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Process & Software Selection for Robotic Process Automation (RPA)

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Abstract: Robotic process automation (RPA) is a technology for office automation to imitate human behaviour when interacting with computers to perform digitized tasks manually, such as opening and closing applications, reading documents, entering data, and sending e-mails. As with any new digital technology answering the question of where to start and what is the right software, is challenging. In the case of RPA, the question of where to start depends on the selection of the business process to be automated and optimized. There are approaches for process selection in research, but they are relatively complex and have not been validated in practice. To fill this gap, we have simplified the process selection method and validated it on a practical example. We also present a simple method to select the appropriate RPA software. The criteria selection and evaluation were done with the Pairwise Comparison and Benefit Value Analysis method. This approach is relatively easy to follow and to apply in practice and thus also closes a gap in applied research.

Keywords: assessment; office automation; process selection; RPA (Robotic Process Automation); software selection

1 INTRODUCTION

The changing global economy driven by the development of new technologies requires organizations to become more reliable and agile in responding to customer needs [23, 31]. In addition, competitive and financial pressures force organizations to seek out new technologies and methodologies that will help them to be more productive, efficient, and cost-effective [30, 31].

One of the emerging technologies is robotic process automation (RPA). RPA is a software-based robot for office automation that imitates human behavior in interacting with computers [30]. RPA enables organizations to shift the employees from repetitive tasks in the office to high-value-added tasks [5, 29]. Unfortunately, it is still constrained by the inability to select which business process is profitable to be automated and what software is suitable for the process [6, 32].

The Research on RPA has been done a lot, but only a few have raised the topic of RPA software and process selection, which is essential before the implementation, and none has simplified and verified these approaches with practical examples. Therefore, this research is triggered by the questions as follows:

- How simply select the best business process to automate with RPA?
- How to simply and transparently select the best software for that process?

To answer these research questions and to clarify the understanding of process and software selection, we present a use case study at Technische Hochschule Ingolstadt (THI). In the *first step*: we identified potential tasks in THI where RPA could be successfully implemented. *Second step:* we chose the best and most suitable process to be automated. And the *third step*: we choose the best RPA software on the market today and compare them with each other.

2 STATE OF KNOWLEDGE

2.1 The Overview of Robotic Process Automation

The Industrial Revolution 4.0 is a combination of a physical and digital system that changes the way humans live. It is supported by various technologies such as the Internet of Things, Automation, Simulation, Big Data Analytics, Vertical & Horizontal Integration, Augmented Reality, Cloud Computing, Additive Manufacturing, and Cyber Security. I4.0 uses the principles of Interoperability, Modularity, Service Orientation, Real-Time Capability, Decentralization, and Virtualization [23].

In the context of automation, the area consists of automation in the offices and factories. The development of office automation is not as fast as automation in the factory. Since 1980, the factory's degree of automation has risen by 75%, while automation in the office just increased by 3 % [18]. Currently, there are several office automation technologies. One of the most promising is RPA, which has a growth rate is around 30% annually [16].

RPA consists of three types, the attended robot, unattended robot, and a combination of them (hybrid robot). The attended robot works directly on the user's computer and acts as a personal assistant, thus requiring the user to trigger or start the process. In contrast, unattended robots work on the company's server and run without or less human interference. The hybrid robot is a combination of attended and unattended robots [5, 30].

The advantages of RPA, such as increased efficiency, productivity, and accuracy, have been described in previous studies [5, 26, 33]. Unfortunately, those have not immediately attracted the companies. One of the obstacle factors is a lack of knowledge about RPA and its future opportunities [4]. Therefore, this study will provide objective information about RPA and how to simply evaluate it.

2.2 RPA Software

There are three major RPA providers currently on the market; UiPath, Automation Anywhere, and Blue Prism [25].

UiPath, or the previous name Desk-Over, was established in 2005 in Bucharest, Romania. It develops an efficient, robust and stable, robotic workforce controlled anytime and anywhere (cloud-based) [12, 29]. Automation Anywhere (AA), or the previous name Tethys Solutions, LLC, was founded in 2003. It has operated more than 1.5 million bots (bots are the other name of RPA robot) in 20 countries [29]. The latest version of this software is Automation Anywhere Enterprise A2019, which uses a web or cloud-based platform and IQ bots as the artificial intelligence feature to recognize documents [4]. Blue Prism was developed in 2001 in Warrington, United Kingdom. The initial goal of Blue Prism was to eliminate manual data entry processes with low returns and high risks. Blue Prism currently offers intelligent and responsive bots that handle various data types in the complete automation process [8, 28].

