A Study of the Impact of the Adoption of Robotic Process Automation (RPA) on Work Productivity in the Retail Banking Industry

By

KO, Eura

THESIS

Submitted to

KDI School of Public Policy and Management

In Partial Fulfillment of the Requirements

For the Degree of

MASTER OF PUBLIC POLICY

2020

A Study of the Impact of the Adoption of Robotic Process Automation (RPA) on Work Productivity in the Retail Banking Industry

By

KO, Eura

THESIS

Submitted to

KDI School of Public Policy and Management

In Partial Fulfillment of the Requirements

For the Degree of

MASTER OF PUBLIC POLICY

2020

Professor Lee, Ju-Ho

A Study of the Impact of the Adoption of Robotic Process Automation (RPA) on Work Productivity in the Retail Banking Industry

By

KO, Eura

THESIS

Submitted to

KDI School of Public Policy and Management

In Partial Fulfillment of the Requirements

For the Degree of

MASTER OF PUBLIC POLICY

Committee in charge:

Professor Lee, Ju-Ho, Supervisor

Professor Cho, Yoon Cheong

Approval as of December, 2020

ABSTRACT

Automation is not a new phenomenon. The automation of activities have proven to be pivotal in productivity growth not only at the individual level, but at the business level and achieved the economies of scale.

One of the emerging technologies that has had a significant impact in the financial services industry is the adoption of Robotic Process Automation (RPA). IBS Intelligence (2019)'s report acknowledged that the RPA technology deploys "*software robots to automate repetitive, rule-based, and high-volume tasks, has helped financial institutions in the phase of digital transformation*".

This research attempts to study the impact of RPA adoption in the South Korean retail banking industry in relation to work productivity through a quantitative analysis. Specifically, the study takes the attributes from the IT innovation theories to observe the front office bank employees' behavior with the adoption of a new technology like RPA is introduced.

Data sources included analysis of financial reports of the major banks in South Korea and business journals. Then, data were collected from 62 front-office bank employees working at the two of the top five retail banks in South Korea with experiences of reassigning tasks to RPA bots.

Keywords: Robotic Process Automation, Banking Industry, Technology Adoption, Financial Services

ACKNOWLEDGEMENTS

First and foremost, I would like to sincerely express my gratitude to my supervisors for their kindness and patience. This research project would not have been possible without their supports.

I would like to thank the survey respondents who were willing to participate at no cost and for giving me the opportunity to conduct this research.

Lastly, I would like to thank my family for their constant encouragement and support that even working mothers can pursue their dreams.

TABLE OF CONTENTS

Chapter 1: Introduction

As noted in Bank of American Merrill Lynch (BAC)'s report released in 2015, "*robots are likely to be performing 45 percent of manufacturing tasks by 2025*" (BAC, 2015). This is a huge leap from a 10 percent figure in 2015. These computer softwares or "robots" will perform activities, which can also be termed as virtual or digital workforce in today's work environment (Kumar & Balaramachandran, 2020). In particular, the adoption of Robotic Process Automation (RPA) is becoming popular in the banking sector as the industry is going through a phase of digital transformation. RPA is referred as "*a tool that can be used to streamline and automate a number of routine, manual banking processes or sub-processes"* (Wilds, 2019). The significance of RPA is that it is continually evolving like any other technology and is now augmenting itself with the potential of Artificial Intelligence technology giving rise to what is known as Cognitive Automation (IBS Intelligence, 2019).

The primary goal of exploring and building RPA capabilities is to handle large amounts of repetitive and tedious tasks with limited resources so that banks can significantly reduce processing time and errors, which consequently leads to increased accuracy and reliability (Romão, Costa & Costa, 2019). However, the banking industry is only at the initial stage of evolution of RPA, where automation tools are used to assist human operations in conducting their jobs (IBS Intelligence, 2019). In the meantime, the effectiveness of Robotic Process Automation (RPA) into daily operations of the Front Office in the banking industry should be examined .

Research Questions (RQ)

1) Does the adoption of RPA in the retail banking industry increase work productivity?;

With this in mind, IT adoption literature has been taken into account to measure the effectiveness of RPA. At the first stage of the RPA development stage, RPA tools are considered easy to use and allows for quick process automation, often with little involvement from a centralized IT department (Lacity & Willocks, 2018).

Even though RPA will serve as a very valuable tool in the banking industry, its actual effects have not been investigated yet. As a consequence, research investigating the relationship between adoption of RPA and productivity is warranted.

Thus, implementation of software bots which captures and interprets the customer requirements and initiates operations across multiple digital systems replacing tasks operated at the Front Office gives a rise to the following research question: 1) Does the adoption of RPA in the banking industry increase productivity ?

In response to the research question, this thesis aims to build a tentative framework based on the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT). Then, the research model will be proposed and tested from the front-office bank employees at local branches, who have experienced using the new RPA tools in their daily routines.

The remainder of the paper is organized as follows. Chapter 2 examines a comprehensive literature review that presents the theoretical foundation of this paper. Chapter 3 presents the

empirical specification, and the implementation of the model. Chapter 4 presents the results of statistical and other computational analyses. Chapter 5 summarizes the findings and provides a brief discussion concerning the shortcomings of the methods employed. Finally, an appendix presenting the detailed algebraic works is presented at the end of the paper.

Chapter 2: Literature Review

The purpose of this chapter is to provide a comprehensive review of previous research on Robotic Process Automation (RPA), followed by an introduction of the most commonly used theoretical IT frameworks to serve as a basis in this study on assessing the effectiveness of the adoption of RPA in relation to work productivity.

2.1 Robotic Process Automation (RPA)

2.1.1 Robotic Process Automation (RPA) Definition

The literature provides several definitions for Robotic Process Automation (RPA). The inventors of RPA define RPA as *"a technology that enables to automate the execution of repetitive and manually intensive* activities." (European Patent Office, 2012, p.1). The Institute for Robotic Process Automation & Artificial Intelligence (2019) proposes another definition of RPA: *"RPA is the application of technology to configure software robots that capture and interpret existing applications for processing transactions, manipulating data and communicating with other software systems".* Willcocks et al. (2015) considers Robotic process automation (RPA) as "*the use of software with artificial intelligence (AI) and machine learning capabilities to handle high-volume, repeatable tasks that previously required humans to perform."*

All these definitions emphasize the main purpose of RPA is to automate repetitive and redundant tasks with the use of technology and *"bots"*. The automation of tasks reduces costs and execution time, increases productivity and accuracy, mitigates or eliminates human errors (Aguirre & Rodriguez, 2017). For example, Willcocks, Lacity & Craig (2015)'s study showed that RPA implementation reduced Full-time equivalent (FTE) employee costs by 50 percent, while back office failure customer calls from industries like telecommunications, utilities, financial services and health care also decreased by 50 percent. With RPA, humans can prioritize working on "*higher value-adding tasks that require human creativity, ingenuity, and decision making*" (Romão, Costa & Costa, 2019).

Like any other industry, banks are constantly looking different ways to maximize profit and stay competitive in which, RPA appears as a solution to further enhance the way that Banking, Financial Services and Insurance (BFSI) are conducting their businesses (Hosadurga, 2017; Kumar, 2020). There are manual tasks such as transaction entry processes and entering customer information based on know-your-customer policies can be reassigned to RPA. In summary, RPA is beneficial when it comes to financial processes containing structured data input in which bank employees can be relieved from work that are repetitive and redundant task such as reporting, data preparation, application processing, knowledge management, transferring data and saving data (Duong, 2018).

2.1.2 Robotic Process Automation (RPA) Development Stages

KPMG International (2016)'s report suggests that RPA can be divided into three stages starting from the basic process automation, enhanced process automation and cognitive automation (Figure 1). The first stage involves basic process automation in order to automate repetitive

transactions or tasks through rule-based programming. In the second stage of "enhanced process automation", the decision-making-based task is imitated, and machine learning is used to recognize unstructured data patterns and limited decision-making automation. Then at the final stage of RPA of the cognitive automation level, the RPA evolves as true artificial intelligence, machine learning, and natural language processing (KPMG,2016).

