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Robotic Automation of University Admission Process

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Robotic Automation of University Admission Processes

Abstract:

Increasing competitiveness forces organizations to be more efficient and service-oriented. Continuous digitization and automation of the business processes are among those solutions which can help companies to achieve those goals. Robotic Process Automation (RPA) is a new emerging and one of the fastest developing tools. It is a combination of hardware and software technologies, dedicated to automating manual tasks and do things very simple. Still, it is considered that RPA is new technology and there are very few empirical studies and research papers in academic and research databases. Therefore, this study is exploratory. The study discovered that Robotic Process Automation technologies can bring immediate value by automating repetitive tasks including, report creation, mail automation and data migration. Robots and Robotic Process Automation technologies cannot just benefit organizations, but also are becoming one of the key competitive advantages for the organization across the globe, which stands with machine learning, data analytics, process mining, artificial intelligence etc. This paper will be a good example of successful implementation of this technology and will help to get an overall idea about RPA opportunities.

Keywords: RPA; Robotic Process Automation; Robotic Automation; Process Automation.

CERCS: P170 - Computer science, numerical analysis, systems, control.

Ülikooli vastuvõtuprotsessi robotiseeritud automatiseerimine

Abstrakt:

Kasvav konkurents sunnib organisatsioone olema üha tõhusamad ja kvaliteetsetele teenustele orienteeritud. Kestev digitaliseerimine ja äriprotsesside automatiseerimine pakuvad lahendusi, mis aitavad ettevõtetel need eesmärgid saavutada. Tarkvararobootika (RPA) on üks kiiremini arenevaid tööriistu. See on kombinatsioon riistvara ja tarkvara tehnoloogiatest, mille eesmärgiks on ülesannete automatiseerimine. Jätkuvalt peetakse tarkvararobootikat uueks tehnoloogiaks, mistõttu on olemas küllaltki vähe empiirilisi uuringuid ja uurimistöid akadeemilistes andmebaasides.

Seetõttu on antud töö uuriv. Antud tööst selgub, et tarkvararobootika tehnoloogiad suudavad pakkuda kohest väärtust läbi korduvate ülesannete automatiseerimise, mille hulgas on näiteks aruannete loomine, meilide automatiseerimine ja andmete automaatne liikumine. Robotid ja tarkvararobootika tehnoloogiad on muutunud üheks oluliseks konkurentsieeliseks erinevatele organisatsioonidele üle maailma, mis tegelevad sellistes valdkondades nagu masinõpe, andmete analüüsimine, protsessikaeve, tehisintellekt jne. Antud töö on heaks näiteks tarkvararobootika tehnoloogia edukast juurutamisest organisatsioonides ja aitab saada ülevaate erinevatest tarkvararobootika võimalustest.

Võtmesõnad: RPA, Tarkvatarobootika, robotiseeritud automaatika, protsesside automatiseerimine.

CERCS: P170- Arvutiteadus, arvutusmeetodid, süsteemid, juhtimine (automaatjuhti-misteooria)

List of abbreviations and terms

BPM	Business Process Management
BPMN	Business process modelling notation
BPA	Business Process Analysis
BPI	Business Process Improvement
ERP	Enterprise Resource Planning
RPA	Robotic Process Automation
CRM	Customer Relationship Management
DA	DreamApply system
FTE	Full Time Equivalent
RDA	Robotic Desktop Automation
CS	Computer science
SE	Software Engineering

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1. Introduction

Competitiveness is the "Perpetuum Mobile" of progress, without competition the development and achievements of mankind would be under the big question. Way back, when industrial revolution began, and first-generation machines started replacing human workforce, there were many different thoughts about it. Some people met it with skepticism while others could see benefits of progress. Anyways, industrial revolution marks as a major turning point in mankind history. Industrial revolution has different stages. First, it created the machine which could replace human workforce in the textile industry, then, by creating assembly lines and with the beginning of mass production Manufacturing Revolution started. And finally, from the late 1950s, by the shift to digital electronics with the adoption and proliferation of digital computers and digital record keeping, the Digital Revolution started that continues to the present day. All these stages have one common thing: every time, whole production processes were re-modelled. This kind of revolutions, which means that occasionally there comes technology that changes the way how things are "usually done"[1]. This ongoing process will always accompany mankind and if we want to maintain competitiveness we must at least follow (if not initiate) these changes timely.

Staying competitive is a vital factor for any organizations, and universities are not an exception. One of the ways to stay competitive is to improve business processes. Processes constitute the life veins of companies and by improving those companies can turn them into a competitive advantage. Every organization manages a lot of business processes. A business process, itself, is a chain of events, activities and decisions involving the number of actors and objects, triggered by a need and leading to an outcome that is of value to a customer.

This paper will focus on the problems which arise during the admission process. Admission process is one of the most important processes for the university, which provides the university with new students, who meet certain criteria. For establishing relations first touch has always high impact. Admission process is that first touch of a student with the university when the first

[1] Robotic Process Automation - The next major revolution in terms of back office operations improvement. Sorin ANAGNOSTE

impressions are formed. Admission process at the same time must be fast, cost-effective and qualitative. If it lasts too long some of the students can be admitted by other universities and the potential students will be lost. If it's not qualitative than the quality of admitted students will decrease and opportunity to admit better applicants will be lost. And if it is not cost-effective, the university spends much on each applicant whose number exceeds several times the number of the admited ones. The task was to find a solution which could improve overall process performance in a short period because the admission process could not wait for a long time for the results.

Today there are integrated applications for everything hosted on the cloud, and employees need inputs from them to deliver business processes or solutions. However, because of security reasons, cloud-based and web-based applications are not easily accessible. This makes difficult to integrate and migrate data between the applications. And people end up spending a lot of time doing simple and repetitive tasks that limit time for customer-centric tasks. However, automating these tasks will ensure employees do not spend time on repetitive tasks. Automation will make them focus on more important, intellectual, value-added tasks, which improve employability while generating value for the business.

Software robots or specifically RPA emerge as software-based solution to automate rules-based business processes that involve routine tasks, structured data and deterministic outcomes. RPA allows adding more value, improving efficiency and improving business KPIs. Recent studies (Derek Miers, Marc Kerremans, Saikat Ray, and Cathy Tornbohm) report the benefits of the application of RPA in terms of productivity, costs, speed and error reduction. Automating repetitive tasks can have many benefits such as improved business results, reduced wage costs or reduced working hours, reduced business risks, improved data quality, reduced human access to sensitive data, no need of developers' involvement. RPA ensures 100% accuracy of integrated and migrated data and faster turnaround time which leads to better customer experience and increased revenue. Automation is becoming an increasingly popular concept across the globe, especially in developed countries where labor costs and competitiveness between operating companies are high.

However, RPA has its limitations. Software robots can easily outperform humans in terms of speed and quality, robots can work 24/7, but it can't work faster than the overall process. Also, RPA is not the most optimal tool for handling complex tasks with many outflows. In addition to this limitation, another major drawback is licensing prices which are quite high if we take into the consideration the fact that almost half of all RPA projects fail.

1.1. Research Problem

Robotic automation of the University Admission process routine tasks, without interruption, and/or remodeling, of the ongoing processes in the time range of 1-8 weeks, maintaining quality of the performed tasks.

1.2. Research Objective

In response to this problem, will be analyzed existing process for international students admissions in at least two institutes of the university, and will be assessed the possibility of automating parts of these processes (especially routine tasks) using RPA technology, without any knowledge of RPA tools. As part of the project, the capabilities of existing RPA tools will be reviewed and at least two repetitive tasks will be automated using one of these tools in order to demonstrate the feasibility and potential benefits of using RPA in the university admission processes. This initial feasibility study and benefit assessment would be used as a basis for preparing a business case for the use of RPA technology to (partially) automated admission process. This paper will answer the next questions:

RQ: How can be RPA used to streamline university admission process?
RQ: What are the benefits and pitfalls of using RPA in this context?

Answering the research questions will be beneficial for the researchers and developers and process owners who can in future use accumulated knowledge for future development. Furthermore, answering the last question can inspire the representers of different business units, to start implementing RPA technologies.

After the research of the existing RPA literature, it is clear that most research papers are based on specific case studies or concept explorations that have special backgrounds and these studies lack generalizations.

2. Background

2.1. Software Robot

First and the most important is to understand what robot means in RPA. ”Robotic Process Automation” connotes futuristic visions, where physical robots walk through the offices and are performing some human tasks. It really means automation of manual tasks performed by a human, but in a different way. RPA is not about physical robots wandering around the futuristic corporations, it’s about “white-collar” software which can replace human workforce while doing some repetitive, routine tasks like transiting data, sending e-mails and others. Different software robotic tools and practices exist for configuring robots to perform the desired processes. Most of these tools offer almost the same functionality including recording workflows, using prepared activities, graphical interfaces with process flowcharts or using scripting and coding.[2]

2.2. Process Automation

According to Dumas(2013), Process automation is a subject that may be approached from different perspectives. In a broad sense, it may refer to the intent to automate any conceivable part of procedural work that is contained within a business process, from simple operations that are part of a single process activity up to the automated coordination of entire, complex processes.