2.3 RPA Process Selection

Process selection in automation projects is a challenging task as it relates to project success [26]. A project is called "Success" if the effort or resources sacrificed by the organization is far less than the benefits achieved [27]. Therefore, the organization must be able to identify any repetitive process and sort it into the priorities and interests of the organization.

In process selection of RPA, Assatiani & Penttinen (2016) explain that processes or tasks that are high in repetition and have a fixed processing standard must be automated first [3]. While Wanner et al (2019) believe that six parameters influence process selection:

- Execution frequency: the number of repetitive processes.
- Execution time: the duration of each process.
- Standardization: streamlined process and not easy to change.
- Stability: the process is not changed or interrupted.
- Failure rate: the process result tends to deviate from the target.
- Automation rate: the process that is already good, without automation.

Furthermore, Wanner et al. (2019) emphasize that the selection process must also refer to the profitability concept or economic benefits, where the fixed and variable costs of human labour (without automation) are compared with the fixed and variable costs of robots (with automation) [32]. The higher gap between the costs of robots and humans means the greater opportunity for the process to be automated [3, 32]. In a conclusion, the best-selected process is a profitable, stable, and standardized process, with high repetition, long-duration to execute, and tends to fail due to human error.

The approach of this study is to revisit Wanner's parameter, which may be difficult to apply in real-life cases, considering that Wanner built the parameter based on a literature study. Besides that, Wanner's parameters are too broad and rather complicated for process selection. The organization will have difficulties finding data and therefore evaluate and compare one process to another. The Research will simplify Wanner's parameters and provide a real example in this process selection.

3 RESEARCH METHODOLOGY

There are two methodological approaches for process and RPA software selection in this research. The pairwise method is used to weigh the criteria. While the benefit value analysis is carried out to select the alternative solution such as the best process to be automated or the best software. The weighing of the criteria with the pair wise comparison and the rating within the benefit value analysis is done by a team of students which have experience and expertise with RPA [2] and supported by a grey literature review [15].

3.1 Pairwise Comparison

Pairwise comparison generally is any method of comparing entities in pairs to judge which of each entity is preferred or has a greater amount of some quantitative property, or whether or not two entities are identical. It is a great tool to visualize similarities and differences between products, services, and technologies, or even better between more complex and abstract concepts like strategies and ideas. The comparison helps us to organize and classify the elements in which we are comparing [10, 13].

The features and characteristics of each element are evaluated according to a set of criteria (C1, C2, …, C6), enabling the easy recognition of their advantages and disadvantages to facilitate the decision-making process. Then these criteria are tabulated into a paired matrix and weighted from 0 to 2 where "0" means for less important, "1" means equally important, and "2" means more important. The result is a weighting of the criteria in percent. An example of a pairwise comparison template is shown in Tab. 1. In this study, pairwise comparison was used to compare the criteria of RPA software selection, based on the needs of the organization.

Table 1 The Example of pairwise comparison

No	C1	C2	C3	C4	C5	C6	Sum	Rank	%
C1		1	1	0	2	2	6	2	20
C2	1		1	2	2	2	8	1	27
C3	1	1		1	1	1	5	3	17
C4	1	0	1		1	2	5	3	17
C5	0	0	1	1		2	4	4	13
C6	0	0	1	0	0		1	5	3

3.2 Benefit Value Analysis

Benefit analysis is a process of economic analysis that was originally developed for the public sector and has gradually become established in the industry. This method is used to compare various alternatives in future investment projects. The advantage of value analysis is that it can be used when the investment project is not based solely on hard factor comparisons, such as the acquisition of value or profit. The benefit analysis also included qualitative factors in the evaluation [17].

