,251,580
 \end{aligned}
 \tag{1}$$

where CS is cost saving per annum; BV is the business volume, which represents credit cards numbers provided; TS is the time saved, and ES is the employee salary released in a minute. According to the computation about, based on the application of AI and RPA, the cost savings in a year totals \$36,251,580.

V. CONCLUSION

Robot Process Automation (RPA) is an emerging technology that is undergoing fast development and is having a significant impact on corporate operations in many sectors. Companies are increasingly embracing RPA technologies, like Blue Prism, UiPath, and Automation Anywhere, as a means to automate routine processes that are governed by predefined rules. The necessity to decrease costs, reduce the impact of errors, and remove hazards is driving the pursuit to adopt this technology, which integrates IT portfolio experts, web crawling, effective business transformation, and content migration. In addition, engineers, process architects, and routine support & maintenance personnel are among the many professionals who help implement and maintain RPA systems and top RPA software vendors, such as Blue Prism, Automation Anywhere, and UiPath, predict this trend will go away on. The banking sector is employing this technology to enhance its operational effectiveness, and potentially automate most of its repetitive tasks, which meet their fiscal requirements. The technology can also be a valuable resource to different banking models such as customer service information, credit card approval and loan processing. Popular and established project management systems including CRM and ERP are also good for RPA implementation. RPAs have helped many international banks increase efficiency and revenue, including ING, Bank of Nanjing, Bank of New York Mellon, and Bank of New York. RPA has shown its efficacy as a significant instrument for augmenting operational efficiency and mitigating expenses within the banking sector. In general, RPA is a technology that brings about significant changes and provides several operational benefits in diverse sectors. As the market progresses in its development, the use of RPA will assume a substantial function in the automation of labor-intensive tasks, enhancing operational effectiveness, and facilitating organizational change.

**Data Availability**

No data was used to support this study.

**Conflicts of Interests**

The author(s) declare(s) that they have no conflicts of interest.

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## Competing Interests

There are no competing interests.