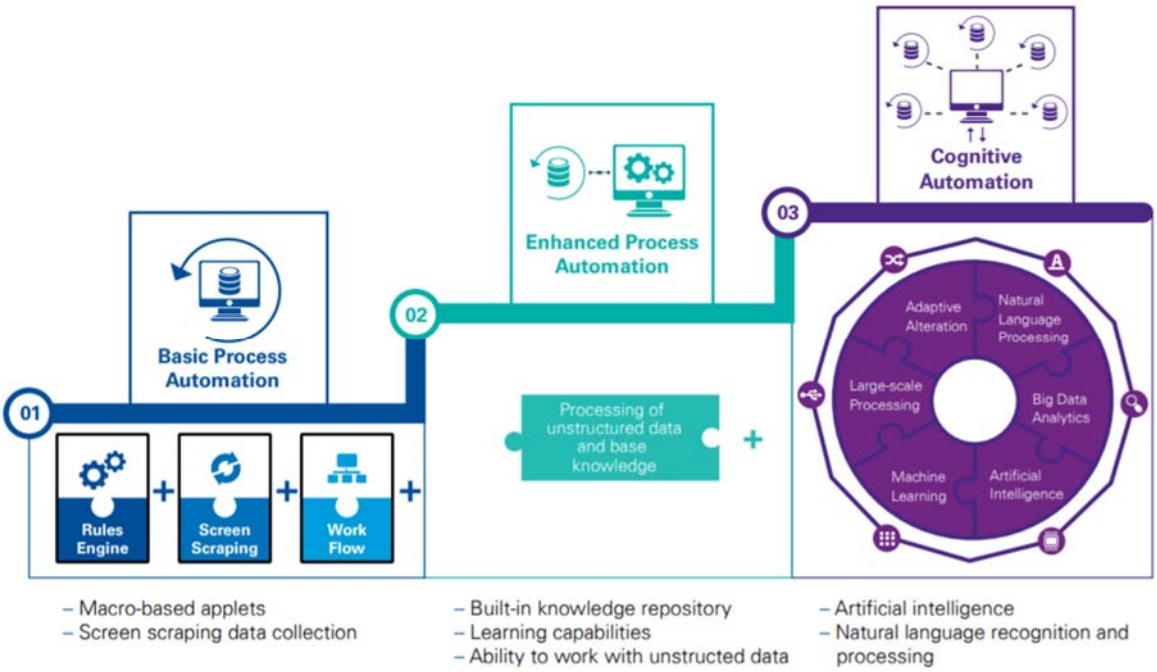

Figure 1: Three classes of robotic process automation (KPMG International, 2016)

According to Forrester research performed in the second quarter of 2018, whilst many organizations remain at the basic automation stage, some organizations, namely Ipsoft and Arago have positioned themselves at the intelligent automation stage. Furthermore, some organizations such as IBM Watson, Wolfram, Alpha and Google Deep Mind have managed to reach the cognitive automation stage. For example, IBM's Watson utilize a combination of artificial intelligence and cognitive technologies that mimic human though processes and

communication which in turn enabled understanding and interface with humans (KPMG International, 2016).

2.1.3 Robotic Process Automation (RPA) Applications in the Financial Industry

The degree of automation varies depending on the nature of the industry. However, RPA is utilized across various industries performing a variety of functions such as HR, IT, Finance, Accounting and even legal services. In South Korea, RPA is mainly conducted in the financial sector, and is operated with limited application to business processes (Lee, 2017).

In the case of the financial industry, credit card issuance, fraudulent claim detection, and loan information update can be performed. In particular, RPA is used in the back office to perform general business affairs, banking's anti-money laundering regulations compliance tasks, and so on. In the front office, it is possible to serve customers as virtual financial assistants, customer-responsive emotion recognition robots, and robot advisors (Yoon, 2017). Moreover, RPA is being used in the insurance industry as well such as insurance payment claims. Earnest & Young (2016) reported that banks and insurance companies are savings costs by 20 to 30 percent in the back offices and the scope of the job performance by RPA will expand even greater in the next 4 to 5 years (Yoon, 2017).

2.2 Benefits of Robotic Process Automation (RPA)

RPA software reduces cycle time at a lower cost than other automation software, enabling time-consuming, rule-based office work to be performed more efficiently. PwC (2017) predicted that 45% of work activities could be automated, thereby saving $2 trillion in global workforce costs.

RPA has advantages not only limited to cost savings and efficiency, but also for the benefits of speed, agility and ease of deployment.

In the past, many businesses have adopted "Business Process Management" scheme as a part of process transformation for the sake of cost savings and efficiencies (PwC, 2016). However, the cost of implementation and the resistance towards changes are often inevitable. In comparison, RPA offers tailored solutions that enable individual business units within a business to rapidly digitize processes, deliver valuable and sustainable value in a short amount of time, and reduce overall risks (PwC, 2016).

Thus, the benefits of RPA can be broken down as follows than can enhance the efficiency and cost optimization. Firstly, reduction in Full-time employee (FTE) can be achieved. RPA allows saving a considerable cost in human resources, which is approximately one-third of the cost per labor. Moreover, a significant enhancement of productivity compared to that of FTE is caused by not only a robot's non-stop working in every hour of 365 days but also its ability of continuously learning and improving their performance.

Secondly, it improves data analytics. RPA has the ability to manage data centrally and keep track of any processing transactions in real time. In addition, any analysis is done based on defined rules and structure that robots can re-train itself. Therefore, a robot can return accurate analytics value as soon as it receives any newly updated data. Thanks to that, a data analytics outcome has been increased in quality, quantity and speed.

Last but not least, the benefits derived from RPA will continually develop towards a merge with Artificial Intelligence which will inevitably change the working dynamics of the financial

services industry. The processes in the banking sector, “right from customer experience, fraud mitigation, digital transformation initiatives, loan processing, wealth advisory would be impacted by the change” (IBS intelligence, 2019, p. 19).

2.3 IT-adopted Frameworks

Over the last decades, the adoption of IT innovations developed a diverse body of literature. When a new technology is introduced and whether end-users will actively accept the change, the most widely used model for approaching such issue is the Technology Accepted Model (TAM) suggested by Davis in 1989.

TAM was initially developed to understand and explain individual behavior of technology adoption and usage (Davis, 1989). The model suggests the attributes of perceived usefulness and perceived ease of use. 'Perceived ease of use' is defined as "the extent to which the individual believe that using a specific system will be effort free" and 'Perceived usefulness' is defined as "the extent to which the individual believes that using a specific system will increase his or her productivity" (Davis, 1989). These two attributes have been widely tested and extended models have been developed further. For example, Venkatesh et al., (2003) suggested a multitude of theoretical perspectives and developed the Unified Theory of Acceptance and Use of Technology (UTAUT). Venkatesh et al. (2003) synthesized these attributes into (1) effort expectancy and (2) performance expectancy. 'Effort expectancy' is defined as "the degree of ease associated with the use of the system" whereas 'performance expectancy' is defined as "the degree to which an individual believes that using the system will help him or her to attain gains in job performance" (Venkatesh et al, 2003, p.447-450).

To further investigate the end-user behavior of RPA in an organizational context, this study will construct a research model based on the attributes of the Technology Acceptance (TAM) Model and the and the Unified Theory of Acceptance and Use of Technology (UTAUT) Model.

Chapter 3: Research Model

3.1 Research Model Design

Currently, the tasks performed by RPA in the South Korean retail banking industry by customer-facing front office bank employees at retail banking branches are in the first stage of RPA Development Stage. The basic process automation is triggered by the execution of a "job order request" by the front office bank employee. In other words, instead of performing a daily routine task manually, the front office bank employee *chooses* to reassign the task to RPA bots.

Thus, this study utilize secondary resources from financial reports, business journals and documents to propose a model (Figure 2) to analyze the effects of the adoption of RPA in the retail banking industry on work productivity. The variables have been identified as: 1) RPA Reliability; 2) RPA Perceived Usefulness; 3) RPA Perceived Ease-of-Use; 4) RPA Effort Expectancy and 5) RPA Performance Expectancy.