In this research, the benefit analysis method is not used to compare various alternatives in future investment projects but is used as a tool to select RPA software and business processes to be automated. The criteria of benefit analysis are based on (*1) What are the main goals of automation, and (2) What is offered by RPA software to achieve the goals of automation.*

The individual criteria are then weighted with the help of pairwise comparisons to obtain meaningful results (see Tab. 1). Once the criteria are weighted, the different RPA software can be evaluated in a value-benefit analysis, in which the RPA software is ranked, and each rating is multiplied by the weight of the criteria to obtain the final result. The result of each RPA alternative is called a score and the alternative with the highest score is selected.

4 USE-CASE STUDY

4.1 Process Selection at Technische Hochshule Ingolstadt

During the identification of potential processes, direct observations to several respective departments at the Technische Hochschule Ingolstadt were carried out [2, 7]. Brainstorming with relevant stakeholders generated many ideas. Unfortunately, these ideas had to be eliminated due to data privacy and regulation issues. The remaining ideas are as follows:

- **The Course Feedback Process:** It is the process followed at THI at the end of every semester to improve the quality of the system. This entire process starts from email rollout to students and ends with report generation for employees.
- **LinkedIn Post Management Process:** At THI, the LinkedIn Posts are managed by a team manually on regular basis. It involves posting open job positions, events, news, etc. The proposal was to automate the process of posting Job positions and events whenever a new Job or event is planned in each department. The post is normally pasted twice, on THI Page and social platforms like LinkedIn.
- **Moodle Study material upload and notification Process:** At THI, Moodle is the portal used for the upload and notification of course-related content by faculty for any particular subject. Often, the course content is updated at regular intervals by including lecture notes, quizzes, and other links for meetings, etc. The notification when new content is uploaded is often send as a group mail to students. This is repetitive work for the course faculty which involves no strategic decision-making process.
- **Buddy Matching Process:** The buddy program provides an opportunity to the international students and exchange students to ask for a buddy. The buddy will act as the first point of contact when the student arrives and gets started at THI. Students who are already in their higher semester of bachelor's or master's program will be assigned a buddy. Currently, buddies are matched to students manually, and is very tedious. Manual matching is done by International Office of THI and the Network & International Culture Exchange (NICE) organization and has to be repeated every semester for a new set of students and buddies.

The assessment process includes the following steps:
Understanding the Process in detail

1) Interviewing or meeting end-users/ customers from respective departments
2) Summarizing the inputs and details provided during the interview/meeting
3) Brainstorming internally with other Project members
4) Rating the RPA potential based on Process knowledge and end-user feedback

The four processes above were then assessed in more detail with several parameters from the Wanner et al. (2019) study. It was the goal to select the most important criteria but at the same time simplify the assessment. The simplification is the efficient way to get the assessment result as soon as possible. Wanner parameters seem complicated because in some real cases, the parameter of failure rate and standardization are not the main considerations for automating processes. For example, a manual process with a high failure rate will not be automated with RPA, as long as it is an occasional or infrequent process [1, 3, 14, 22].

Table 2 Process Selection Matrix

Processes	Course Feedback Process	LinkedIn Post Management Process	Moodle Study Material Upload Process	Buddy Matching Process
Parameters				
Execution Frequency	2	3	2	2
Execution Time	1	2	1	3
Stability	1	1	3	2
Automation Rate	3	1	1	3
Sum	7	7	7	10
Selected				√
1 = low, 2 = medium, 3 = high rating				

The Matrix consists of the potential processes that are given a weight based on the following parameters: *execution frequency, execution time, stability, and automation rate*. The weights are rate 1 to 3, where 1 means low, 2 means medium, and 3 means high. According to the selection matrix (see Tab. 2), the buddy-matching process has the highest score, meaning that automating this process will provide greater benefits than any other process.

4.2 Use Case: Buddy Matching Process

Every year the international office of THI engages in organizing buddies for international students who require assistance in orienting at the university. This organizational process is strenuous and time-consuming because there exist multiple criteria for the matching process, and because it is done by manual repeatedly.