Achieving automation is not a simple task. It requires a lot of patience and effort especially when human factors are targeted, specifically the cognitive ones which are difficult to identify, during

[2] Turning robotic process automation into commercial success – Case OpusCapita Aleksandre Asatiani, Esko Penttinen

the robotic automation, are often misunderstood and neglected in system design[3] (Sheridan, 2002). This is one of the reasons why automation is related to many risks.

The first step is the identification of automation boundaries and type of tasks. Not all parts of the process can be automated. In a process, there are three different types of tasks: automated, manual and user tasks. The second step is to review manual tasks and assess if it is possible to hook up these tasks to the BPMS. If it is not possible, we will have to consider whether it is convenient to automate the rest of the process without these manual tasks.[4]

2.3. Description of RPA

"Robotic Process Automation is the next wave of innovation, which will change outsourcing. We already are seeing the beginnings of a race to become the top automation-enabled service provider in the industry. In time, we are likely to see an arms-race for innovation in automation tools leading to new offerings and delivery models." - Sarah Burnett, Vice President of Research at the Everest Group

According to Slaby (2012) RPA is the technological imitation of a human worker, the goal of which is to complete structured, routine, tasks in a fast and cost-efficient manner[5]. Robotic Process Automation (RPA) is not about physical robots, which walk through the futuristic corporations, it's about white-collar software. More industries like financial services telecom and healthcare are adopting it. For business processes, the term RPA most commonly refers to configuring the robot which will work in the software to do the work previously done by people, such as transferring data from multiple input sources like email and spreadsheets to systems of record like Enterprise Resource Planning and Customer Relationship Management (CRM) systems[6].

RPA robots are integrated into IT systems and are using IT systems the way human uses. RPA is not a part of an IT infrastructure of a company, it works like a separate front-end solution which

[3] Sheridan, T. B. (2002). Humans and automation: System design and research issues. Human Factors and Ergonomics Society.
[4] Marlon Dumas _ Marcello La Rosa, Jan Mendling, Hajo A. Reijers Fundamentals of Business Process Management
[5] Slaby, J.: Robotic automation emerges as a threat to traditional low-cost outsourcing, HfS Res. 1–18 (2012)
[6] HOW TO CHOOSE BETWEEN ROBOTIC PROCESS AUTOMATION AND BACK-END SYSTEM AUTOMATION? Research paper Penttinen, Esko, Aalto University, Helsinki, Finland, esko.penttinen@aalto.fi Kasslin, Henje, Aalto University, Helsinki, Finland, henje.kasslin@aalto.fi Asatiani, Aleksandre, Aston University, Birmingham, UK, aleksandre.asatiani@iki.fi

sits on the top of it. Anybody who has working experience could easily notice that among their responsibilities are repetitive tasks which don't require intellectual work. By the RPA it is possible to automate all those routine tasks, structured data and deterministic outcomes, such as: transferring data from multiple input sources like email and spreadsheets, sending and receiving emails, creating reports and others.[7] RPA can bring immediate value to the company by automating core business processes.

For business processes, the term RPA most commonly refers to the software configured to do the work previously done by people manually, such as transferring data from multiple input sources like spreadsheets and email into systems of record like Customer Relationship Management (CRM) and Enterprise Resource Planning (ERP) systems, or creation of reports out of received information like emails invoices and so on. Robotic automation is the tool combining specific technology and methodologies, which uses a robot rather than a person to perform different rule-based tasks.

There are many companies which provide RPA tools. Among these companies Automation Anywhere (USA), Blue Prism (UK), Softomotive (Greece) and UiPath (Romania) are considered as leaders and star performers of this market (van der Aalst et al., 2018). Software robots will be replacing a high percentage of today white-collars jobs, not only repetitive and routine manual tasks; with future development and AI techniques, it will allow to use it for more complex tasks. The Robotics can even be used outside the routine processes.

2.4. Strengths, weaknesses and limitations of RPA

The RPA technology enables the automation of repeatable business processes, eliminating lower complexity tasks currently undertaken especially by back-office teams. It may sound contrary to intuition, but this approach has a lot of advantages. First, it is possible to integrate RPA with any software used by a human worker without interruption of these processes. Second, RPA implementation requires less time than more traditional software integration.

[7] Organizing Robotic Process Automation: Balancing Loose and Tight Coupling. Karen Osmundsen, Jon Iden, Bendik Bygstad (2019)

The RPA implementation time ranges from 1 to 8 weeks, while back-end software integration can take months or even years, which is an additional cost for a company. For some automation cases, back-end solutions are costly and not relevant. Second, RPA implementation requires less time than more traditional software integration. Third, processes automated via software robots are easily modifiable. By modifying relatively simple logical statements, it is possible to create another robot. Another important advantage, from my point of view, is that it does not require advanced coding skills. RPA can be instructed by creating graphical charts of logic statements or simple screen recording of the process performed by a human. This makes RPA highly versatile and flexible in its scope.[8]

While all this sounds promising, the use of RPA has also some risks, as any other automation technology does. On the one hand, RPA helps to do routine work faster and at a higher quality, on the other hand, it can make mistakes which can be detected too late. RPA requires detailed knowledge about the business process it is used in – otherwise expected performance improvements will not be realized. The use of RPA may also just cover symptoms without correcting the real reasons for issues. RPA may, for example, be used for the automated reconciliation of account differences. However, in the mid and long-term it would be much more beneficial to correct the issues leading to those differences. Hence, RPA may hinder real progress. RPA vendors stress that their tools are easy to implement and use – also for a business person. This may be right for simple straight forward applications. However, to achieve the full potential of sophisticated RPA environments some expert know-how is required for implementation and ongoing adjustment[9]. This should be part of the process management capabilities of the organization or RPA expectations may not be met or not met fully. These potential risks can make RPA a dangerous illusion. However, those risks can be minimized by addressing RPA the right way.[10]

We should also mention other limitations which are connected with the implementation stage and licensing prices for these tools. Many employees see software robots as their competitors, and mostly because of this fear they don't cooperate properly, which is vital for RPA projects'

[8] Turning robotic process automation into commercial success – Case OpusCapita Aleksandre Asatiani, Esko Penttinen

[9] Harmon, P.: Robotic Process Automation comes of Age. In: BPTrends.com, June 2017.

[10] Mathias Kirchmer: Robotic Process Automation – Pragmatic Solution or Dangerous Illusion? June 2017

success. To avoid this risk before starting the project communication must be initiated between management and employees[11].

It is considered that RPA solutions are cost-effective. As already mentioned, automating repetitive tasks can have many benefits, but still, this technology must not be considered cheap especially for developing countries, where labor costs are lower than in the countries with developed economies. For example, identical projects in some countries can be counted as efficient because of reduced labor expenses, while in others it can increase total processing costs due to high fixed costs (licensing) can be higher than employee salary, which is performing tasks manually.

2.4.1. Limitations of attended bots

Attended Automation robots can automate processes but only to a point and only one at a time, per desktop machine and per set of shared log-in credentials with real human staff. While Assisted Automation Solutions are usually up and running quickly, they completely stop working anytime a third-party system's interface changes from the initial "recording," like moved login field was moved, a new box to tick or while transiting data additional column added. And if a hundred machines are running on the same process, then it automatically means that hundred bots need to be re-recorded.

2.5. Existing RPA tools

At this moment, there are many RPA vendor service providers which offer their products. Competitiveness between them increases daily and this pushes them to develop their products as fast as possible. Some of them have more customized versions while others more flexible ones. Each vendor has its strengths and weaknesses. The most famous RPA players are: Automation Anywhere (USA), UiPath (Romania), BluePrsim (UK), RedWood (Netherlands), Workfusion (USA) and Openspan (USA) (see Figure 1.)

