Robotic Process Automation:
A Lean Approach to RPA

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November 2018

Abstract

Automation is not a new concept in organisations as a way to improve their processes. However, Robotic Process Automation is an emerging form that automates processes with software, which the industry calls robots. These robots perform repetitive and low-complexity tasks previously performed by humans in front of a computer - perhaps the most commonly used feature in a company nowadays. Using the Design Science Research methodology to build up this thesis, it argues that RPA is being used idly compared to what it could be using process improvement techniques before applying the automation itself. Thus, this thesis proposes a new approach to RPA: using techniques of Lean. This thesis assesses two market leaders on RPA, and suggests a framework of activities for organisations that are investing in RPA and that want to take advantage of the capabilities that this technology currently offers. The majority of the proposal demonstration was done in a Portuguese private bank, in three processes. It had an overall positive evaluation in the field or the simulations, depending on the different cases. Comparing RPA and Lean RPA projects in the amount of resources (time, FTE) needed to carry out business processes, the latter approach presented values significantly lower and, consequently, satisfactory.

Keywords: Robotic Process Automation, Lean Management, Lean RPA, Process Automation, Business Processes, Continuous Improvement

1. Introduction

A fourth wave of technological advancement is being witnessed - a new digital industrial technology known as Industry 4.0. Technologies are already positively impacting productivity and employment on large enterprises [17].

That is the path this paper follows. In the enterprise world, there's a ceaseless need of doing more with fewer resources as possible. This objective creates a high demand for continuous improvement in the business' processes of organisations, using rationalisation and optimisation of the resources [12]. Accordingly, this is the beginning point for Robotic Process Automation (RPA).

The term *automation* will be employed as the use of scientific and technological principles to replace business-related tasks, previously done by humans. The term *process* will be used to define a collection of tasks taken in a specific arrangement to achieve a determined output.

1.1. Robotic Process Automation

RPA is an emerging form of process automation, whereas one, or more, software robots perform the exact same procedure as a human would do. The *Robotic* part in the term, only emphasises the idea of a machine doing utilities, instead of a human worker, as in it's not a real physical robot. Robot is the concept used in the RPA industry and it will be the concept used throughout this paper to define the software robot.

By using robots there is a reduced risk for cross-organisations errors, as well as higher availability since robots can work 24 hours a day, 7 days a week and will never get sick or need vacations, bringing faster results. Currently, the tool offers basic digitisation and enhanced digitisation, not being able yet to perform cognitive decision management.

1.2. Lean

The origins of Lean come from Japanese manufacturers, in the 1950s and consists of the following principles: the identification of the value, the elimination of the identified waste activities, the generation of flow, pulling work instead of pushing it, and continuous improvement in the organisation, while reaching a cost-value equilibrium [13].

To progress the reading of this paper, it's necessary to define certain used concepts. *Value* is something the customer is willing to pay for. *Flow* is

used as a concept to describe how work progresses in the system [13]. *Waste* on the other hand, should be considered as everything that does not add value. Waste can be found in any activity of the flow.

1.3. Research Methodology & Paper Outline

The research methodology that is used throughout this work is the Design Science Research Methodology (DSRM) [5]. DSRM aims to solve identified organisational problems by designing and evaluating IT artefacts. It consists of six activities, as seen in the figure 1.

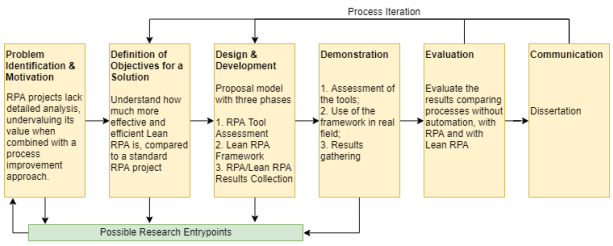

Figure 1: Detailed DSRM for this work. Adapted from [14]

This paper begins with a brief Introduction (section 1), about RPA and Lean. It advances to the discovered Research Problem (section 2). Section 3 is the related work for this paper. In section 4, the Research Proposal and the Objectives are detailed, and its application is described in section 5 (Demonstration). Follows with an Evaluation of the results (section 6) and concludes in section 7.

2. Research Problem

Nowadays RPA is being used as an (almost) instantaneous automation tool because it delivers quick results and doesn't involve changing the already existing underlying computer systems inside organisations [7]. RPA developers don't usually care about optimisation [8], since that as long as it mimics the work that has been successfully done by human workers, the project is sold. But what if RPA technology was more present inside an organisation's processes?