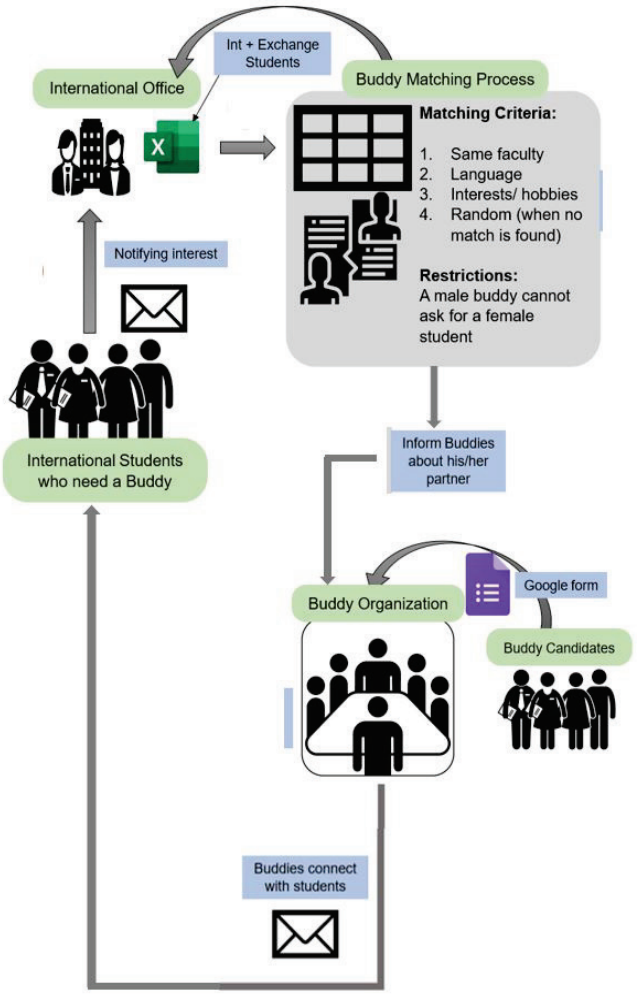

Figure 1 Buddy-Matching Process

As illustrated by Fig. 1, the current process is such that the international student notifies the international office about their interest in having a buddy via email soon after receiving admittance to the university. Afterward, the international office sends the interested students a PDF form to fill out basic information which would later be utilized for the buddy matching process. The international office then registers the student information in an excel sheet and compares it with a list of buddies. The buddy candidates must fill out a google form to be a candidate for assisting the international students. The current matching criteria are as follows:

- Degree – Masters, Bachelors or PhD
- Faculty
- Language
- Interests or hobbies.

In exceptions, the buddy is selected randomly when no similarities are found. The only restriction the international office has by experience is to avoid a male buddy requesting a female international student. Soon after the matching process is complete the international office informs the buddy students about their matched partner students in the form of an email. Through the buddy organization, the buddy then contacts the international student whom they were partnered with. Although the process seems straightforward, the current process entails a few loopholes. For example, when the Buddy or international student backs off or in other words withdraws from the program, the international office has to take care of such an exception.

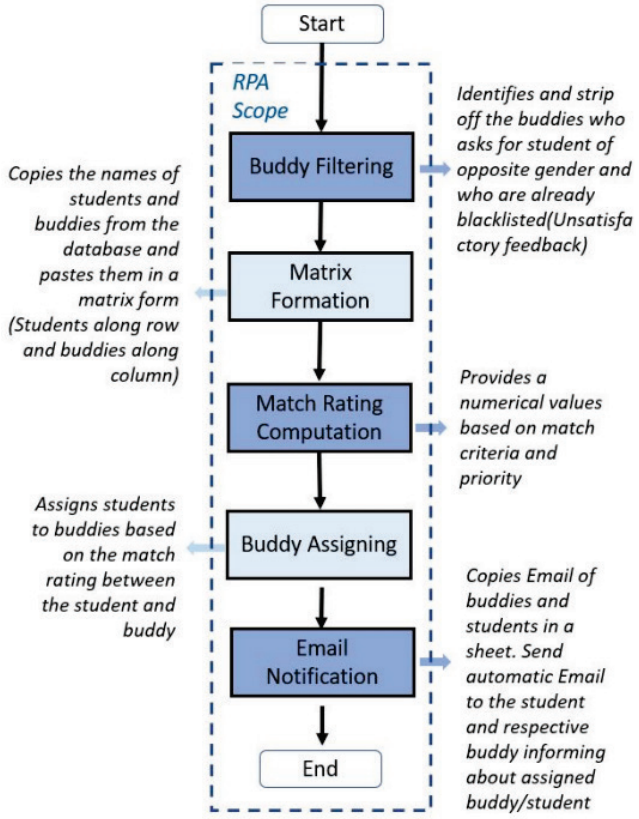

Figure 2 RPA Scope on Buddy-Matching Process

In order to implement the buddy-matching process in RPA, one of the initial steps is to convert the process to a logic flow chart. The program is initially visualized as the chart and then implemented in software. The entire process is converted to the following five subroutines (see Fig. 2)