[11] Turning robotic process automation into commercial success – Case OpusCapita Aleksandre Asatiani, Esko Penttinen

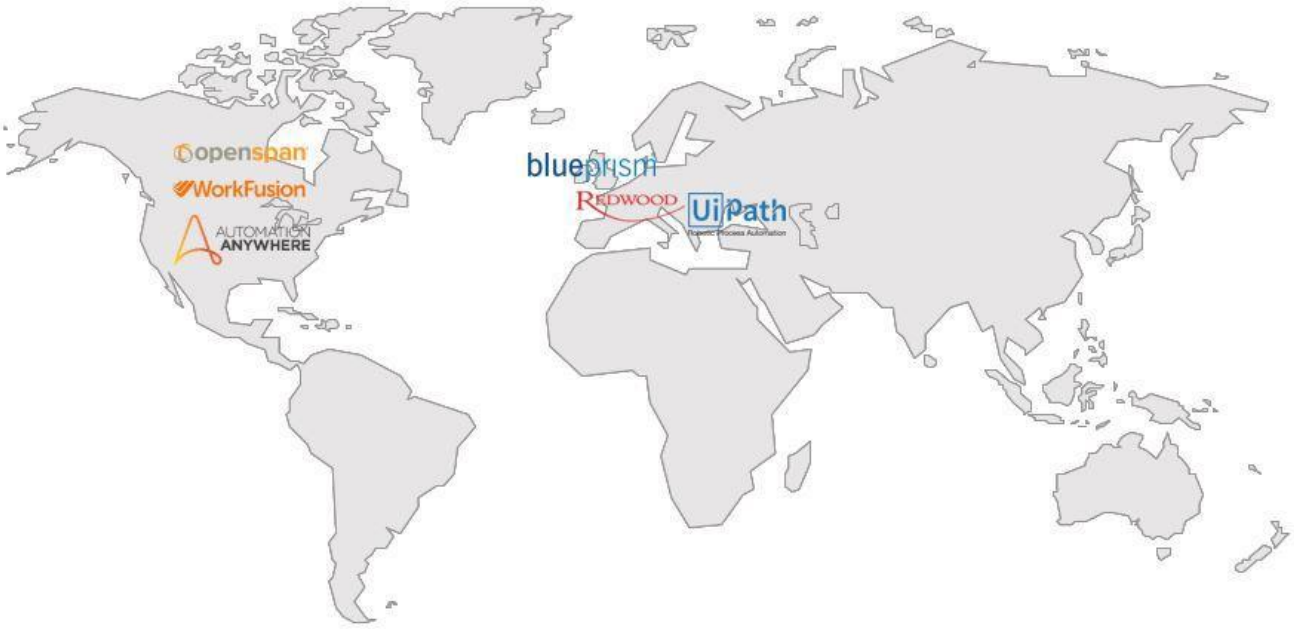

Figure 1: Leading RPA providers[12]

As already mentioned, RPA is emerging technology and the development speed is very high. For example, each tool is developing so fast that it's unpredictable which of the providers will be leading or what kind of tool will they provide.

The fact that, during the implementation phase, the only tool which was providing lifetime free version was Uipath and after three months Automation Anywhere began providing the same community tool is a good illustration of it. Uipath was on the third place between market leaders and in this period, by different consulting and research companies, it was recognized the leader of the market[13] (Figure2 and Figure 3).

The reasons why this happened are that Uipath created strong community thanks to its community edition, Uipath academy and forum. Uipath created the most accessible source to get used to this technology and get knowledge. It was the first RPA tool which was offering community edition that helped to popularize their product across the world. Also, would like to

[12] Robotic Automation Process - The next major revolution in terms of back office operations improvement. Sorin ANAGNOSTE

[13] Derek Miers, Marc Kerremans, Saikat Ray, Cathy Tornbohm: Magic Quadrant for Robotic Process Automation Software. Published 8 July 2019 - ID G00379618

mention Uipath Forum it was connecting developers around the world and created a knowledge-sharing platform. By this step, Uipath pushed other market players to create free editions and online academies. RPA providers like Automation Anywhere already released Community edition which is available for small businesses[14], developers and students. For this reason, RPA becomes very popular among people without coding skills who try to simplify their everyday tasks by automation.

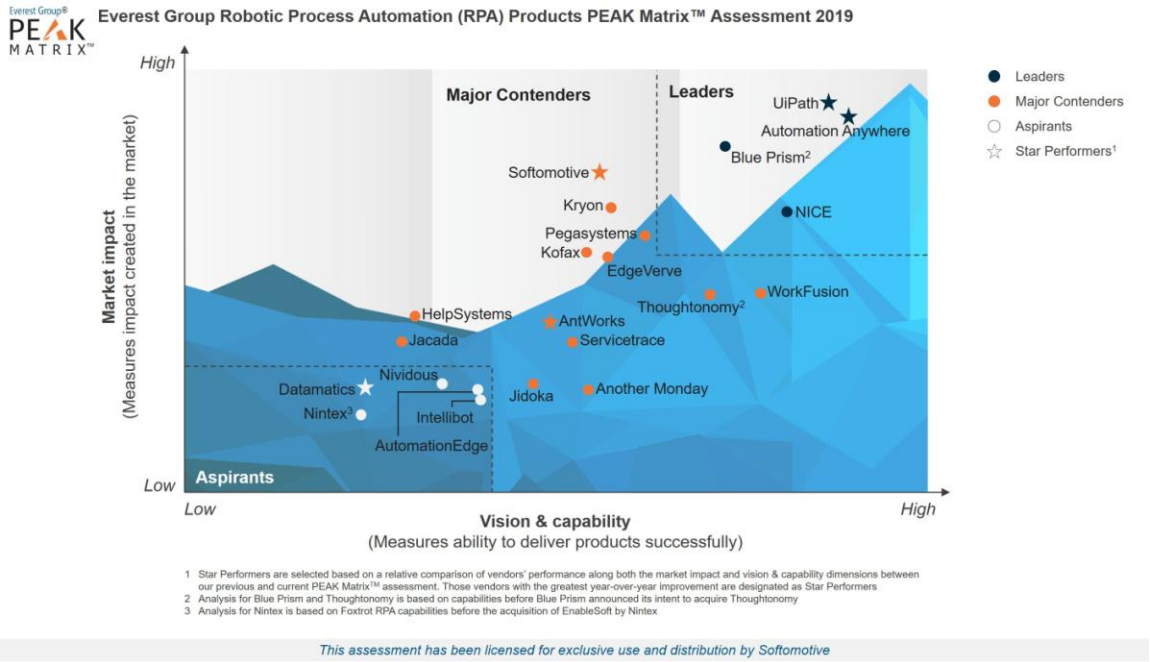

Figure 2: July 2019 research by Everest group

[14] An organization is considered a 'small business' only if: 1) your organization has less than 250 machines (physical or virtual), 2) your organization has less than 250 users or 3) your organization has less than $5 million US in annual revenue. (https://www.automationanywhere.com/lp/community-edition)

Figure 3: Gartner research 8 July 2019.

2.5.1. Uipath

Uipath, founded, in 2005 by Daniel Dines, is standing in the leading position of the RPA revolution across the globe. In 2018, Accel, CapitalG, and Kleiner Perkins Caufield & Byers invested in UiPath $153 million, and by the March 2018, the market cap of the company was evaluated at $1.1 billion.

UiPath software robots can be deployed rapidly, without interrupting ongoing processes and back-end development. Uipath platform consists of three key components:

Uipath Studio – a flowchart-based visual process modelling tool. Powerful and user-friendly automation canvas is an essential component in the UiPath platform, where robots are built by the blocks. It features a rich collection of pre-built activities which can be managed by its libraries. For each project library is selected separately, that helps to avoid overload of the tool.

Uipath studio integrates with several programming languages and promotes ease-of-use, scalability, and efficiency. It allows running robots directly, without orchestrator (see below.), but for scheduling robots, orchestrator is a must.

UiPath Robot – unattended and attended robots which are designed in UiPath Studio. Robots are managed through UiPath Orchestrator (but it is not necessary, to run attended bots studio is enough, but scheduling is only possible by Orchestrator).

UiPath Orchestrator – a web-based control-centre, which helps Robot operator to manage the robots, make qualitative and quantitative analysis about robot performance, etc. Unattended robots need Orchestrator to run and schedule. Also, is providing dashboards for deeper analysis. It is the most expensive product of Uipath and having it is vital for large enterprises. In some cases, orchestrator can be shared or replaced with different products, for example, Microsoft Orchestrator.

There were several reasons why Uipath was chosen as a development platform for the project. First and the most important was its community edition. During the period when the project was launched Uipath was the only RPA tool which offered completely free Community edition, it allowed fulfilling the goal (additional financial expenses were not required for this project). In addition, Uipath was simple enough to understand and has the feature of the lock screen which is especially important in the information era when there are a lot of regulations about data protection and due to this function developer can avoid damage of the robot by the user. Uipath Community edition is providing two Uipath studios for different devices and gives access to a limited number of bots; it just requires updating license every 3 months.

Also, must be mentioned Uipath Academy, it is open-source of free courses for all the people who want to get used to its technology. Courses are well organized and helps start building robots even in several days.