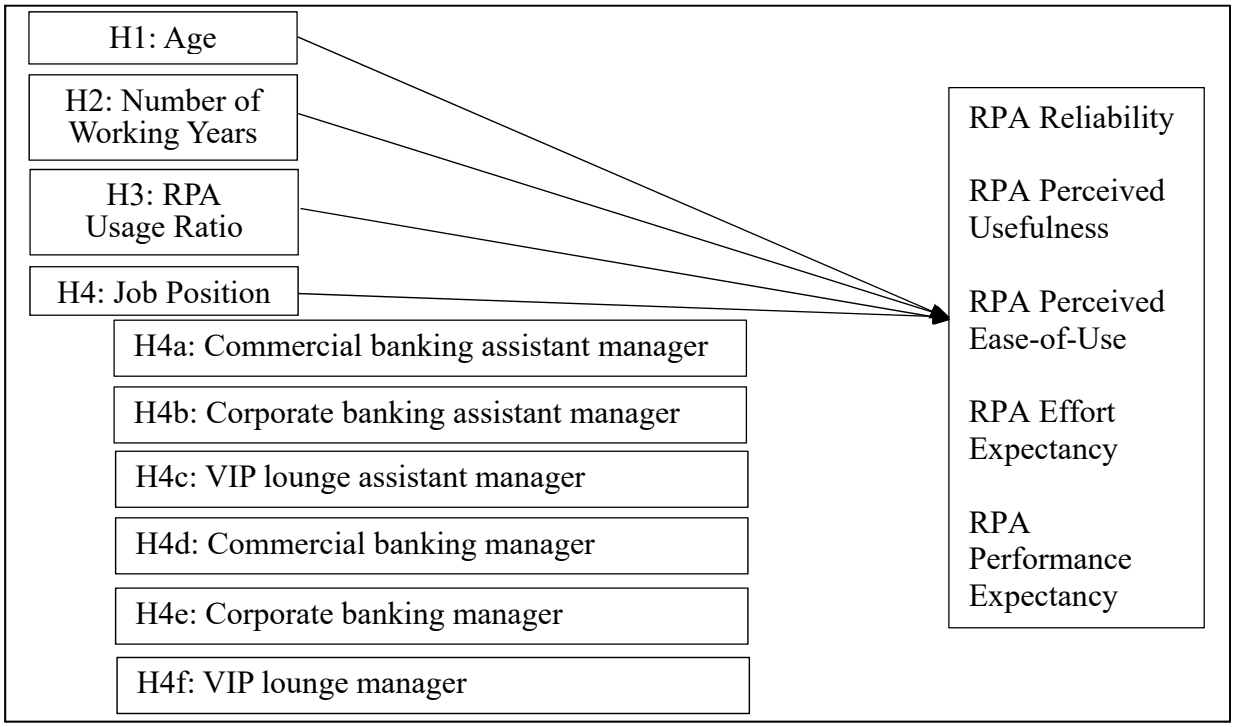

Figure 2: Research Model

The research model was tested using a survey questionnaire. The survey instrument was constructed by identifying relevant measurements from a comprehensive literature review and from discussions with RPA experts in retail banks. The questionnaire consisted of five parts; first part was on demographics and the latter four parts related to the four independent variables. There were a total of 26 questions and a 10 point Likert scale was used to measure the survey items. An explanation on the subject and the purposes of the research were mentioned at the start of the survey for the better awareness of this study. In addition, the voluntary nature of the survey and the assurance of privacy of data were also stated. The questionnaires were circulated

to employees of the two biggest retail banks in South Korea. This study reached out to a target sample size of 80+ by providing an offline survey. Due to segregation of internal and external network of firewall restrictions, online survey option was not possible. Out of a total of 80+ targeted bank employees, 62 responses were received.

3.2 Research Method, Data Analysis and Results

3.2.1 Demographics (Total Obs: 62)

Variable: q_1_1	Freq.	Percent
1 (Commercial banking assistant manager)	28	45.16
2 (Corporate banking assistant manager)	18	29.03
3 (VIP lounge assistant manager)	1	1.61
4 (Commercial banking manager)	10	16.13
5 (Corporate banking manager)	2	3.23
6 (VIP lounge manager)	3	4.84
Total	**62**	**100.00**

Table 1: Job Position

This table summarizes the results of frequency analysis of the participants' current job position. This study sample consisted of 62 people, and 'Commercial banking assistant manager' accounted for 45.16% of the total sample, followed by 'Corporate banking assistant manager' (29.03%), 'Commercial banking manager' (16.13%), VIP lounge manager (4.84%), 'Corporate banking manager' (3.23%) and 'VIP lounge assistant manager' (1.61%).

Variable: q_1_2	Freq.	Percent
1 (Teller)	26	15.76
2 (Personal Banking Representative/Financial Adviser)	38	23.03
3 (Loan Officer)	37	22.42
4 (FX Transactions)	30	18.18
5 (Corporate Loan Officer)	12	7.27
6 (General Affairs)	6	3.64
7 (Internal Control Officer)	6	3.64
8 (Performance Manager, KPI)	5	3.03
Total	**165**	**100.00**

Table 2: Major Tasks

This table summarizes the results of frequency analysis of major tasks performed by each participant in which multiple selection was possible. Out of a total of 62 participants, 23.03% answered “Personal Banking Representative/Financial Adviser” followed by 22.42% of Loan Officers and 18.18% of FX Transactions. These results can be interpreted in relation to the results of q_1_1 Job positions. In other words, since the ratio of respondents with assistant managerial positions (Commercial banking, Corporate banking and VIP lounge assistant managers) is as high as 75.80% among the respondents, outcome of the major tasks performed by the respondents is expected. For this variable (q_1_2), participants could make multiple selections. Of these, it was revealed that a total of 4 people were involved in being in charge of 5 major tasks in which the most common task performed were "Teller", "Personal banking representative", "Loan Officer" and "FX Transactions". Also, it was confirmed that 74.19% of the total sample was engaged in more than one job.

Variable: q_1_3	Freq.	Percent	Variable: q_1_4	Freq.	Percent
1 (Aged 20-30yrs)	9	14.52	2 (Working Years 1-5)	11	17.74
2 (Aged 31-40yrs)	19	30.65	3 (Working Years 6-10)	8	12.90
3 (Aged 41-49yrs)	28	45.16	4 (Working Years 11-20)	27	43.55
4 (Aged 50yrs~)	6	9.68	5 (Working Years 20~)	16	25.81
Total	**62**	**100.00**	**Total**	**62**	**100.00**

Table 3 & 4 : Age & Number of Working Years

This table summarizes the results of frequency analysis of the ages of the sample (q_1_3) and number of working years in terms of work experiences (q_1_4). As a result of the analysis of the ages of the respondents, 28 persons (45.16%) were those aged 40 years or older and younger than 50 years old, and 19 persons (30.65%) were aged 30 years or older and younger than 40 years old, which was 75.81% of the total sample size. In addition, as a result of the analysis of the number of working years of the sample, 27 (43.55%) people (43.55%) for those with more than 10 years and less than 20 years, 16 (23.81%) those with more than 20 years, and 11 (17.74%) those with more than 1 year and less than 5 years.

Variable: q_1_5_usage ratio	Freq.	Percent
0.1≤usage ratio< 0.2	8	12.90
0.2≤ usage ratio <0.3	6	9.68
0.3≤ usage ratio <0.4	28	45.16
0.4≤ usage ratio <0.5	4	6.45
usage ratio≥ 0.5	16	25.81
Total	**62**	**100.00**

Table 5: RPA Usage Ratio

This table summarizes the ratio of RPA usage by computing the total number of employees using RPA divided by the total number of employees at the affiliated bank branch. As a result, 28 people (45.16%) revealed the ratio to be over 30% but less than 40%. 16 people (25.81%) responded the ratio to be over 50% followed by 8 people (12.9%) who answered to be over 10 % but less than 20%.

3.3.2 Findings

In this section, participants were asked to choose the top three preferred tasks to reassign to RPA instead of performing them manually and compare the time taken for each task. The results of the top three RPA-performing tasks showed similar results that there was no difference between the average time spent in the case of performing the task manually and the average time spent by RPA bots with the same task.