- Blacklist routine for buddy filtering
- Matrix creation routine
- Match computation routine
- Scoring routine/match rating
- E-Mail notification routine.

Blacklist routine: The target of this routine is to filter out individuals with the below conditions and move them to a separate sheet called the blacklist sheet. The conditions are:

- The buddy requested a student from their opposite gender.
- The buddy details are there in the previously blacklisted individuals list.
- The buddy has a German level less than B1 (This person will not be blacklisted but be deleted from the current list).

The result of this step is a filtered in the buddy sheet and updated in the blacklist sheet.

Matrix creation routine: This routine aims to create a base matrix for pasting match-ratings and performing calculations. The outcome of this routine is an empty matrix with student's names in rows and buddy's names in columns.

Scoring routine: This routine aims to calculate the numerical equivalent of the compatibility between Students and buddies' preferences. The condition of this routine is every matching feature is given a unique prime number to multiply the match rating with. This helps us in the further routines to analyse the data easily and assign the best buddy to the student. The outcome of this routine is a filled matrix with a match-rating for every student-buddy pair.

Match computation routine: Depending on the match-rating, a best buddy is chosen for the student. Here the highest value isn't considered but rather the priority and the preferences chosen are put in combinations to choose the best pair. This is done using If conditions and Mod arithmetic operators as illustrated below.

The conditions are:

- Degree (D), Gender (G) and Priority (P) are given weightage for matching.
- DGP means all three Degree, Gender and Priority are matching.
- The order of priority for matching is - DGP, DG, DP, D, GP, G.
- After every matching is done, the flag count is incremented by 1. Buddies cannot have more than 2 students and students cannot have more than 1 buddy.

The Result of this routine is achieved, when the best buddy is assigned to the student. The student and buddy details are moved to a separate sheet with their e-mail addresses.

Email notification routine: This routine aims to send emails to the student and buddy regarding their respective partners from the results of the match-computation routine. The result of this routine is achieved, when the template emails are send to the student and buddy with details of their respective partners. Once it is done, a flag is assigned in the excel sheet indicating completion of the activity.

4.3 RPA Software Selection

Once the Buddy matching process is selected and the RPA scope plan for that process has been determined, the next task is to determine what software is suitable for the selected process and brings maximum benefit to the organization.

4.3.1 Determination of Selection Criteria

The first step of RPA software selection is to define the criteria by which the RPA providers will be selected. Before the brainstorming about the criteria started, it was fundamental to get an overview of the RPA providers and their products. The aim was to see what the offer of the RPA market is like, how similar the products are and how much information do the companies share online. After extensive research and brainstorming, at least there are seven important criteria for selecting RPA software:

- **Required Programming skills**: The Software should require no coding or just basic level coding, so that person without programming expertise is also able to use it.
- **Ease of use**: If there are too many fields requiring data or the application is difficult to understand, it might be difficult to get efficiency during the use of the software.
- **Product Availability**: The product should be available as a free version or trial version to satisfy the basic need of automation or at least to get the experience of the user interface.
- **Pricing**: The pricing is considered as a cost of the software license in a certain period.
- **Integration**: The Software should integrate easily with other management tools or applications, as well compatible with the existing information systems.
- **Reliability & Security**: Depending on the importance of data, users want to set different permissions based on user accounts or groups. Some tools allow organizations to define who can edit what in the application.
- **Operational Scalability**: Depending upon the scale of the project, the software should be able to perform the task without getting crashed.