Two of the questions raised in this paper are *how can RPA take advantage of a continuous process improvement approach* and *what is its impact.*

To summarise what has been stated, the main problem found is that *RPA is being taken as a quick fix, existing a lack of detailed processes' analysis, undervaluing its value to organisations when combined with a process improvement approach such as lean.*

3. Related Work

This section presents background information about RPA and Lean tools.

3.1. RPA - Life Cycle

The currently RPA development model widely used is expressed in Fig. 2, obtained from Anagnoste (2018) [1] and Blue Prism's Guide [16]. The maintenance phase is not represented.

Figure 2: Currently most used RPA development model (from [1])

First, there's a gathering of the processes suitable for automation and then it proceeds with choosing one. A specific RPA report from EY [4], enhances three key characteristics for a strong RPA candidate: The *actions need to be consistent*, the process should be *template driven* and *rules-based*. A technical report from Symphony Ventures [2] utters an additional characteristic: must be *raw-based*, i.e. does not require human judgement element.

Next, the goal of Process Reengineering is also to provide a high-level analysis of the process solution, the automation efficiency and estimation of effort [16].

Following the project approval, comes a detailed study, where the RPA developer gets in detail with chosen process. After having a functional documentation and the project plan defined, it is time for building the robot and test it.

There is no average time for the total time of an RPA project since it depends on the selected processes and its business' complexity.

3.2. RPA Tools Available in the Market

For the past couple of years, only Forrester Research [9] is doing research on RPA tools on the market and publicly communicate the results.

According to Forrester Research's RPA Report from 2017 [8] and from 2018 [9], the market leaders are: *Automation Anywhere*, *Blue Prism* and *UiPath*, although currently there exists more than 15 tools.

3.3. Lean - 8 Wastes

Lean tools are known for actively trying to reduce the following eight wastes [19, 10]: *Transporting*, *Excess Motion*, *Waiting*, *Overproduction*, *Unnecessary Inventory*, *Over Processing*, *Defects* and *Skills*.

3.4. Lean - *Kaizen*

Kaizen is a Japanese word that translates to continuous improvement. *Kaizen* consists of small steps for each improvement, whilst the traditional manner mostly improves in substantial form causing high costs and affecting most people in the organisation. Regarding potential and benefits, *kaizen* invokes workers to participate in the upgrade from the

beginning, unlike traditional improvement where the idea to change stays with the organisation top management until it goes live [11].

3.5. Lean - SMART Goals

The appliance of lean tools to a system must have a reason - goals must support that reason. The term *SMART Goals* has been on trend for a long time and literature is abundant about its definition and usage.

Conzemius et al. (2009) [3] define SMART goals to be **S**pecific, **M**easurable, **A**ttainable, **R**elevant and **T**ime-specific.

3.6. Lean - Value Stream Management

Value Stream Management is *a process for planning and linking lean initiatives through data capture and analysis* and consists of a guideline that a company must follow to achieve *lean processes.* Tapping et al. (2002) [18] asserts that the guideline is suitable for office processes - that is, processes that don't produce a physical product but instead provide value to the final customer, through a value stream composed by work units.

4. Research Proposal

In this section, the proposal objectives and the proposal description are defined.

4.1. Proposal Objectives

This section is connected to the "Definition of the Objectives for a Solution" activity of the Design Science Research Methodology.

The primary objective this work aims to achieve is to *understand how much more effective and efficient Lean RPA*[1] *is, comparing to a standard RPA project.*

To help solve that statement, the following sub-objectives must be achieved:

1. *RPA Tools Assessment:* In order to proceed to the next sub-objectives, it's necessary to choose one tool to work with. The two possible tools to work on are two of the current market leaders - BP and UiPath;

2. *Framework for Lean RPA:* This work defends that analysing and changing processes should be taken into account before the development of any RPA project. This being said, a framework that joins both lean and RPA life-cycles must be created;

3. *Collection of RPA/Lean RPA Results:* Gather results of applying both RPA and Lean RPA either in simulation or real-field, in order to compare both approaches, in terms of processing time.

[1] Lean RPA is now the created term for RPA when combined with a lean approach.

Accomplishing these three sub-objectives will provide enough results to answer the primary objective.

4.2. Proposal Description

This section is connected to the "Design & Development" activity of the Design Science Research Methodology.

The proposal model is represented in Figure 3. This model helps to visualise how the solution unrolls, following the previously written three sub-objectives.

The trigger "Desire to Change" is represented only to enhance a beginning. It exhibits the sense of change and innovation that is necessary for processes' improvement projects. If this trigger is neglected, then the following information is meaningless since it is based on continuous improvement.