2.5.2. Blue prism

Blue Prism or Blue Prism Group is a multinational software organization, based in the UK, founded in 2010 by a group of experts in the field of process automation in order to increase the effectiveness and efficiency of the companies. The technology that is used by Blue Prism is based on Microsoft .net framework and supports all types of applications and platforms. This tool, like Uipath, can be used in various industries like healthcare, public sectors, financial sector and healthcare. Blue Prism tool has a set of libraries which can be launched separately for each project. It has two main parts – process studio and object studio.

Process Studio - looks like a flowchart it is almost the same product as Uipath studio. It is an area where an actual process is created with business logic, loops, variables, and object call (activities) to be sequenced. A process acts like a human user. It implements a software robot's logic. It is almost similar to personal interaction, repeats human activities and works with several applications together to do human tasks faster.

Object Studio is very similar to Uipath studio. it is used to create the Visual Business Object. VBO is created to interact with other applications. Object Studio and process studio look very similar, but there are key differences.

2.5.3. Softomotive

According to Everest Group, Softomotive is named as a star performer provider of Robotic Process Automation (RPA) solutions. Both attended and unattended bots are delivered through two different tools: WinAutomation and ProcessRobot, both can be used for different purposes starting from desktop installation to server-based software. Both are quick to deploy and easy to use. It is one of the challengers on the market which focuses on creating more no-coding and easy-to-use tools. Maybe Softomotive products are not the most advanced but it has one of the simplest interfaces and it is really easy to use. Softomotive also has its academy which helped to popularize its product.

The company offers the most reliable and scalable automation solutions, bridging the gap between best-of-breed technology and continuous innovation to deliver true business

transformation. It provides a powerful automation platform that enables organizations to develop, manage and track their digital workforce.

WinAutomation is Robotic Desktop Automation (RDA) tool (niche tool for only desktop automation, in fact, it is RPA tool with less functionality) which provides quite simple, easy to use Windows-based platform where software robots can be built for single desktops. This tool provides the best value for money. By the latest prices, it would only cost 500$ per year to get a license which could be enough for our project (Note: To complete the project we used Uipath tool which had the only free tool (community edition) for the moment of implementation).

ProcessRobot is the latest product of Softomotive. It is one of the simplest RPA tools on the market.

2.5.4. Automation Anywhere

Automation Anywhere, USA based company product, is the most cognitive robotic process automation platform designed to automate the most complex business process in any organization.

Automation Anywhere – "The worlds most deployed RPA platform" or "Rolls-Roys of RPA" is one of the leading RPA tools. It has the biggest market share thanks to its highest rate of success (as mentioned above nearly 50% of all RPA projects fail). Automation Anywhere allows organizations to automate the processes which are performed by humans. It is a Web-Based Management System which uses a Control Room to run the Automated Tasks. Automation Anywhere tool can automate ends to end business operations for companies.

Automation Anywhere has 3 primary components:

Control Room - is a web-based platform that controls the Automation Anywhere, like Uipath orchestrator. In other words, it's the control room to manage Automation Anywhere bots generate flowcharts and monitor all the bots.

Bot Creator - is a desktop-based tool, used by the developers to create bots. Bot creator has almost the same functionality as Uipath studio or Blue Prism Object Studio, except running the bots for this Plue Prism has a separate solution. The main difference with Uipath is that Bots are

stored in the control room, not in the Bot Creator. Blue Prism also has a good security system. Control room administrator gives a different type of permissions to Bot Creator.

Bot Runner - is the machine which runs bot. It is one of the advantages of Blue Prism over Uipath. it allows to run multiple bots in parallel, in case of Uipath it is only possible with Orchestrator. You only need the Run License to run the bots.

Automation Anywhere has three different types of robots:

- **Task Bots** – like Uipath Studio Activities, automate rule-based, repetitive tasks in the areas like document administration, data transition, and so on.
- **Meta Bots** - Automation building blocks almost the same as Task bot but, designed in such a way that with application updates or changes you need to make minimal edits to the bot. Changes automatically apply to any process utilizing that bot. this is one of the main reasons why Automation Anywhere has highest success rate in implementation.
- **IQBOT** - It is an advanced, AI like tool which can learn and perform a task on its own. IQ Bot offers automation using the highly advanced cognitive technology. It works on the concept to organize an unstructured data while improving its skills and performance.

Other important components of Automation Anywhere are:

- **BOT insights** -The tool shows statistic and display graphs to analyze the performance of every bot in the system, almost alike blue Prism tool does. In this tool, the administrator can calculate saved time after the process automation.
- **BOT STORE** - Bot Store is digital workforce market, enabling developers to find and purchase, or even get for free, already pre-built bots for various applications like SAP or 1C and use them even without building any robot.

2.6. Comparison of back-end solutions and RPA

Robotic Process Automation is an emerging business process automation technology. Its approach is different from back-end system automation. RPA uses existing features and user

interfaces of already existing applications[15]. RPA, for the implementation, does not require changes of underlying back-end systems and programming logic. RPA projects do not disturb existing systems. It does not require some shut-downs or changing business model like traditional back-end automation solutions. In RPA, robots are configured to interact with existing information systems, without any changes, replicating the rule-based actions of human workers. Moreover, it does not require advanced IT and programming skills like back-end automation, which means that business users can create solutions themselves without additional IT department resources.

Another important reason for the increasing demand for RPA is continual growth mergers and acquisitions of companies. In the case when two large-scale companies with different IT infrastructure, merge the IT department starts to merge this infrastructure. In some cases, there is no possibility to merge the whole infrastructure or they have to prioritize tasks. In this case, RPA can help in both situations. For the prioritization, they can measure processes by frequency and type of cases. It will help in positioning processes by recommended automation type (Figure 3).

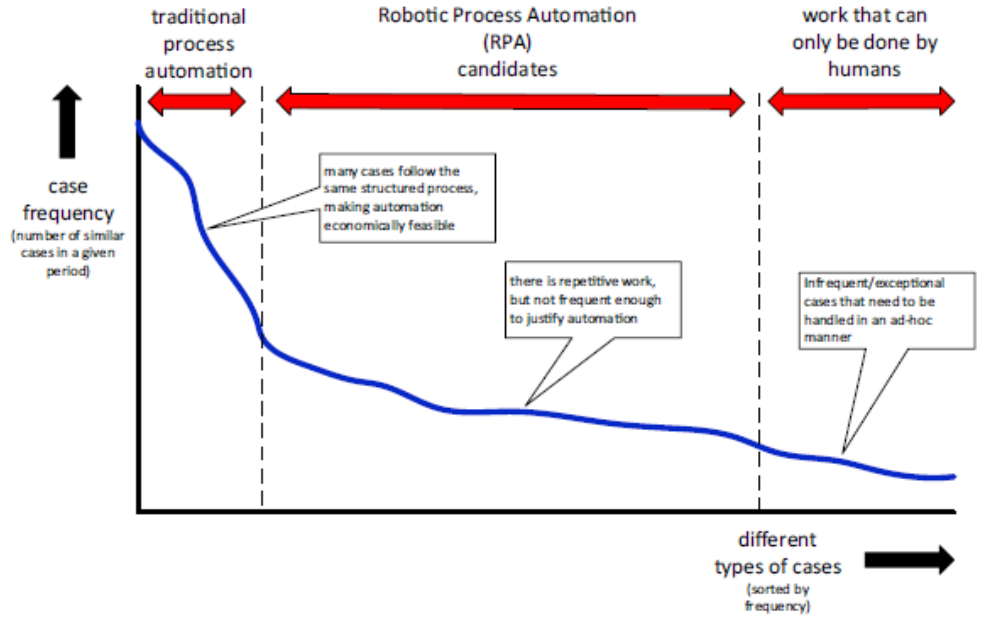

Figure 4: Positioning of RPA and Back-end automation[16]

[15] HOW TO CHOOSE BETWEEN ROBOTIC PROCESS AUTOMATION AND BACK-END SYSTEM AUTOMATION? Aleksandre Asatiani, Esko Penttinen

[16] Robotic Process Automation Wil M. P. van der Aalst, Martin Bichler, Armin Heinzl

3. Solution

To put RPA journey into the context first we should discuss the background of the University of Tartu, the biggest university in Estonia with the biggest number of international students. University of Tartu is one of the top universities in Eastern Europe, but growing competitiveness on the education market pushes even such university to become more student-oriented. University of Tartu belongs to the top 1.2% of the world's best universities. To make the first contact with potential students less painful and costly without losing admission quality, the decision was made to implement RPA in some of its processes.

University admission consists of different complex processes and tasks. In this paper whole process won't be discussed but only those parts where RPA technology will be implemented and those who might seem interesting for future development.