4.3.2 Determine the Weighting of the Criteria

Since not all selected criteria are equally important for the particular project, the next important step was to determine an appropriate weighting of each criterion. One of the most common methods for determining a weighting of criteria is the pairwise comparison. To make this comparison more transparent and understandable, a rating of 0-2 to the criteria are given, which "0" means vertical criterion more important, "1" means both criteria are equally important "2" means horizontal criterion more important (see Tab. 3)

Table 3 The Pairwise Comparison of Criteria to Select RPA Software

	C1	C2	C3	C4	C5	C6	C7	Sum	%
C1		0	0	0	0	0	2	2	4.8
C2	2		1	0	1	1	2	7	16.7
C3	2	1		1	2	1	2	9	21.4
C4	2	2	1		1	1	2	9	21.4
C5	2	1	0	1		1	2	7	16.7
C6	2	1	1	1	1		2	8	19
C7	0	0	0	0	0	0		0	0
Sum								42	100

C1	Required programming skills	C5	Integration
C2	Ease of use	C6	Reliability and security
C3	Product availability	C7	Operational scalability
C4	Pricing		

In this pairwise comparison, after calculating the total rating of each criterion, the weighting for each criterion will be gained. The weighting is used to perform a benefits analysis of the different RPA software.

4.3.3 Benefit Analysis of Different RPA Software

Product Availability: UiPath Community edition is available for all to use but the bots created cannot be distributed. Enterprise edition is available on 60 days free trial, while Automation Anywhere gives one month trial is available in enterprise edition whereas community edition is available to use with only Bot Creator rights. Microsoft Power Automate also provides a community version and enterprise version without advanced features, but Blue Prism does not provide a community edition, but it provides a one-month free trial of the product [20, 24].

Pricing: Pricing for Microsoft Power Automate is around 7,000 USD Annually [24], while for Automation Anywhere is approx. 20,000 USD annually, for UiPath, is approx. 18,000 USD annually, and for Blue Prism is Around 15,000USD annually [2, 9, 11].

Reliability & security: UiPath comes with incomplete security standards and certifications that creates business and compliance risks and to enhance the security features the user has to put in extra efforts and bear the costs. However, Blue Prism offers complete security features for the enterprise level. The encryption feature ensures data protection and also offers easy additional encryption features. Automation Anywhere is the only RPA platform that consists of a Bot security framework, and the highest compliance and security ratings [2, 21].

Ease of Use: UiPath is a clear winner as it offers a user-friendly dashboard with simple drag-and-drop functionalities. And Automation Anywhere is developer-friendly and is completely script-based. While Blue Prism is much easier than Automation Anywhere and is a visual designer based but not completely like UiPath [11]. While Power Automata's user interface has a familiar feel like the UiPath as it mimics most of Microsoft's Office UI [2, 9].

Integration: UiPath, Automation Anywhere, and Microsoft Power Automate are easily interactable with other applications including word, excel, Email with easier identification of objects on screen while Blue Prism is also easily interactable with other applications including word, excel, Email but a bit complex to the identification of object on the screen [2, 19].

Required Programming Skills: UiPath doesn't require any programming language knowledge. It provides RPA functionalities in a much simpler way than any other RPA tool. Blue prism needs a basis of programming to manage the business objects and Automation Anywhere does require a little knowledge of coding to use the activities [11]. While Microsoft Power Automate also required some basic programming knowledge [2, 9].

Operational Scalability: Microsoft Power Automate is a newcomer so not suitable for enterprise [24] while UiPath also lacks scalability features and often crashes while working on medium projects. Automation Anywhere Offers limited deployment in large-scale robot integration, while Blue Prism has good operational scalability with high execution speed [21].

The benefit analysis is used to prioritize the software that is efficient and useful for the use-case implementation. The prioritization is done amongst four RPA software: UiPath, Automation Anywhere, Blue Prism, and Microsoft Power Automate. To make this analysis more transparent and understandable, a rating from 1 to 5 for each criterion has been given. "1" means lowest benefits, and "5" means highest benefits. The rating value is based on literature review and user experience (use-case study)