Preference RPA Tasks

Front-office bank employees' preference for reassigning work to RPA bots (1st)

Classification	Variable: q_2_2_1_no1 Variable: q_2_2_2_no1	
	Freq.	**Percent**
1 (Verification of Business Licenses)	39	62.90
3 (Automatic Email Forwarding from External to Internal Mail Inbox)	10	16.13
15 (Large-scale Access to Real Property Registry Records)	5	8.06
5 (Payroll Request)	3	4.84
4 (Automatic Confirmation Calls List)	2	3.23

7 (Defined-Contribution Retirement Plan Deposit Request)	2	3.23
17 (Alerts before Roll-over or Extension of Corporate Debts)	1	1.61
Total	**62**	**100.00**

	Variable: q_2_2_1_time1			|t-value|	p-value
	Mean	**Std. Dev.**	**Median**		
time1	**302.627**	54.810	180	0.982	0.327
	Variable: q_2_2_2_time1				
	Mean	**Std. Dev.**	**Median**		
	218.066	518.321	60		

The most preferred task reassigned to RPA bots was "Verification of Business Licenses" which accounted for 62.90% followed by "Automatic Email Forwarding from External to Internal Mail Inbox" recorded at 16.13%. A t-test for each group of work completion time when performing the task manually and reassigning to RPA bots showed that the p-value was 0.327, and the null hypothesis that there is no difference between the average time spent in the case of performing the task manually and the average time spent in the case of reassigning the task to RPA bots could not be rejected. That is, it was verified that there is no difference in the average time of performance.

Front-office bank employees' preference for reassigning work to RPA bots (2nd)

Classification	**Variable: q_2_2_1_no2** **Variable: q_2_2_2_no2**	
	Freq.	**Percent**
1 (Verification of Business Licenses)	11	20.00
4 (Automatic Confirmation Calls List)	9	16.36
10 (Verification of Lease Deposit Recommendations provided by the	7	12.73

Seoul Metropolitan Government)		
2 (Customer Due Diligence / Enhanced Due Diligence (CDD/EDD) Procedures)	5	9.09
3 (Automatic Email Forwarding from External to Internal Mail Inbox)	5	9.09
5 (Payroll Request)	5	9.09
6 (Issuance of Payroll Request Receipts)	5	9.09
Others	8	14.55
Total	**55**	**100.00**

	Variable: q_2_2_1_time2			**|t-value|**	**p-value**
	Mean	**Std. Dev.**	**Median**		
time2	**316.153**	231.212	300	1.235	0.219
	Variable: q_2_2_2_time2				
	Mean	**Std. Dev.**	**Median**		
	242.961	359.327	60		

The second most preferred task reassigned to RPA bots was "Verification of Business Licenses" which accounted for 20.00% followed by "Automatic Confirmation Calls List" recorded at 16.46%. A t-test for each group of work completion time when performing the task manually and reassigning to RPA bots showed that the p-value was 0.219, and the null hypothesis that there is no difference between the average time spent in the case of performing the task manually and the average time spent in the case of reassigning the task to RPA bots could not be rejected. That is, it was verified that there is no difference in the average time of performance.

Front-office bank employees' preference for reassigning work to RPA bots (3rd)

Classification	Variable: q_2_2_1_no3 Variable: q_2_2_2_no3	
	Freq.	**Percent**
5 (Payroll Request)	5	15.63
7 (Defined-Contribution Retirement Plan Deposit Request)	5	15.63
10 (Verification of Lease Deposit Recommendations provided by the Seoul Metropolitan Government)	5	15.63
15 (Large-scale Access to Real Property Registry Records)	4	12.50
4 (Automatic Confirmation Calls List)	3	9.38
9 (Issuance of Vehicle Registration Documents (Verifications for Car Loans)	3	9.38
Others	7	21.88
Total	**32**	**100.00**

	Variable: q_2_2_1_time3			|t-value|	p-value
	Mean	**Std. Dev.**	**Median**		
time3	**335**	296.669	300	0.696	0.488
	Variable: Variable: q_2_2_2_time3				
	Mean	**Std. Dev.**	**Median**		
	397.187	408.721	180		

The third most preferred task reassigned to RPA bots showed three equally weighted responses as follows; “Payroll Request”, “Defined-Contribution Retirement Plan Deposit Request” and “Verification of Lease Deposit Recommendations provided by the Seoul Metropolitan Government” accounted for 15.63%. A t-test for each group of work completion time when performing the task manually and reassigning to RPA bots showed that the p-value was 0.488, and the null hypothesis that there is no difference between the average time spent in the case of performing the task manually and the average time spent in the case of reassigning the task to RPA bots could not be rejected. That is, it was verified that there is no difference in the

average time of performance.

3.3.3 Data Reliability and Consistency

This table summarizes the results of ANOVA analysis and Cronbach's alpha to measure reliability or consistency of survey responses. The survey consisted of 4 questions related to "RPA reliability" tasks reassigned to RPA, 4 questions on its "perceived usefulness", 4 questions on its "perceived ease-of-use", 3 questions on "effort expectancy", and 3 questions on "performance expectancy". To measure whether the mean within each group was significantly different from each other, an ANOVA analysis was conducted. As a result of the analysis, it was confirmed that the p-value was within the rage of 0.60 to 0.96, which failed to reject the null hypothesis that the average value of each item was not very different. In other words, the result was that the average of each item was not different indicating that there is consistency. Furthermore, the results from Cronbach's alpha showed that the alpha coefficient was within the range of 0.943 and 0.973. This confirms that there is a strong consistency between the questions and the responses from the survey conducted.

The results of Pearson's correlation analysis of the RPA-related query parameter also showed similar results and confirmed that there is a correlation of all the items indicating that the responses from the query items are consistent (Appendix).

Variable	define	Obs	Mean	Std. Dev	Min	p50	Max	F-value	P-value	Cronbach's alpha
q_3_1_1	RPA Reliability	62	7.935	1.726	5	8.5	10	0.42	0.74	0.943
q_3_1_2		62	7.968	1.828	4	8.5	10			
q_3_1_3		62	8.113	2.001	4	9	10			
q_3_1_4		62	7.742	1.890	4	8	10			
q_3_1_5		62	492.742	1935.226	10	30	9000			
q_3_2_1	RPA Perceived Usefulness	62	7.935	1.678	4	8	10	0.10	0.96	0.956
q_3_2_2		62	7.871	1.769	4	8	10			
q_3_2_3		62	7.823	1.645	3	8	10			
q_3_2_4		62	7.774	1.920	1	8	10			
q_3_3_1	RPA Perceived Ease-of-Use	62	8.113	1.830	3	9	10	0.33	0.80	0.957
q_3_3_2		62	7.823	1.824	3	8.5	10			
q_3_3_3		62	8.032	1.727	3	9	10			
q_3_3_4		62	8.081	1.730	3	9	10			
q_3_4_1	RPA Effort Expectancy	62	7.806	1.687	3	8	10	0.51	0.60	0.943
q_3_4_2		62	7.710	1.562	5	8	10			
q_3_4_3		62	8	1.640	5	8	10			
q_3_5_1	RPA Performance Expectancy	61	7.951	1.811	3	9	10	0.17	0.85	0.973
q_3_5_2		61	8	1.761	3	9	10			
q_3_5_3		61	7.820	1.775	3	8	10			

3.3.4 Additional Findings

RPA Reliability

	q_1_3	q_1_4	q_1_5_ratio	q_3_1_1	q_3_1_2	q_3_1_3	q_3_1_4	q_3_1_5
q_1_3	1.000							
q_1_4	0.700***	1.000						
q_1_5_ratio	0.152	-0.002	1.000					
q_3_1_1	0.429***	0.314**	0.368***	1.000				
q_3_1_2	0.363***	0.196	0.324**	0.888***	1.000			
q_3_1_3	0.337***	0.156	0.140	0.790***	0.826***	1.000		
q_3_1_4	0.412***	0.222*	0.142	0.764***	0.842***	0.727***	1.000	
q_3_1_5	0.122	0.266**	-0.075	0.267**	0.246*	0.217*	0.265**	1.000

1) This table reports the Pearson correlations among variables used in this study.
2) ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively(two-tailed).