3.1. Business Analysis for RPA

Before robot implementation, there is a need for preparing the business analysis. Analytics oversees transferring knowledge from business units to technical solution level to make a design decision. The purpose is to ensure that the technical solution satisfactorily meets the needs of the business requirements. BA is critical before every RPA project; even most experienced teams fail RPA implementation projects. Tasks must meet several RPA requirements. Despite the fact that tasks for robotic automation were already chosen, to achieve successful implementation analytical work must be done, at least to make sure that task is suitable for RPA implementation by checking RPA requirements for the tasks. First, we had to check the complexity of the task and make calculations about potential benefits. During this project, there was used Uipath community edition, which avoided additional licensing costs.

During the analysis, there must be checked process complexity: how many applications will be used by robot and how many steps should be done. Also, it is important to determine standard input and free input (not rule-based).

To evaluate complexity level Uipath Academy RPA Business Analysis course offers three-level divisions:

- Low - automation easily created with a recorder. Includes desktop and web applications _ 1-2 week for development;
- Medium - automation of processes that require data transfer between applications (3-4 weeks for development);
- High - automation requiring strong programming skills (4-6 weeks for development).

Factors driving automation potential

- Rule-based - predefined logic determines to course of action (no judgmental decisions)
- Process type - (manual & repetitive, semi-manual & repetitive, automated, manual & non- repetitive)
- Standard input degree - standard or non-standard
- Processes of applications used - if it's going to change in 3-6 months, complexity increases
- Frequency of unknown exceptions - processes that cannot be processed without external approval

Process deep dive

On the analytics stage, all the process-related documents like standard operating procedures, process maps, user manuals and organizational charts have to be gathered or created. Aim of this stage is to prepare as-is process flow and to design the to-be process. This approach helps to eliminate mistakes during development.

The approach of the process deep dive is to:

- Conduct workshops and meetings with product owners
- Capture process metrics (scope, apps involved, time dependencies, stakeholders involved and their role)

- Prepare process definition documents;
- Mark what is in scope and out of the scope of RPA

3.2. As-is process

In order to apply for admission, international candidates fill in an online application form by a fixed deadline (the deadline is the same for all applicants). Online applications are recorded in an information system, Dreamapply, to which all staff members involved in the admissions process have access. Prior to submitting the online form, the applicant must upload electronic copies of the following documents:

- A motivation letter;
- Certified copies of previous degree and academic transcripts;
- Copy of identity document;
- Copy of English language test results. Applicants can view and track the status of their application via the online application system.

Each applicant has personal ID number; also, each application has its own number (Application Number). One applicant ID can be linked to several application number.

A few days after an application is submitted online, an admissions officer checks it in order to determine if the application is administratively correct and complete. If any deficiency is identified in the application, an email is sent to the applicant. The applicant has to resubmit their application after correcting the identified deficiencies.
Before committees start to make an admission decision admission office check:

- Motivation letter
- English language test
- Academic performance and achievements

Motivation letter - Perform a plagiarism check of the motivation letter using a Web-based plagiarism detection software - Urkund. Urkund is a web-based tool which checks documents on plagiarism.

English language test - The academic officer uses a web-based interface to verify that the provided English language test result is valid.
Academic verification - An admission officer sends the certified copies of the degrees to an academic recognition agency, which checks the degree and gives an assessment of the equivalence of the degree in terms of local education standards.

Once all documents of an applicant have been verified, the admissions office marks the application as "Ready for assessment". The application is automatically forwarded to the admissions committee of the relevant study program (e.g. medicine, IT, etc.).

About one week after a committee has produced its ranking, the admission office sends the corresponding notifications. An applicant may be notified that their application is:

- Accepted with a scholarship;
- Accepted without scholarship;
- Admissible but not accepted unless a study place is freed up by a higher-ranked applicant;
- Rejected due to low scores or plagiarism.

Committees make their decisions based on academic transcripts and motivation letters. The committee meets once to examine the applications submitted to its study program, which have passed all verifications made at the admissions office.

Two tasks were chosen [Note: request from Admission office] for robotic automation – plagiarism checking of motivation letters and plagiarism report generation. There were several reasons for it. First, these tasks were completely rule-based and did not require any additional human involvements, except running the robots. While looking for robotic automation opportunity, this fact was taken into consideration.

Admission office performs a plagiarism check manually. In the spreadsheet, they prepare basic information about applicant where Dreamapply application link and applicant ID-s are attached. Admission officer is creating motivation letter files one by one for each applicant. In each file, there are all motivation letters of an applicant. Mostly, applicants apply to several programs. The

number of motivation letters is equal to the number of applied programs but mostly they are, almost, identical. If these letters are sent separately, the system returns a high plagiarism rate, which must be avoided. After the creation of files, the admission officer sends them to Urkund system. As soon as plagiarism report is received by email, admission officer is extracting received information like plagiarism percentage and analysis link from a mail message and imports it manually in the excel report.

To check the motivation letter and create excel report, for each applicant A lot of repetitive and routine tasks must be performed. Checking motivation letter consists of two sub-processes:

1. Prepare files (motivation letter files) from DA for Urkund analysis (see Figure: 4).

    1.1. Click DA link from spreadsheet to open DA application;
    1.2. Click on motivation letter/letters hyperlink (motivation letters number is equal to the number of programs applicant applied);
    1.3. Copy motivation letters from DA application;
    1.4. Create word/txt file;
    1.5. Paste motivation letter into the file;
    1.6. Copy applicant ID from the spreadsheet;
    1.7. Paste applicant ID into the file;
    1.8. “Save as” (name of file applicant ID) file;
    1.9. Close file.

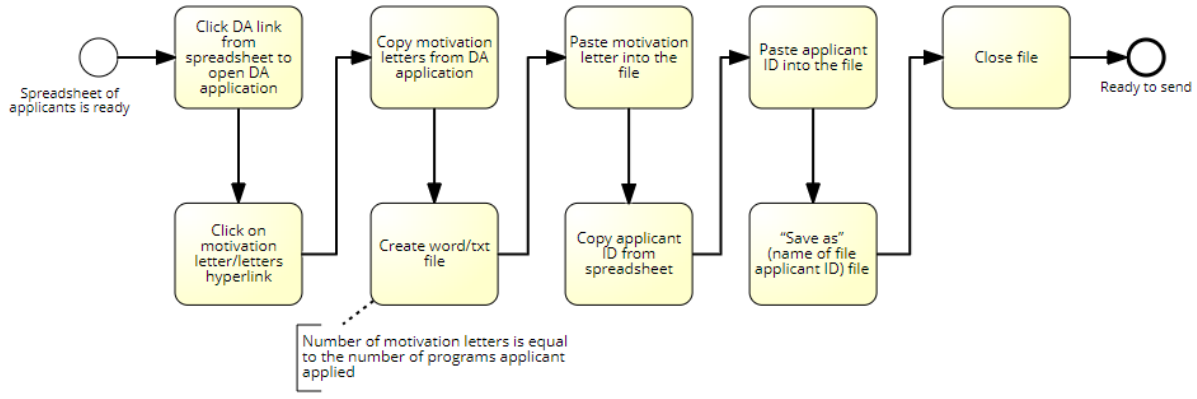

Figure 5: Process chart - File preparation.

2. Send file by e-mail to Web-based plagiarism detection software – Urkund (see Figure: 5).

    2.1. Open new email message;
    2.2. Write/Paste e-mail address;
    2.3. Attach file;
    2.4. Send email.

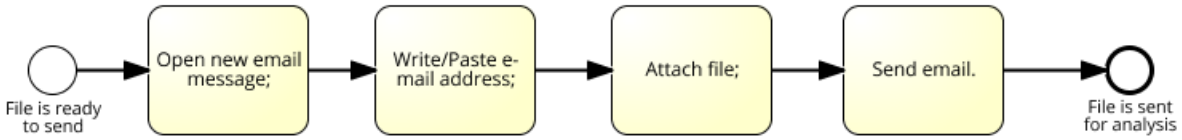

Figure 6: Process chart - Sending file for analysis.

3. As soon as Urkund report is received, the percentage of plagiarism and Urkund analysis link are transited to the above-mentioned spreadsheet and plagiarism report is created (see Figure: 6):

    3.1. Open received email;
    3.2. Copy applicant ID form received email;
    3.3. Paste applicant ID to a spreadsheet;
    3.4. Copy plagiarism percentage form received email;
    3.5. Paste plagiarism percentage to a spreadsheet;
    3.6. Copy Urkund analysis link form received email;
    3.7. Paste analysis link to a spreadsheet.

For each motivation letter, these steps must be performed separately. This approach increases the human error rate during the process, so robotic automation will be quite beneficial.