Table 4 The Benefit Analysis for Selecting RPA Software

RPA Software		UiPath		MS Power Automate		Automation Anywhere		Blue Prism	
Criteria	Weighting (%)	Rating	Benefit Value	Rating	Benefit Value	Rating	Benefit Value	Rating	Benefit Value
C1	21.4	5	1.07	4	0.86	4	0.86	3.5	0.75
C2	21.4	4	0.86	5	1.07	3	0.64	4	0.86
C3	19	4	0.76	4	0.76	5	0.95	4.5	0.86
C4	16.7	5	0.84	4.5	0.75	4	0.67	4.5	0.75
C5	16.7	5	0.84	5	0.84	5	0.84	4.5	0.75
C6	4.8	5	0.24	4.5	0.21	4.5	0.21	4	019
C7	0	4	0	3.5	0	4.5	0	5	0
Sum	100	32	4.61	30.5	4.49	30	4.17	30	4.16

RPA Software	Total Rating	Total Benefit Value	Rank
UiPath	32	4.61	1
MS Power Automate	30.5	4.49	2
Automation Anywhere	30	4.17	3
Blue Prism	30	4.16	4

Furthermore, the benefit value of each software is a result of multiplying the weighting value and rating. This benefit value shows the gained benefit of RPA software for each criterion for buddy-matching process implementation.

Tab. 4 concludes that UiPath has more benefits compared to Microsoft Power Automate, Blue Prism, and Automation Anywhere for particular this buddy use case implementation. So UiPath will be used for RPA implementation and with UiPath, a second beneficial RPA software Microsoft Power Automate also will be used to get some overview of this newcomer RPA software.

4.4 The Results of RPA Implementation

For use-case, the selected software, UiPath has been proved to reduce the process time by nearly tenfold. It has also been observed that the operational reliability and customer satisfaction have been improved [7]. Deploying RPA is also expected to increase intangible benefits like enhanced student satisfaction and reduction in non-value-adding activities. RPA also offers the ability to free up some of the time of the employees to undertake more investigative and value-adding tasks. RPA is not necessarily replacing any of the organizational roles but making their work more interesting and value-adding.

From the use-case implementation, it can be understood that the NICE and International Office of THI now can focus on more important tasks than spending days on performing the matching process and notifying the students [7]. The implementation has attained maximum accuracy leading to heavy cost savings for the customer. Additionally, the

automation solution saves 85% of the time, save 85% of cost and 100% accuracy.

Time savings and accuracy are obtained from the comparison between manual and robot processing time to 100 data of student and buddy. In a manual process, the data is processed by different skill operators. The high skilled operator can process 100 data in 9 hours, the intermediate skill operator in 11 hours, and the beginner skilled operator in almost 14 hours. So, on average the operators can process 100 data in 11 hours with an accuracy of around 70%. While the RPA robot (UiPath & Power Automate) can process data in an average of 1,5 hours with an accuracy of 100%. From this calculation, it is seen that RPA can reduce the processing time by up to 85 %.

The cost-saving is determined by comparing cost components in the manual process and RPA process, as seen in the Tab. 5.

Table 5 The Cost-saving of RPA Process

100 Buddies × 100 Students Data		
Cost Involved	Manual	Robot
Total saving time is converted to Euro	693,90	55,68
Cost of operating computer	2657,64	213,27
Internet charge	2,63	0,21
Labour cost	138,78	11,14
Cost for OS	99	99
Hosting cost (clouds)	0	0
Software licence (Community edition)	0	0
IT support	60	240
Total Cost	3651,95	563,40
Saving Cost	**85%**	

5 CONCLUSIONS

Many companies and organizations are just beginning to explore the use of robotic process automation as a part of their digital transformation strategy. Careful planning and implementation of RPA can pave the way to achieve cost and operational efficiencies in companies.

This paper presents the selection process for potential software implementation of RPA at THI. From the observations, there are four potential processes to be selected using the modified parameter of Wanner. The Modification is to simplify and speed up the decision-making process in the organization.

The selection of RPA software involves four software: UiPath, MS Power Automate, Automation Anywhere, and Blue Prism. It consists of three stages:

- Determination of selection criteria using literature study and brainstorming
- Determining the weighting of criteria using pairwise comparisons
- Selection of software using value-benefit analysis.

Finally, the body matching process with UiPath software was selected to be automated in Technische Hochschule Ingolstadt. In the future, the implementation of RPA in THI can be more broadly, given the many potential processes that can be automated within organization. However, guarantee of data protection and privacy must be ensured first by RPA providers.

Notice

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