H1: Bank employees' age affects RPA Reliability

H2: Bank employees' number of working experiences affects RPA Reliability

H3: RPA Usage Ratio affects RPA Reliability

The results of the Pearson correlation analysis of Hypothesis 1, 2, and 3 is shown above. When checking the results of the correlation analysis of the reliability of the RPA bots according to the age of hypothesis 1 (q_1_3), the correlation coefficient (rho) in question 1, question 2, question 3, and question 4 was 0.429, 0.363, 0.337, and 0.412, respectively at a significance level of 1%. It was confirmed that there is a positive correlation at the level. The increase in age is highly related to the high score of the above question. When examining the results of the correlation analysis of the reliability of RPA bots according to the hypothetical 2-number of working experiences (q_1_4), the correlation coefficients (rho) in question 1, question 4, and question 5 were 0.314, 0.222, and 0.266, respectively, at a significance level of 5% to 10%. It

was confirmed that there is a positive relationship. Thus, the increase in work experience is highly related to the high score in the above questions. If we check the results of the correlation analysis of the reliability of RPA bots according to the hypothesis 3 RPA usage ratio (q_1_5_ratio), the correlation coefficients (rho) in question 1 and question 2 were 0.368 and 0.324, respectively, indicating positive relevance at the 1% to 5% significance level. Hence, the increase in the proportion of RPA usage is highly related to the high score to the *reliability of RPA.*

	dum_1	dum_2	dum_3	dum_4	dum_5	dum_6	q_3_1_1	q_3_1_2	q_3_1_3	q_3_1_4	q_3_1_5
dum_1	1.000										
dum_2	-0.580***	1.000									
dum_3	-0.116	-0.082	1.000								
dum_4	-0.398***	-0.280**	-0.056	1.000							
dum_5	-0.166	-0.117	-0.023	-0.080	1.000						
dum_6	-0.205	-0.144	-0.029	-0.099	-0.041	1.000					
q_3_1_1	-0.004	-0.349***	0.080	0.426***	-0.260**	0.184	1.000				
q_3_1_2	-0.091	-0.224*	0.073	0.395***	-0.248*	0.170	0.888***	1.000			
q_3_1_3	-0.101	-0.323**	0.057	0.417***	-0.010	0.177	0.790***	0.826***	1.000		
q_3_1_4	-0.065	-0.177	0.086	0.294**	-0.218*	0.151	0.764***	0.842***	0.727***	1.000	
q_3_1_5	-0.213*	-0.135	-0.032	0.508***	-0.031	-0.046	0.267**	0.246*	0.217*	0.265**	1.000

1) This table reports the Pearson correlations among variables used in this study.

2) ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively(two-tailed).

H4: Bank employee's job position affects RPA Reliability

H4a:Bank employee's job position as "Commercial banking assistant manager" affects RPA Reliability

H4b: Bank employee's job position as "Corporate banking assistant manager" affects *RPA Reliability*

H4c: Bank employee's job position as "VIP lounge assistant manager" affects *RPA*

Reliability

H4d: Bank employee's job position as "*Commercial banking* manager" affects *RPA Reliability*

H4e: Bank employee's job position as "Corporate banking manager" affects *RPA Reliability*

H4f: Bank employee's job position as "VIP lounge manager" affects *RPA Reliability*

This table summarizes the results of the Pearson correlation analysis of Hypothesis 4. Here, the operational definition of dum1-6 is as follows. dum_1 is a member of the commercial banking assistant manager, dum_2 is a member of the corporate banking assistant manager, dum_3 is a VIP lounge team member, dum_4 is the commercial banking manager, dum_5 is the corporate banking manager, and dum_6 is the VIP lounge manager. As a result of the analysis, dum_4 (individual general counter team leader) showed a strong positive correlation with all inquiries regarding the reliability of RPA bots. In other words, it can be said that in the case of the commercial banking manager, a high score was given to the five queries.

RPA Perceived Usefulness

	q_1_3	q_1_4	q_1_5_ratio	q_3_2_1	q_3_2_2	q_3_2_3	q_3_2_4
q_1_3	1.000						
q_1_4	0.700***	1.000					
q_1_5_ratio	0.152	-0.002	1.000				
q_3_2_1	0.283**	0.209	0.284**	1.000			
q_3_2_2	0.311**	0.208	0.321**	0.908***	1.000		
q_3_2_3	0.144	0.053	0.418***	0.780***	0.758***	1.000	
q_3_2_4	0.168	0.081	0.271**	0.881***	0.860***	0.885***	1.000

1) This table reports the Pearson correlations among variables used in this study.
2) ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively(two-tailed).

H1: Bank employees' age affects RPA Perceived Usefulness

H2: Bank employees' number of working experiences affects RPA Perceived Usefulness

H3: RPA Usage Ratio affects RPA Perceived Usefulness

The results of the Pearson correlation analysis of Hypothesis 1, 2, and 3 is shown above. When checking the results of the correlation analysis of the *perceived usefulness of the RPA bots* according to the age of hypothesis 1 (q_1_3), the correlation coefficient (rho) in question 1 and question 2 were 0.283 and 0.311, respectively at a significance level of 5%. It was confirmed that there is a positive correlation at the level. The increase in age is highly related to the high score of the above question. The correlation analysis of the perceived usefulness of the RPA bots according to the hypothetical 2-number of working experiences (q_1_4) showed that there is a weak correlation. However, the hypothesis 3 RPA usage ratio (q_1_5_ratio), revealed that the correlation coefficient (rho) in question 1, question 2, question 3, and question 4 was 0.284, 0.321, 0.418, and 0.17`, respectively at a significance level of 1% to 5%. It was confirmed that there is a positive correlation at the level. Hence, the increase in the proportion of RPA usage is highly related to the *perceived usefulness of RPA.*

s	dum_1	dum_2	dum_3	dum_4	dum_5	dum_6	q_3_2_1	q_3_2_2	q_3_2_3	q_3_2_4
dum_1	1.000									
dum_2	-0.580***	1.000								
dum_3	-0.116	-0.082	1.000							
dum_4	-0.398***	-0.280**	-0.056	1.000						
dum_5	-0.166	-0.117	-0.023	-0.080	1.000					
dum_6	-0.205	-0.144	-0.029	-0.099	-0.041	1.000				
q_3_2_1	-0.082	-0.018	0.082	0.175	-0.267**	0.099	1.000			
q_3_2_2	-0.063	-0.054	0.082	0.182	-0.247*	0.102	0.908***	1.000		
q_3_2_3	0.138	0.004	0.092	-0.140	-0.372***	0.163	0.780***	0.758***	1.000	
q_3_2_4	-0.063	0.095	0.082	0.029	-0.314**	0.106	0.881***	0.860***	0.885***	1.000

1) This table reports the Pearson correlations among variables used in this study.

2) ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively(two-tailed).

H4: Bank employee's job position affects RPA Perceived Usefulness

H4a:Bank employee's job position as "Commercial banking assistant manager" affects RPA Perceived Usefulness

H4b: Bank employee's job position as "Corporate banking assistant manager" affects *RPA Perceived Usefulness*

H4c: Bank employee's job position as "VIP lounge assistant manager" affects *RPA Perceived Usefulness*

H4d: Bank employee's job position as "*Commercial banking* manager" affects *RPA Perceived Usefulness*

H4e: Bank employee's job position as "Corporate banking manager" affects *RPA Perceived Usefulness*

H4f: Bank employee's job position as "VIP lounge manager" affects *RPA Perceived Usefulness*

This table summarizes the results of the Pearson correlation analysis of Hypothesis 4.

As a result of the analysis, dum_5 (corporate banking manager) showed a strong negative correlation with all inquiries regarding the perceived usefulness of RPA bots. In other words, it can be said that in the case of the corporate banking manager, a low score was given to the four queries.

RPA Perceived Ease-of-Use

	q_1_3	q_1_4	q_1_5_ratio	q_3_2_1	q_3_2_2	q_3_2_3	q_3_2_4
q_1_3	1.000						
q_1_4	0.700***	1.000					
q_1_5_ratio	0.152	-0.002	1.000				
q_3_2_1	0.283**	0.209	0.284**	1.000			
q_3_2_2	0.311**	0.208	0.321**	0.908***	1.000		
q_3_2_3	0.144	0.053	0.418***	0.780***	0.758***	1.000	
q_3_2_4	0.168	0.081	0.271**	0.881***	0.860***	0.885***	1.000

1) This table reports the Pearson correlations among variables used in this study.
2) ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively(two-tailed).