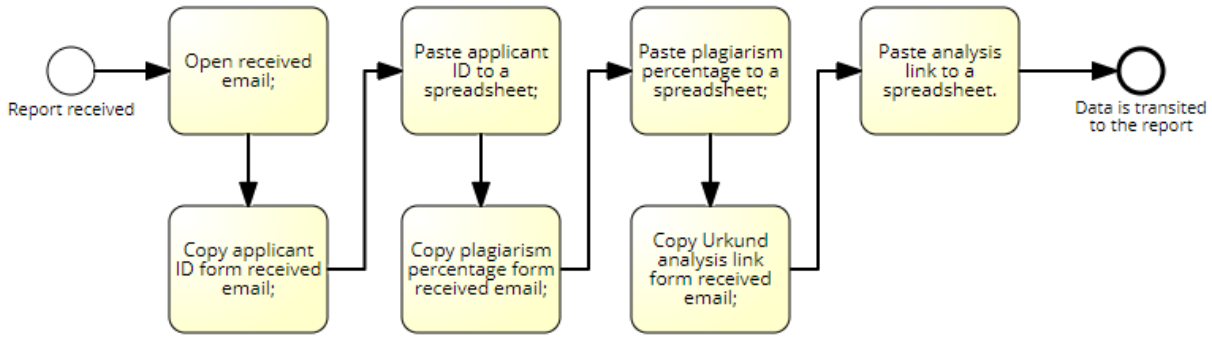

Figure 7: Process chart - Transit data to the report.

Such detailed process maps are needed for robot development. During regular interviews respondents don't talk about tiniest details which are in some cases more cognitive and intuitive, this makes difficult to develop bots which will perform this task automatically. Even one missed mouse click or incorrect position for recording can effect on robot performance and results.

3.3. To-be process

Two tasks were chosen [Note: request from Admission office] for robotic automation – perform a plagiarism check of a motivation letter and plagiarism report generation. There were several reasons for it. First, these tasks were completely rule-based and did not require any additional human involvements, except running the robots. Also, these tasks could have a big impact on the total admission process.

3.3.1. First and second tasks

For the robots Urkund check was divided into two sub-processes:

1. Preparation of motivation letters
2. Send to the Urkund system for analysis.

Both parts are performed by two robots and tasks are split, but they are, both, part of the plagiarism checking process. Taking into account the fact that Orchestrator is not available for the community version there was no available to develop unattended bots, so after implementation, there will be needed human assistance for these bots several times.

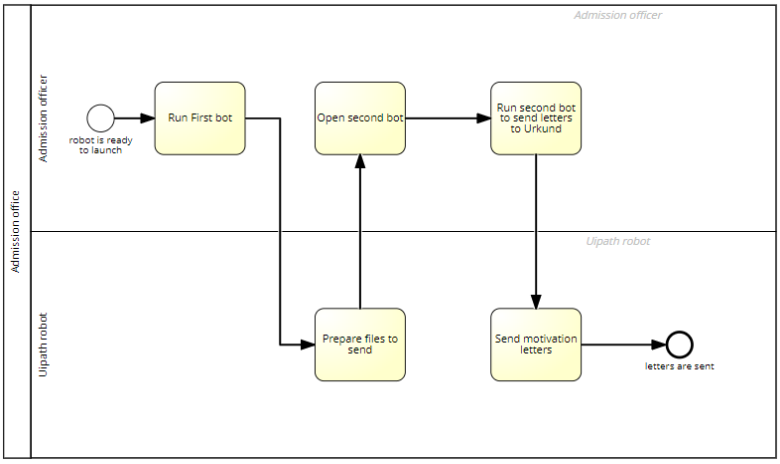

Figure 8: Process flow chart – Urkund check.

3.3.2. Third task – Report generation

Urkund analysis report generation is the task which was also possible to automate by an attended robot. The goal of the third robot was to create Urkund analysis report out of emails received from Urkund system. In this case, the process was changed. If a human had to go through emails one-by-one, Robot could extract data from all received emails together. But in this case, there is a need to perform additional step by a human (see main design decisions).

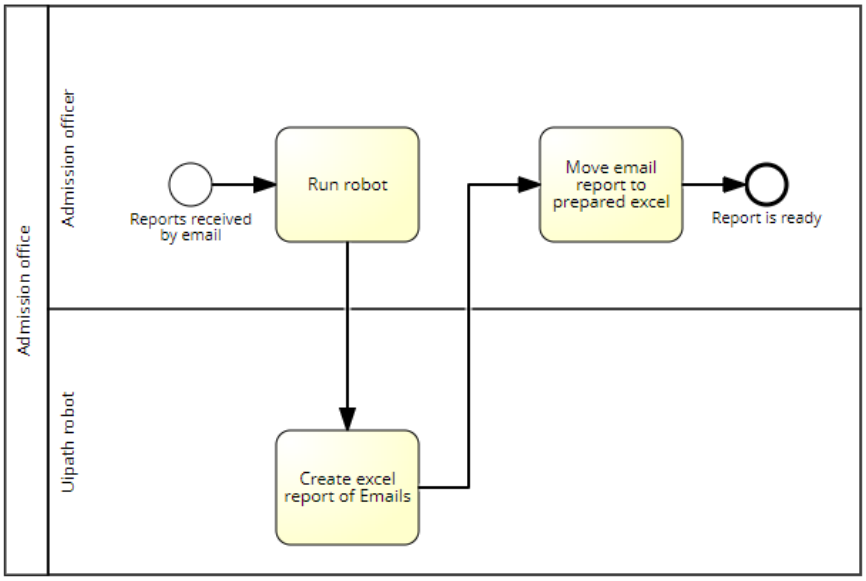

Figure 9: Process flow chart – Urkund report generation.

3.4. Implementation

While developing bots recording and screen scrapping was avoided as much as it was possible. Recorded processes have many weaknesses and limitations. In case of minor changes in the application, a robot is unable to execute tasks without process re-recording. The most sustainable robots are those which are built by Activity blocks because if there are some changes it is easier to rebuild robot.

The fact that Orchestrator is not available for the community version it was not available to develop unattended bots but only attended ones. So before starting building robots, it was clear that human attendance will be needed.

3.4.1. Main design decisions

To automate the chosen tasks decision was made to build three robots. Two of them would automate plagiarism checking process which is already divided in two subprocesses and the third one will create Urkund analysis report out of received emails.

3.4.1.1. First robot (DA)

The first robot, designed to prepare files with motivation letters was developed according to file preparation flowchart (see Figure: 4). It took one week to develop test and deploy robot. In fact, the robot was created using mostly Activity Blocks, but to coping motivation letter required to be recorded using screen scrapping function (see Figure: 9). Despite the difficulties while using screen scraping Complexity level of the process is low, it included only two applications, Microsoft excel and Google Chrome (to access DA system) and automation potential was high for the reasoning process itself was meeting all the requirements, it was strictly rule-based and repetitive, also were not expected changes in used applications. In addition, the frequency of unknown exceptions did not exist. The only weakness of this bot as already mentioned was the task when the robot had to open a web browser and copy motivation letter.

To process 344 applications it took 368 seconds, which means that average processing time was 1.9 seconds for each applicant. Processing time is also variable, it depends on other ongoing applications which slows processing, but the deviation is very low so it is not taken into the consideration (while processing 500 applications/letters difference in tame can be no more than 6 seconds).

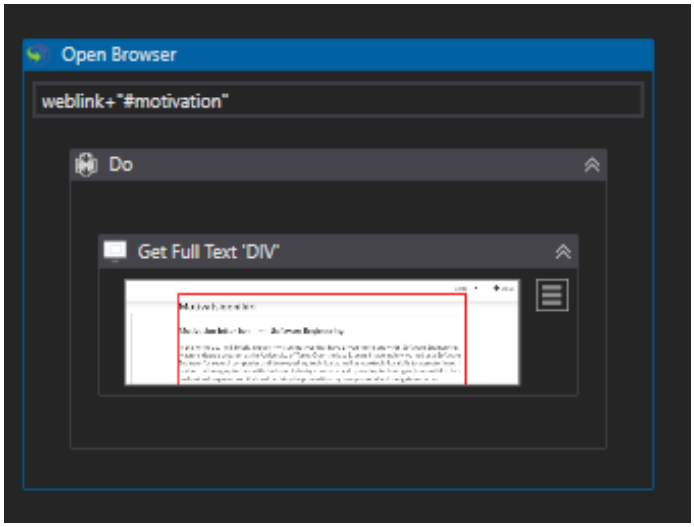

Figure 10: Screen scraping used to copy motivation letters.

3.4.2. First task robot (Excel database)

After successful processing of SE and CS applications by RPA, when all the goals of the project were achieved, admission office made decision to implement robots for other master programs and for the bachelor studies. This time, admission office provided Urkund application report in excel. Structure of the report was the next:

ID	Applicant	Application	Status	Offer type	Offer course name	Motivation letter

This report allowed avoiding recording for copying motivation letter. Instead of recording, it made possible to add motivation letter as a variable into the file. So, robot task was simplified and processing time for the robot was decreased. Robot development did not take much time because it was possible to re-configure existing robot (3.4.1.1). After removing Open Browser Activity and adding another variable for motivation letters column robot was ready to launch. This time robot had to prepare files of 1603 applicants.