## References

- [1]. J. Ribeiro, R. Lima, T. Eckhardt, and S. Paiva, "Robotic Process Automation and Artificial Intelligence in Industry 4.0 – A Literature review," *Procedia Computer Science*, vol. 181, pp. 51–58, Jan. 2021, doi: 10.1016/j.procs.2021.01.104.
- [2]. R. Syed et al., "Robotic Process Automation: Contemporary themes and challenges," *Computers in Industry*, vol. 115, p. 103162, Feb. 2020, doi: 10.1016/j.compind.2019.103162.
- [3]. A. Asatiani and E. Penttinen, "Turning robotic process automation into commercial success – Case OpusCapita," *Journal of Information Technology Teaching Cases*, vol. 6, no. 2, pp. 67–74, Nov. 2016, doi: 10.1057/jittc.2016.5.
- [4]. J. Viehhauser, "Is robotic process automation becoming intelligent? Early Evidence of influences of artificial intelligence on robotic process automation," in *Lecture notes in business information processing*, 2020, pp. 101–115. doi: 10.1007/978-3-030-58779-6\_7.
- [5]. J. Siderska, "The Adoption of Robotic Process Automation Technology to Ensure Business Processes during the COVID-19 Pandemic," *Sustainability*, vol. 13, no. 14, p. 8020, Jul. 2021, doi: 10.3390/su13148020.
- [6]. F. Shafiei and D. Sundaram, "Multi-enterprise collaborative enterprise resource planning and decision support systems," *37th Annual Hawaii International Conference on System Sciences*, 2004. Proceedings of The, Jan. 2004, doi: 10.1109/hicss.2004.1265557.
- [7]. E. J. Umble, R. R. Haft, and M. M. Umble, "Enterprise resource planning: Implementation procedures and critical success factors," *European Journal of Operational Research*, vol. 146, no. 2, pp. 241–257, Apr. 2003, doi: 10.1016/s0377-2217(02)00547-7.
- [8]. M. Gomes and I. Seruca, "The perception of the management and lower-level employees of the impacts of using Robotic Process Automation: the case of a shared services company," *Procedia Computer Science*, vol. 219, pp. 129–138, Jan. 2023, doi: 10.1016/j.procs.2023.01.273.
- [9]. R. Corkrey and L. Parkinson, "Interactive voice response: Review of studies 1989–2000," *Behavior Research Methods Instruments & Computers*, vol. 34, no. 3, pp. 342–353, Aug. 2002, doi: 10.3758/bf03195462.
- [10]. S. Madakam, R. M. Holmukhe, and D. K. Jaiswal, "The future digital work force: Robotic Process Automation (RPA)," *Journal of Information Systems and Technology Management*, vol. 16, pp. 1–17, Jan. 2019, doi: 10.4301/s1807-1775201916001.
- [11]. D. Choi, H. R'bigui, and C. Cho, "Robotic Process Automation implementation challenges," in *Lecture notes in networks and systems*, 2020, pp. 297–304. doi: 10.1007/978-981-15-7990-5\_29.
- [12]. J. Gao, S. J. Van Zelst, X. Lu, and W. M. P. Van Der Aalst, "Automated Robotic Process Automation: a Self-Learning approach," in *Lecture Notes in Computer Science*, 2019, pp. 95–112. doi: 10.1007/978-3-030-33246-4\_6.
- [13]. I. Kregel, J. Koch, and R. Plattfaut, "Beyond the hype: robotic process automation's public perception over time," *Journal of Organizational Computing and Electronic Commerce*, pp. 1–21, Apr. 2021, doi: 10.1080/10919392.2021.1911586.
- [14]. L. S. Lubis and D. E. Sembiring, "Driving Digital Transformation: Leveraging Robotic Process Automation (RPA) to Enhance Business Process Efficiency and Reducing Manual Errors," *2023 IEEE International Conference on Data and Software Engineering (ICoDSE)*, Sep. 2023, doi: 10.1109/icodse59534.2023.10291662.
- [15]. W. M. P. Van Der Aalst, M. Bichler, and A. Heinzl, "Robotic Process Automation," *Business & Information Systems Engineering*, vol. 60, no. 4, pp. 269–272, May 2018, doi: 10.1007/s12599-018-0542-4.
- [16]. T. R. Eikebrokk and D. H. Olsen, "Robotic Process Automation and Consequences for Knowledge Workers; A Mixed-Method study," in *Lecture Notes in Computer Science*, 2020, pp. 114–125. doi: 10.1007/978-3-030-44999-5\_10.
- [17]. P. William, V. M. Tidake, S. Thorat, and A. Verma, "Future of Digital Work Force in Robotic Process Automation," *Robotic Process Automation*, pp. 297–314, Aug. 2023, doi: 10.1002/9781394166954.ch20.
- [18]. C. Flechsig, F. Anslinger, and R. Lasch, "Robotic Process Automation in purchasing and supply management: A multiple case study on potentials, barriers, and implementation," *Journal of Purchasing and Supply Management*, vol. 28, no. 1, p. 100718, Jan. 2022, doi: 10.1016/j.pursup.2021.100718.
- [19]. A. Albu-Schäffer, S. Haddadin, C. Ott, A. Stemmer, T. Wimböck, and G. Hirzinger, "The DLR lightweight robot: design and control concepts for robots in human environments," *Industrial Robot-an International Journal*, vol. 34, no. 5, pp. 376–385, Aug. 2007, doi: 10.1108/01439910710774386.
- [20]. S. Ayub, N. Singh, Md. Z. Hussain, M. Ashraf, D. K. Singh, and A. Haldorai, "Hybrid approach to implement multi-robotic navigation system using neural network, fuzzy logic, and bio-inspired optimization methodologies," *Computational Intelligence*, vol. 39, no. 4, pp. 592–606, Sep. 2022, doi: 10.1111/coin.12547.
- [21]. K. S. Umadevi, K. S. Thakare, S. Patil, R. Raut, A. K. Dwivedi, and A. Haldorai, "Dynamic hidden feature space detection of noisy image set by weight binarization," *Signal, Image and Video Processing*, vol. 17, no. 3, pp. 761–768, Aug. 2022, doi: 10.1007/s11760-022-02284-2.
- [22]. M. Amanullah, S. Thanga Ramya, M. Sudha, V. P. Gladis Pushparathi, A. Haldorai, and B. Pant, "Data sampling approach using heuristic Learning Vector Quantization (LVQ) classifier for software defect prediction," *Journal of Intelligent Fuzzy Systems*, vol. 44, no. 3, pp. 3867–3876, Mar. 2023, doi: 10.3233/jifs-220480.
- [23]. K. J. A. H. P. V. Y. S. and G. N., "A Study Of Dynamic Thresholds Power Detection Spectrum Sensing Techniques In CRN," *2023 9th International Conference on Advanced Computing and Communication Systems (ICACCS)*, Mar. 2023, doi: 10.1109/icaccs57279.2023.10112923.
- [24]. "Company information," *UiPath Investor Relations*. <https://ir.uipath.com/company-information>
- [25]. "2023 Technology Fast 500 Award winners," *Deloitte United States*. <https://www2.deloitte.com/us/en/pages/technology-media-and-telecommunications/articles/fast500-winners.html>
- [26]. Automation Anywhere, "Home page | Automation Anywhere," *Automation Anywhere*. <https://www.automationanywhere.com/>
- [27]. Automation Anywhere, "RPA-as-a-Service: Helping SMBs ease into Automation," *Automation Anywhere*. <https://www.automationanywhere.com/company/blog/rpa-thought-leadership/rpa-as-a-service-helping-smbsease-into-automation>
- [28]. B. Prism, "Blue Prism Secures £100 Million in New Funding," *Pmnewswire*, Apr. 21, 2020. [Online]. Available: <https://www.pnewsire.com/news-releases/blue-prism-secures-100-million-in-new-funding-301043893.html>
- [29]. A. Tardif, "Jason Kingdon, chairman and CEO at Blue Prism &#8211; interview series," *Unite.AI*, May 08, 2020. <https://www.unite.ai/jason-kingdon-chairman-and-ceo-at-blue-prism-interview-series/>
- [30]. V. Murinde, E. Rizopoulos, and M. Zachariadis, "The impact of the FinTech revolution on the future of banking: Opportunities and risks," *International Review of Financial Analysis*, vol. 81, p. 102103, May 2022, doi: 10.1016/j.irfa.2022.102103.
- [31]. Y. He, Y. Chiu, and Z. Bin, "The impact of corporate governance on state-owned and non-state-owned firms efficiency in China," *The North American Journal of Economics and Finance*, vol. 33, pp. 252–277, Jul. 2015, doi: 10.1016/j.najef.2015.06.001.