H1: Bank employees' number of working experience affects RPA Perceived Ease-of-Use

H2: Bank employees' number of working experiences affects RPA Perceived Ease-of-Use

H3: RPA Usage Ratio affects RPA Perceived Ease-of-Use

The results of the Pearson correlation analysis of Hypothesis 1, 2, and 3 is shown above. When checking the results of the correlation analysis of the *perceived ease-of-use* of *RPA bots* according to the age of hypothesis 1 (q_1_3) and to the hypothetical 2-number of working experiences (q_1_4), both showed a weak correlation. Thus, the age and the number of working experiences of a bank employee has relatively low impact on how bank employees perceive the ease-of-use of RPA bots. Moreover, If we check the results of the correlation analysis of the perceived ease-of-use of RPA bots according to the hypothesis 3 RPA usage ratio (q_1_5_ratio), the correlation coefficients (rho) in question 1 and question 2 were 0.344and 0.358, respectively, indicating positive relevance at the 1% significance level. Hence, the increase in the proportion of RPA usage is highly related to the high score to the perceived ease-of-use of RPA.

	dum_1	dum_2	dum_3	dum_4	dum_5	dum_6	q_3_3_1	q_3_3_2	q_3_3_3	q_3_3_4
dum_1	1.000									
dum_2	-0.580***	1.000								
dum_3	-0.116	-0.082	1.000							
dum_4	-0.398***	-0.280**	-0.056	1.000						
dum_5	-0.166	-0.117	-0.023	-0.080	1.000					
dum_6	-0.205	-0.144	-0.029	-0.099	-0.041	1.000				
q_3_3_1	-0.199	0.273**	-0.008	0.045	-0.263**	0.027	1.000			
q_3_3_2	-0.251**	0.239*	0.013	0.116	-0.234*	0.064	0.846***	1.000		
q_3_3_3	-0.206	0.216*	-0.077	0.094	-0.217*	0.084	0.793***	0.845***	1.000	
q_3_3_4	-0.250**	0.198	-0.006	0.184	-0.275**	0.077	0.769***	0.862***	0.965***	1.000

1) This table reports the Pearson correlations among variables used in this study.
2) ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively(two-tailed).

H4: Bank employee's job position affects RPA Perceived Ease-of-Use

H4a:Bank employee's job position as "Commercial banking assistant manager" affects RPA Perceived Ease-of-Use

H4b: Bank employee's job position as "Corporate banking assistant manager" affects *RPA Perceived Ease-of-Use*

H4c: Bank employee's job position as "VIP lounge assistant manager" affects *RPA Perceived Ease-of-Use*

H4d: Bank employee's job position as "*Commercial banking* manager" affects *RPA Perceived Ease-of-Use*

H4e: Bank employee's job position as "Corporate banking manager" affects *RPA Perceived Ease-of-Use*

H4f: Bank employee's job position as "VIP lounge manager" affects *RPA Perceived Ease-of-Use*

As a result of the analysis, dum_5 (corporate banking manager) showed a strong negative correlation with all inquiries regarding the perceived ease-of-use of RPA bots. In other words, it can be said that in the case of the corporate banking manager, a low score was given to the

four queries.

RPA Effort Expectancy

	q_1_3	q_1_4	q_1_5_ratio	q_3_4_1	q_3_4_2	q_3_4_3
q_1_3	1.000					
q_1_4	0.700***	1.000				
q_1_5_ratio	0.152	-0.002	1.000			
q_3_4_1	-0.056	-0.129	0.203	1.000		
q_3_4_2	-0.061	-0.286**	0.289**	0.837***	1.000	
q_3_4_3	0.104	-0.078	0.232*	0.818***	0.883***	1.000

1) This table reports the Pearson correlations among variables used in this study.
2) ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively(two-tailed).

H1: Bank employees' number of working experience affects RPA Effort Expectancy

H2: Bank employees' number of working experiences affects RPA Effort Expectancy

H3: RPA Usage Ratio affects RPA Effort Expectancy

The results of the Pearson correlation analysis of Hypothesis 1, 2, and 3 is shown above. When checking the results of the correlation analysis of the *effort expectancy of RPA bots* according to the age of hypothesis 1 (q_1_3), showed a weak correlation. Thus, the age of a bank employee has relatively low impact on the effort expectancy of RPA bots. When examining the results of the correlation analysis of the reliability of RPA bots according to the hypothetical 2-number of working experiences (q_1_4), the correlation coefficients (rho) in question 2 resulted -0.286 at a significance level of 5%. It was confirmed that there is a negative relationship. Thus, the increase in work experience is highly related to the low score in the above questions. If we check the results of the correlation analysis of the effort expectancy of RPA bots according to the hypothesis 3 RPA usage ratio (q_1_5_ratio), the correlation

coefficients (rho) in question 2 and question 3 were 0.289 and 0.232, respectively, indicating high relevance at the 5% to 10% significance level. Hence, the increase in the proportion of RPA usage is highly related to the high score to the *reliability of RPA.*

	dum_1	dum_2	dum_3	dum_4	dum_5	dum_6	q_3_4_1	q_3_4_2	q_3_4_3
dum_1	1.000								
dum_2	-0.580***	1.000							
dum_3	-0.116	-0.082	1.000						
dum_4	-0.398***	-0.280**	-0.056	1.000					
dum_5	-0.166	-0.117	-0.023	-0.080	1.000				
dum_6	-0.205	-0.144	-0.029	-0.099	-0.041	1.000			
q_3_4_1	-0.244*	0.201	0.091	0.051	-0.143	0.116	1.000		
q_3_4_2	-0.102	0.005	0.107	0.110	-0.202	0.139	0.837***	1.000	
q_3_4_3	-0.219*	-0.022	0.079	0.377***	-0.281**	0.092	0.818***	0.883***	1.000

1) This table reports the Pearson correlations among variables used in this study.
2) ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively(two-tailed).

H4: Bank employee's job position affects RPA Effort Expectancy

H4a:Bank employee's job position as "Commercial banking assistant manager" affects RPA Effort Expectancy

H4b: Bank employee's job position as "Corporate banking assistant manager" affects *RPA Effort Expectancy*

H4c: Bank employee's job position as "VIP lounge assistant manager" affects *RPA Effort Expectancy*

H4d: Bank employee's job position as "*Commercial banking* manager" affects *RPA Effort Expectancy*

H4e: Bank employee's job position as "Corporate banking manager" affects *RPA Effort Expectancy*

H4f: Bank employee's job position as "VIP lounge manager" affects *RPA Effort Expectancy*

As a result of the analysis, dum_5 (corporate banking manager) showed a negative correlation at a 5% significance level. This indicates that in the case of the corporate banking manager, a low score was given to the three queries.

RPA Performance Expectancy

	q_1_3	q_1_4	q_1_5_ratio	q_3_5_1	q_3_5_2	q_3_5_3
q_1_3	1.000					
q_1_4	0.700***	1.000				
q_1_5_ratio	0.152	-0.002	1.000			
q_3_5_1	0.270**	0.092	0.280**	1.000		
q_3_5_2	0.229*	0.046	0.154	0.904***	1.000	
q_3_5_3	0.104	-0.030	0.114	0.904***	0.960***	1.000

1) This table reports the Pearson correlations among variables used in this study.
2) ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively(two-tailed).

H1: Bank employees' number of working experience affects RPA Performance Expectancy

H2: Bank employees' number of working experiences affects RPA Performance Expectancy

H3: RPA Usage Ratio affects RPA Performance Expectancy

The results of the Pearson correlation analysis of Hypothesis 1, 2, and 3 is shown above. When checking the results of the correlation analysis of the *performance expectancy of the RPA bots* according to the age of hypothesis 1 (q_1_3), the correlation coefficient (rho) in question 1 and question 2 were 0.270 and 0.229, respectively at a significance level of 5% to 10%. The correlation analysis of the performance expectancy of RPA bots according to the hypothetical 2-number of working experiences (q_1_4), showed a weak correlation. Thus, the number of working experiences of a bank employee has relatively low impact on the performance expectancy of RPA bots.

The results of the correlation analysis of the performance expectancy of RPA bots according to the hypothesis 3 RPA usage ratio (q_1_5_ratio), the correlation coefficients (rho) in question 1 marked as 0.280 at a level of 5% significance level. In other words, the increase in the proportion of RPA usage is highly related to the high score to the performance expectancy of RPA.

	dum_1	dum_2	dum_3	dum_4	dum_5	dum_6	q_3_5_1	q_3_5_2	q_3_5_3
dum_1	1.000								
dum_2	-0.580***	1.000							
dum_3	-0.116	-0.082	1.000						
dum_4	-0.398***	-0.280**	-0.056	1.000					
dum_5	-0.166	-0.117	-0.023	-0.080	1.000				
dum_6	-0.205	-0.144	-0.029	-0.099	-0.041	1.000			
q_3_5_1	-0.325**	0.118	0.075	0.308**	-0.302**	0.175	1.000		
q_3_5_2	-0.340***	0.226*	0.074	0.203	-0.316**	0.174	0.904***	1.000	
q_3_5_3	-0.340***	0.291**	0.087	0.146	-0.347***	0.152	0.904***	0.960***	1.000

1) This table reports the Pearson correlations among variables used in this study.
2) ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively(two-tailed).