Robot processed 1603 applicants in 2 seconds. As a result, 1212 files were prepared. That average processing time for the per applicant was very low (0.00125 seconds for each applicant). Processing time is also variable, it depends on other ongoing applications which slow processing, but because of low deviation and processing time it is insensible. The robot was launched twice, one for the master's program and another for bachelor's studies.

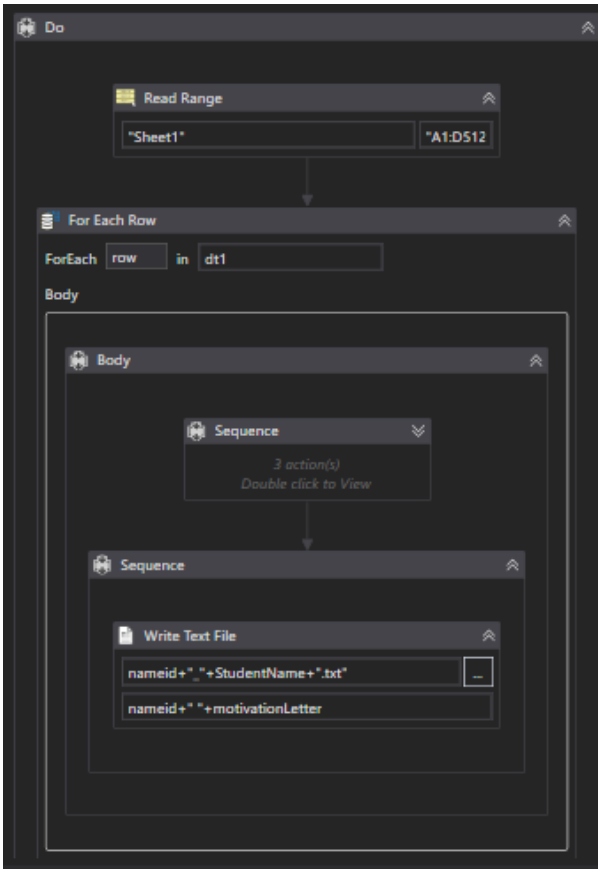

Figure 11: Remodeled first robot.

3.4.3. Second task robot

The second robot was designed to send motivation letter files to Urkund system. Uipath has Outlook Automation Library and excel automation Library. These libraries provide all the necessary Activities that allowed building a robot without using the recorder. It took several days to build test and deploy robot.

The complexity level of the process, in this case, was low too. It included only one application – Microsoft outlook. Automation potential was high for this reason process itself was meeting all the requirements, it was strictly rule-based and repetitive, also were not expected changes in user applications. Frequency of unknown exceptions did not exist. For the robot processing time for this task ranges from 18 to 22 seconds. Processing time is variable; it depends on other ongoing

applications which slow processing and the number of applications but the deviation is very low so it is not taken into consideration.

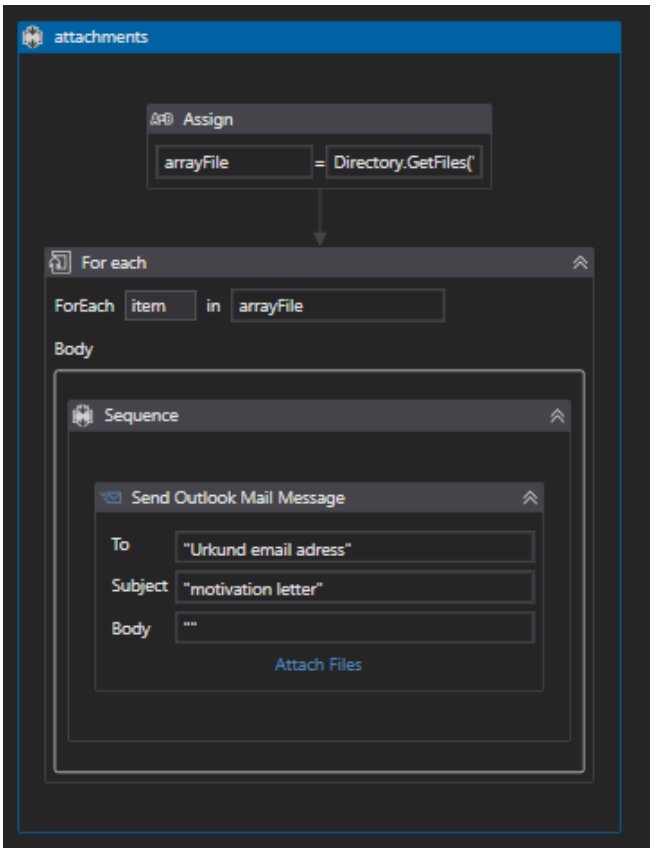

Figure 12: Second robot – Sending files to Urkund system.

3.4.4. Third robot (Urkund report)

The goal of the third robot was to create a report by processing emails, received from Urkund system. For this robot Outlook Automation Library which provided all the necessary activities that allowed to build a robot without using the recorder. It took several days to build, test, and deploy robot.

The complexity level of the process, in this case, was low too. It included two applications – Microsoft Outlook and Microsoft Excel. Automation potential was high for this reason process itself was meeting all the requirements, it was strictly rule-based and repetitive, also were not expected changes in user applications. Frequency of unknown exceptions did not exist.

During development additional user was not created to have access to Urkund. This This made receiving emails difficult. To solve this problem, all the responses, sent from Urkund to users' email addresses, were forward to the one where it was sent from.

The robot was extracting the next information:

- Name of a person who has sent the email. – This information was needed to filter emails. As already mentioned, Urkund answers were sent to the same email address used for the previous robot, where confirmation email was also received.
- Email subject – contained the file name and plagiarism percentage, so it could be used to extract information.
- Email body – completely standardized text with only several dynamic texts including Urkund analysis link.

Dynamic fields of the email body were always located in one place, but because of different length off those fields, it was almost unable to perform data extraction with the recorder. To avoid this problem, the decision was made to solve this problem by Microsoft Excel formulas which easily find the location of the texts and length of this text doesn't have any effect on the formula.

3.5. Results

3.5.1. First results – Computer Science and Software Engineering

Robots were used to create motivation letter files for applications of CS and SE programmes. Total execution time for the robots was depending on the number of applicants only in the case of the first robot (DA). In other cases, mostly, the difference was between 2-3 seconds so during the calculations this small deviation is not taken into account.

The first robot was launched 4 times to process all the SE and CS applications because processing started before the admission deadline and applications were received in three batches, in the first batch CS and SE applications were separately and in others, they were received together. From the one point, it was not efficient but on the other hand, it allowed to reduce the total processing time of these applications.

The second and the third robots, both, were launched 3 times to process all the SE and CS applications because processing was started before application deadline. Applications were received in three batches; in the first batch CS and SE applications were separately and in others, they were received together. From the one point, it was not efficient but on the other hand, it allowed to reduce the total processing time of these applications. Processing different number of motivation letters, by the second robot took from 18 to 22 seconds. For the third robot it was varying from 30 to 36 seconds.

To compare the as-is manual human performed process with a robotic one, BIMP simulator of the University of Tartu and process flowcharts prepared during as-is process modelling were used. The simulation was not used to count the exact time of the to-be process. Instead of this were used activity logs of Uipath, which were the most correct way to get processing time.

According to simulation Processing of CS and SE applications could 262.2 minutes and after robotic automation processing time decreased to 17.6 minutes, which means that processing time decreased by 93.3%. In both calculations waiting time is excluded. This decision reasons that this calculation approach helps to compare human performance with robot's one.

Firsts results		Number of applications for processing			
		First batch	Second batch	Third batch	**Total**
First robot (DA)	Computer Science	196	63	67	474
	Software Engineering	148			
	Time of processing (sec.)	653.6	119.7	127.3	900.6
	Time of processing (min.)	10.9	2.00	2.12	15.01
Second robot	N of files to send	294	53	50	397.0
	Time of processing (sec.)	22	18	18	58.0
	Time of processing (min.)	0.37	0.30	0.30	1.0
Third robot	N of mails for processing	294	53	50	397.0
	Time of processing (sec.)	32	32	32	96.0
	Time of processing (min.)	0.53	0.53	0.53	1.6
Total Time of whole Process (minutes)		17.6			

Figure 13: First results of robotic automation.

3.5.2. Final results – Other Masters and Bachelor programs

As already mentioned, admissions office decided to use benefits of RPA for other master's programs and bachelors' applications. To provide the final results of this project, first the time spent by Uipath robot was calculated. And after by BIMP simulation was calculated time which could be spent on this task. For this was created an additional, simplified flowchart because in fact, admission officers did not have the opportunity to create Motivation letter files out of Urkund applications report.