H4: Bank employee's job position affects RPA Performance Expectancy

H4a:Bank employee's job position as "Commercial banking assistant manager" affects RPA Performance Expectancy

H4b: Bank employee's job position as "Corporate banking assistant manager" affects *RPA Performance Expectancy*

H4c: Bank employee's job position as "VIP lounge assistant manager" affects *RPA Performance Expectancy*

H4d: Bank employee's job position as "*Commercial banking* manager" affects *RPA Performance Expectancy*

H4e: Bank employee's job position as "Corporate banking manager" affects *RPA Performance Expectancy*

H4f: Bank employee's job position as "VIP lounge manager" affects *RPA Performance Expectancy*

As a result of the analysis, dum_5 (corporate banking manager) showed a strong negative correlation with all inquiries regarding the performance expectancy of RPA bots. In other words, it can be said that in the case of the corporate banking manager, a low score was given to the three queries.

Chapter 4: Discussion

This study gained some robust results on the impact of the adoption of RPA strategies on work productivity in the retail banking industry by the front-office bank employees (IRPAAI, 2018) The literature review suggested that RPA offers many benefits such as improved business efficiency and increased productivity while employees are relieved from repetitive and tedious tasks, some of the findings in this study showed contrasting results. When analyzing the top three daily routine tasks reassigned to RPA bots, the average time taken to complete the task manually and by RPA bots showed no difference. However this work is still at an early stage of implementation in fact, the adoption of RPA bots in the front-office bank employees at retail banking branches have only been implemented for three months on average.

Hence, the latter part of the research focused on the relationship between each of the feature of the demographics and on their perceptions regarding the attributes of RPA bots developed from the TAM and UTAUT models. In overall, the research found that the usage rate of RPA bots is relatively low but as the usage ratio increases, the more likely that the results will become favorable. Thus, installation of a sound system that works properly will be the top priority but training and follow-up management for users are equally important so that the RPA system can be utilized.

Chapter 5: Conclusion

Robotic Process Automation (RPA) is increasingly gaining recognitions in various industries but as a relatively new topic of examination, this study proposes to observe the effectiveness of RPA in the retail banking sector in relation to employee work productivity. This paper establishes as a preliminary study and provides insights for businesses when designing and implementing a RPA tool to increase work productivity. It can be further researched focusing on the end users of RPA for a successful implementation.

5.1 Future Research Implications

Previously, researchers mainly focused on the concept of RPA itself and case studies related to technical performances. However, this study proposes and tests the impact of the adoption of RPA technology on front-office bank employees' work productivity. Although the development of RPA-based technology is vital, in order to successfully implement and develop the technology to leap to the next stage, it is equally important to carefully plan and monitor for the end-users to actually use the available technology at the early stages of the adoption. The higher the usage rate, the more likely to leap into the cogitative automation stage. Thus, for practical implications, it is suggested to develop the necessary supporting units and training programs so that the end-users can adapt quickly and monitor the usage rate after implementation.

Furthermore, this study provides several directions for future researches to identify the priorities that should be taken into consideration in the adoption and implementation of RPA technology.

5.2 Limitations

This research mainly focused on collecting data in the retail banks in South Korea in which, the samples collected were from two of the top five retail banks in South Korea. The number of retail banks who have adopted RPA-related technologies for client-facing front-office bank employees at bank branches is small and due to the limited size of the samples collected, it is difficult to generalize based on the findings.

References

1. Aguirre, S., & Rodriguez, A. (2017). Automation of a business process using robotic process automation (RPA): A case study. *Workshop On Engineering Applications*, 65-71.

2. Asatiani, A., & Penttinen, E. (2016). Turning robotic process automation into commercial success – Case OpusCapita. *Journal Of Information Technology Teaching Cases*, *6*(2), 67-74. doi: 10.1057/jittc.2016.5

3. Corbin, J. M., & Strauss, A. L. (2008). Basics of qualitative research : techniques and procedures for developing grounded theory (3rd Edition ed.). Los Angeles: SAGE Publications.

4. Davis FD. Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly* 1989;13(3):319–340.

5. Dobson, G., & Sainathan, A. (2011). On the impact of analyzing customer information and prioritizing in a service system. *Decision Support Systems*, *51*(4), 875-883. doi: 10.1016/j.dss.2011.02.006

6. European Patent Application Robotic Process Automation - EP3112965A1. (2015). Retrieved 14 April 2020, from https://patents.google.com/patent/EP3112965A1/en .

7. Golafshani, N. (2003). Understanding Reliability and Validity in Qualitative Research. *The Qualitative Report* , 8 (4), 597-607.

8. IBS intelligence. (2019). Cognitive Automation - Convergence of AI and RPA in Banks. Retrieved 30 April 2020, from https://ibsintelligence.com/wp-content/uploads/2019/10/Cognitive-Automation-Covergence-of-AI-RPA-in-Banks.pdf

9. Institute for Robotic Process Automation & Artificial Intelligence: Definition and Benefits. (2019). Retrieved 14 April 2020, from https://irpaai.com/definition-and-benefits/

10. IRPAAI (2018). Robotic Process Automation in the Real World: How 3 Companies are Innovating with RPA, from https://irpaai.com/robotic-process-automation-real-world-3-companies-innovating-rpa/

11. KUMAR, K., & BALARAMACHANDRAN, P. (2020). ROBOTIC PROCESS AUTOMATION - A STUDY OF THE IMPACT ON CUSTOMER EXPERIENCE IN RETAIL BANKING INDUSTRY. Retrieved 12 April 2020, from http://www.icommercecentral.com/open-access/robotic-process-automation-a-study-of-the-impact-on-customer-experience-in-retail-banking-industry.php?aid=87176

12. Lacity, M., & Willcocks, L. P. (2018). Innovating in Service: The role and management of automation, in L. Willcocks, I. Oshri & J. Kotlarsky (eds) *Dynamic Innovation in Outsourcing.Technology*, *Work and Globalization,* Palgrave Macmillan, Cham, pp. 269-325

13. Moffitt, K., Rozario, A., & Vasarhelyi, M. (2018). Robotic Process Automation for Auditing. *Journal Of Emerging Technologies In Accounting*, *15*(1), 1-10. doi: 10.2308/jeta-10589

14. Oliveira, T., & Martins, M. F. (2011). Literature Review of Information Technology Adoption Models at Firm Level, *The Electronic Journal Information Systems Evaluation*, vol. 14, no. 1,pp. 110-121

15. PwC. (2017). Rethinking retail artificial intelligence and robotic process automation. Retrieved 25 April 2020, from https://www.pwc.be/en/documents/20171123-rethinking-retail-artificial-intelligence-and-robotic-process-automation.pdf

16. Romão, M., Costa, J., & Costa, C. (2019). Robotic Process Automation: A case study in the Banking Industry. *Iberian Conference On Information Systems And Technologies (CISTI),19 – 22 June 2019.*

17. Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User Acceptance of Information Technology: Toward a unified view, *MIS Quarterly*, vol. 27, no. 3, pp. 425-478

18. Willcocks, L., Lacity, M., & Craig, A. (2015). The IT function and robotic process automation. *The Outsourcing Unit Working Research Paper Series*, *15(5)*, 1-39.

19. Wilds, C. (2019). Examples of RPA in Banking Operations - Implementation in Lending |

The Lab. Retrieved 10 April 2020, from https://thelabconsulting.com/examples-rpa-banking-operations-robotic-process-automation-implementation-commercial-lending/

20. Yin, R. K. (2009). Case Study Research: Design and Methods (4th Edition ed.). California, U.S.A: SAGE Publications.

21. 윤일영. (2017). 로봇과 비즈니스의 융합, 로봇 프로세스 자동화(RPA). 융융합 Weekly TIP, 99 (2017 December), 1-10.