According to simulation Processing of additional Master's program and Bachelor studies, applications could last 595 and 310 minutes (905 minutes in total). What about RPA solution it took 11 minutes (see Figure 14 & 15), which means that processing time decreased by 98.8%. In both calculations waiting time is excluded. This decision reasons that this calculation approach helps to compare human performance with robot's one.

According to the calculations, total processing time for all applications is 1167 minutes (CS, SE, other master's program and bachelor studies) while RPA solution manages to do the same in 28.6 minutes which is 97.5% less than without Robotic automation.

		Per batch	**Total (6 batches)**
First robot (excel)	Other master's programs	1603	1603
	Time of processing (seconds)	2	2
	Time of processing (minutes)	0.0	0.0
Second robot	N of files to send	160	918.0
	Time of processing (seconds)	22	132.0
	Time of processing (minutes)	0.37	2.20
Third robot	N of mails for processing	160	918.0
	Time of processing (seconds)	32	192.0
	Time of processing (minutes)	0.53	3.20
Total Time of the whole Process (minutes)		5.4	

		First batch	Total (2 batches)
First robot (excel)	Bachelors studies	511	511
	Time of processing (seconds)	2	2
	Time of processing (minutes)	0.0	0.0
Second robot	N of files to send	243	486.0
	Time of processing (seconds)	22	132.0
	Time of processing (minutes)	0.37	2.20
Third robot	N of mails for processing	243	918.0
	Time of processing (seconds)	32	192.0
	Time of processing (minutes)	0.53	3.20
Total Time of the whole Process (minutes)		5.4	

Figure 14 & 15: Second results of robotic automation.

4. Pitfalls.

Besides good results, during implementation and development phase some problems occurred. It could be a good lesson for the future to avoid them.

Many RPA vendors promote their products that it does not require development involvement, and it is like common sense already, but still there is a need of basic understanding of programming languages, otherwise one incorrect variable can fail the whole robot and to understand the real problem. But this leak of knowledge can be easily compensated by several courses which are provided by RPA vendors.

The problem appeared when related to limited access to DA system, several times when Outlook of the user, which was receiving report mails, was not connected to the internet, Urkund was not sending answers on all submitted files.

Building robots for repetitive rule-based tasks sometimes seems easy but in fact, always must be in mind that Robots need more detailed instructions to understand and perform tasks than humans. For example, if one mouse click is missing human will push, but a software robot won't make decisions.

Another pitfall was Uipath limitation which could not allow creating a report by running all the emails together. Unfortunately, the robot could not process more than 500 emails. Maybe it is a special limitation for community addition, but still especially when using only attended robots it can cause many problems.

In some cases, problems occur not by the reason of RPA tool but applications used by it. During the project, there was a case when Outlook was overloaded and it could not receive emails. To avoid such occurrences developer should analyze possibilities of those applications which will be used by RPA.

5. Conclusions

As mentioned above, benefits of RPA include error reduction, an increase of processing speed and productivity improvement and cost reduction, without interruption of ongoing processes and additional expenditures. The goal of this research paper was to answer two research questions regarding the possible use of RPA tool to streamline admission office and what benefits can be gained by it.

As results showed implemented RPA robots increased the processing time of Urkund check and helped to generate Urkund report analysis. It was possible due to high-volume standardized tasks that are rules-driven. Both processes mostly consisted of repetitive tasks performed by humans. Unfortunately, there is no enough information about error rate while these tasks were performed by admission officers, but the fact that these tasks were performed by robots, excludes the possibility of single error or mistake during processing.

There can be identified more robotic automation opportunities not only in the admission process but in the entire back office. It is important that RPA can avoid undesirable human access to sensitive, private data. It is possible because just knowing database structure is enough to build a robot and deploy it even without knowing what kind of data is processed.

This paper also proved that RPA implementation requires less time than back-end solutions, and even using enterprise edition, licensing costs are way less than software development costs.

From the point of view of the author main benefit of RPA is cost reduction, based on processing time decrease it can be assumed that RPA can be considered as one of the best solutions for cost optimization.

5.1. Other robotization opportunities of the admission process.

5.1.1. Mail automation

As it has been shown by the process, as soon as the committee produces its ranking, the admission office sends the corresponding notifications. An applicant may be notified that their application is:

(i) Accepted with a scholarship;
(ii) Accepted without scholarship;
(iii) Admissible but not accepted unless a study place is freed up by a higher-ranked applicant;
(iv) Rejected due to low scores or plagiarism.

This process can be automated with RPA. E-mail texts, in this case, can be mostly static and there are only four varieties of emails. The same logic can be used to automate email notifications in those cases when a deficiency is identified in the application, and admission office has to send emails.

5.1.2. Checking English language test results

As mentioned above, the English language test is verified by the academic officer. For the verification, the web-based interface is used. This process can be handled easily by one or two bots, depends on the task complexity.

Both mentioned tasks can be considered as a potential RPA automation opportunity. Because in both cases process intense is high and even little part of its automation can give reasonable effect.

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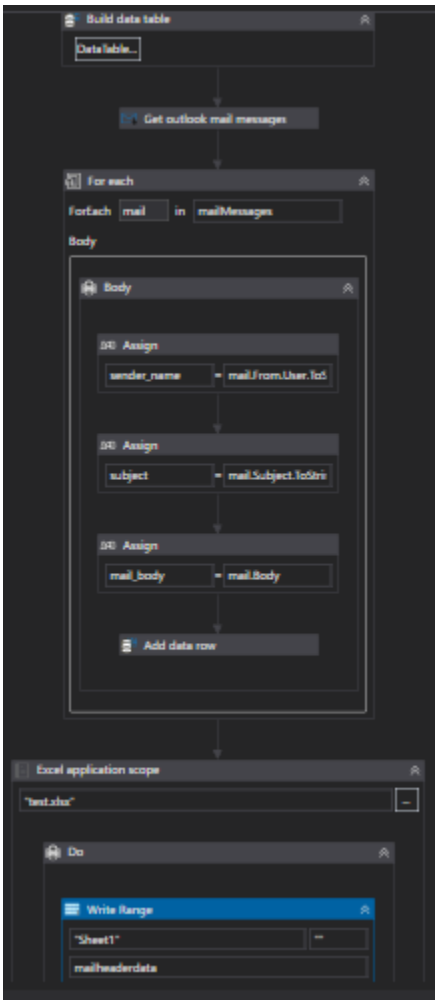
Appendix 1

Third robot (Urkund report generation)



Appendix 2

Simulation Numbers for http://bimp.cs.ut.ee/simulator

First Results

Create Files		
Task Name	**Time (sec.)**	**Std. deviation**
Inter arrival time	1	
1.1. Click DA link from spreadsheet to open DA application;	1	
1.2. Click on motivation letter/letters hyperlink (motivation letters number is equal to the number of programs applicant applied);	2	1
1.3. Copy motivation letters from DA application;	4	1
1.4. Create word/txt file;	2	1
1.5. Paste motivation letter into the file;	1	
1.6. Copy applicant ID from spreadsheet;	2	1
1.7. Paste applicant ID into the file;	2	1
1.8. "Save as" (name of file applicant ID) file;	2	1
1.9. Close file.	1	
Total number of process instances:	474	

Send files to Urkund		
Task Name	**Time (sec.)**	**Std. deviation**
Inter arrival time	1	
1.1. Open new email message;	2	1
1.2. Write/Paste e-mail address;	1	
1.3. Attach file;	2	1
1.4. Send email.	1	
Total number of process instances:	397	

Urkund analysis report		
Task Name	**Time (sec.)**	**Std. deviation**
Inter arrival time	1	
1.1. Open received email;	1	
1.2. Copy applicant ID form received email;	2	1
1.3. Paste applicant ID to a spreadsheet;	2	1
1.4. Copy plagiarism percentage form received email;	2	1
1.5. Paste plagiarism percentage to a spreadsheet;	2	1
1.6. Copy Urkund analysis link form received email;	3	1
1.7. Paste analysis link to a spreadsheet.	2	1
Total number of process instances:	397	

Final Results

Create Files		
Taks Name	**Time (sec.)**	**Std. deviation**
Inter arrival time	1	
1.1. Copy motivation letters from excel report;	2	1
1.2. Create word/txt file;	2	1
1.3. Paste motivation letter into the file;	1	
1.4. Copy applicant ID from excel report;	2	1
1.5. Paste applicant ID into the file;	1	
1.6. “Save as” (name of file applicant ID) file;	2	1
1.7. Close file.	1	
Total number of process instances:	1603(Master program) 511(Bachelor studies)	

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11/08/2019