22. 이창섭. (2017). RPA, Office에 가져다 줄 변화. 디지에코보고서. KT경영경제연구소

Appendix

<Table 1-1> Survey Items (continued)

Variable	Question	Response
ID	Identification Number	
q_1_1	Job Position	1 (Commercial banking assistant manager), 2 (Corporate banking assistant manager), 3 (VIP lounge assistant manager), 4 (Commercial banking manager), 5 (Corporate banking manager), 6 (VIP lounge manager)
q_1_2	Major Tasks (multiple selection possible)	1 (Teller), 2 (Personal Banking Representative/Financial Adviser), 3(Loan Officer), 4 (FX Transactions), 5 (Corporate Loan Officer), 6 (General Affairs), 7 (Internal Control Officer), 8 (Performance Manager, KPI)
q_1_3	Age	1 (20＜Age≤30), 2 (30<Age≤40), 3 (40<Age≤50), 4 (Age>50)
q_1_4	Years of Work Experiences	1 (<1 YR), 2 (1YR≤Working Years≤5YRs), 3 (5YRs＜Working Years≤10YRs), 4 (10YRs＜Working Years≤20YRs), 5(Working Years＞20YRs)
q_1_5_total	Total Number of People	Total number of people at your branch

q_1_5_part	Number of RPA Users	Total number of people RPA users at your branch
q_1_5_usage ratio	RPA Users /Total Number of People	The number of RPA users compared to the total number of people at the affiliated branch

<Table 1-2> Survey Items (continued)

Variable	**Question**	**Response**
q_2_1_1	Daily Tasks	Dummy Variable) Verification of Business Licenses
q_2_1_2		Dummy Variable) Customer Due Diligence / Enhanced Due Diligence (CDD/EDD) Procedures
q_2_1_3		Dummy Variable) Automatic Email Forwarding from External to Internal Mail Inbox
q_2_1_4		Dummy Variable) Automatic Confirmation Calls List
q_2_1_5	Payrolls-related and Defined-Contribution Retirement Plan-related Tasks	Dummy Variable) Payroll Request
q_2_1_6		Dummy Variable) Issuance of Payroll Request Receipts
q_2_1_7		Dummy Variable) Defined-Contribution Retirement Plan Deposit Request
q_2_1_8		Dummy Variable) Changes to the list of Defined-Contribution Retirement Plan and Appropriations
q_2_1_9	Personal Loans	Dummy Variable) Issuance of Vehicle Registration Documents (Verifications for Car Loans)
q_2_1_10		Dummy Variable) Verification of Lease Deposit Recommendations provided by the Seoul

		Metropolitan Government
q_2_1_11		Dummy Variable) Verification of Lease Funds for Housing Loans for Employees of Small to Medium Enterprises
q_2_1_12		Dummy Variable) Loan Registration for Military Personnel
q_2_1_13		Dummy Variable) Mortgage Loans and Collateralization of Debt Obligation
q_2_1_14		Dummy Variable) Establishment of the Right to Collateral Security
q_2_1_15	Corporate Loans	Dummy Variable) Large-scale Access to Real Property Registry Records
q_2_1_16		Dummy Variable) Listing of Potential Corporate Clients
q_2_1_17		Dummy Variable) Alerts before Roll-over or Extension of Corporate Debts
q_2_1_18		Dummy Variable) Automatic Evaluation and Approvals of B2B Finance Requests

<Table 1-3> Survey Items (continued)

Variable	**Question**	**Response**
q_2_2_1_no1	Manual Process of Performing Job Order 1	
q_2_2_1_no2	Manual Process of Performing Job Order 2	
q_2_2_1_no3	Manual Process of Performing Job Order 3	
q_2_2_1_time1	Total Time for Job Order 1 (sec)	Total time taken to perform the Job order manually (in seconds)
q_2_2_1_time2	Total Time for Job Order 2 (sec)	

q_2_2_1_time3	Total Time for Job Order 3 (sec)	
q_2_2_2_no1	RPA Processed Job Order 1	
q_2_2_2_no2	RPA Processed Job Order 2	
q_2_2_2_no3	RPA Processed Job Order 3	
q_2_2_2_time1	Total Time by RPA for Job Order 1 (sec)	Total time taken to perform the Job order by RPA (in seconds)
q_2_2_2_time2	Total Time by RPA for Job Order 2 (sec)	
q_2_2_2_time3	Total Time by RPA for Job Order 3 (sec)	

<Table 1-4> Survey Items (continued)

Variable	Question	Response
q_3_1_1	RPA Reliability (10-point Likert Scale)	Work requests have been processed at once
q_3_1_2		The requested data were entered correctly
q_3_1_3		Responses to the results of the treatment were made
q_3_1_4		It is more accurate than entering data manually
q_3_1_5		Time taken to verify the data entered (secs)
q_3_2_1	RPA Perceived Usefulness (10-point Likert Scale)	RPA helps you to be more efficient
q_3_2_2		RPA helps you to be more productive
q_3_2_3		RPA saves your time
q_3_2_4		RPA is useful as expected

q_3_3_1	RPA Perceived Ease-of-Use (10-point Likert Scale)	Easy to use
q_3_3_2		User-friendly
q_3_3_3		Requires minimal steps to perform the job
q_3_3_4		Does not require much effort when using
q_3_4_1	RPA Effort Expectancy (10-point Likert Scale)	Quickly learned to use
q_3_4_2		Easy to learn to use
q_3_4_3		Adapted quickly to use
q_3_5_1	RPA Performance Expectancy (10-point Likert Scale)	Satisfied
q_3_5_2		Recommend it to others
q_3_5_3		Works the way you want

	q_3_1_1	q_3_1_2	q_3_1_3	q_3_1_4	q_3_1_5	q_3_2_1	q_3_2_2	q_3_2_3	q_3_2_4	q_3_3_1	q_3_3_2	q_3_3_3	q_3_3_4	q_3_4_1	q_3_4_2	q_3_4_3	q_3_5_1	q_3_5_2	q_3_5_3
q_3_1_1	1.000																		
q_3_1_2	0.888***	1.000																	
q_3_1_3	0.790***	0.826***	1.000																
q_3_1_4	0.764***	0.842***	0.727***	1.000															
q_3_1_5	0.267**	0.246*	0.217*	0.265**	1.000														
q_3_2_1	0.712***	0.763***	0.598***	0.817***	0.280**	1.000													
q_3_2_2	0.674***	0.703***	0.551***	0.769***	0.274**	0.908***	1.000												
q_3_2_3	0.521***	0.614***	0.430***	0.644***	-0.121	0.780***	0.758***	1.000											
q_3_2_4	0.594***	0.698***	0.498***	0.725***	0.143	0.881***	0.860***	0.885***	1.000										
q_3_3_1	0.470***	0.560***	0.337***	0.449***	0.109	0.558***	0.526***	0.513***	0.544***	1.000									
q_3_3_2	0.402***	0.416***	0.271**	0.343***	0.150	0.467***	0.541***	0.377***	0.367***	0.846***	1.000								
q_3_3_3	0.281**	0.385***	0.331***	0.329***	0.258**	0.346***	0.404***	0.331***	0.289**	0.793***	0.845***	1.000							
q_3_3_4	0.326***	0.405***	0.352***	0.382***	0.252**	0.386***	0.469***	0.368***	0.316**	0.769***	0.862***	0.965***	1.000						
q_3_4_1	0.384***	0.588***	0.565***	0.575***	0.025	0.511***	0.513***	0.566***	0.614***	0.639***	0.532***	0.610***	0.601***	1.000					
q_3_4_2	0.419***	0.577***	0.551***	0.580***	-0.107	0.412***	0.407***	0.497***	0.437***	0.631***	0.528***	0.624***	0.646***	0.837***	1.000				
q_3_4_3	0.544***	0.678***	0.630***	0.719***	0.272**	0.530***	0.559***	0.468***	0.505***	0.612***	0.570***	0.677***	0.740***	0.818***	0.883***	1.000			
q_3_5_1	0.619***	0.720***	0.550***	0.742***	0.252*	0.665***	0.689***	0.635***	0.753***	0.660***	0.513***	0.513***	0.566***	0.772***	0.673***	0.787***	1.000		
q_3_5_2	0.502***	0.659***	0.503***	0.768***	0.260**	0.748***	0.748***	0.674***	0.792***	0.662***	0.525***	0.554***	0.613***	0.769***	0.655***	0.787***	0.904***	1.000	
q_3_5_3	0.434***	0.564***	0.420***	0.677***	0.280**	0.674***	0.682***	0.640***	0.764***	0.648***	0.521***	0.584***	0.624***	0.763***	0.637***	0.753***	0.904***	0.960***	1.000