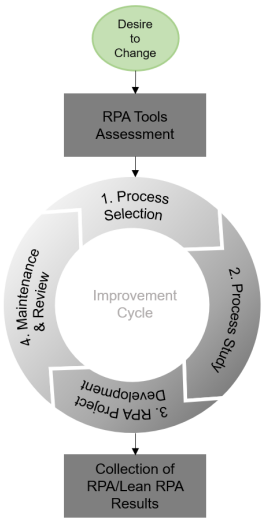

Figure 3: Proposal model

4.2.1 RPA Tools Assessment

Criteria The criteria for assessment was based on the criteria that Le Clair et al. (2018) [8] proposed, but also on ISO/IEC 25010 characteristics [6] that were mapped to RPA:

- *Functional Suitability*: Functional Appropriateness, Third-party Integrations;
- *Functional Efficiency*: Time Behaviour, Error-proofing Mechanisms;
- *Usability*: Previously required programming skills, Overall Usability, and available Training courses;
- *Reliability:* Robustness;
- *Security*: Robots' deployment (Scheduling) and Logs quality;

- *Maintainability:* Re-usability of modules;
- *Portability*: Performance of the program on different information systems (IS) and performance of robots.

4.2.2 Lean RPA Framework - *Improvement Cycle*

The *Improvement Cycle* is detailed on the Figure 4. Each one of the four steps has a set of activities below, that must be completed before moving on to the next step. Those activities should be done in the order they're presented.

1. Process Selection

The first step has activities are very centred on lean principles whilst the decision point starts taking RPA into account.

Lean suggests that defining a value stream (VS) is the initial point for change. Next, processes that belong to the VS should be sorted and one must be embraced to further mapping.

When mapping processes, it's fundamental to be simple, yet detailed. Everyone involved in the process should be able to understand and identify waste tasks, with at least one the eight wastes of Lean.

If the chosen process requires mainly cognitive actions, even after identifying waste to be removed, then it's not suited for RPA and the first step should be repeated. Otherwise it's viable to continue to step 2.

2. Process Study

This step starts with the RPA Analysis activity. It's necessary to assert what RPA can or cannot do in the process, based on the current functionalities it offers. Once that is finished, it's time for defining *kaizen* plans. *Kaizen* is the correct choice here since it incrementally changes the process to consolidate with the RPA solution.

The next activity is mapping the future state. Mapping the future state will help developing the robot, implementing change to the process flow and having the new process documented. Furthermore, after having some documented processes improved by the *improvement cycle*, it might become effortless to find similarities between processes and start standardising it.

Actions that should be redirected to the robot must be stated in the low-level map.

Before the implementation, it's also indispensable to define SMART goals for the project. Without goals, one could not understand if it was successful or not. The goals should also be documented to be revisited later, in step 4.

3. RPA Project Development

It's the step where the process flow changes should occur and the robot should be developed. This step is on constant repetition, so the process doesn't stop working - another reason for *kaizen* plans.

After some iterations of the *improvement cycle*, the developers might notice some similarities between processes/sub-processes. If that's the case, this situation deserves an analysis to see if the used methodology can become a standard for the organisation.

While implementing the robot, standard operation procedures (SOP) and Simulations should be used to observe and test the development. These activities avoid advancing to step 4 with errors and performance issues.

4. Maintenance & Review

After the RPA Project Development, it's necessary to review the goals. For this, one should compare the obtained results with the goals defined in step 2. If the project achieves those goals, the project goes live and a maintenance activity to that project shall be supported from now on. If the project doesn't comply with the goals from step 2, it's necessary to go back to step 2 and check what went wrong.

Finally, the cycle ought to continue, since lean proclaims for continuous improvements.

4.2.3 Collection of RPA/Lean RPA Results

Once the *improvement cycle* has had enough processes, the results for each selected process should be gathered through simulation (for RPA approach) and real-field logs (for Lean RPA approach).

5. Demonstration

This section connects to the "Demonstration" activity of the DSRM.

5.1. RPA Assessment Results

The methodology used to gather information about the selected RPA tools was based on the analysis of the characteristics presented in technical reports by the vendors, Forrester Wave reports [9, 8], participation on official online learning courses, communication with other professional RPA developers, and more than one year of experience developing robots for professional and recreational purposes.

The results are stated below and Table 1 briefly summarises what has been assessed and the prices for each tool, per year. It is assessing UiPath without Orchestrator (no scheduling and additional costs), and without the additional cost of acquiring the development environment (for more $3k).

Table 1 shows that it's safe to assert that UiPath is more adequate for entry-level. It's cheaper and possesses an active online community and free training. However, being BP more robust it's more adequate for processes dealing with audits, frauds situations, etc. It takes longer for a beginner to

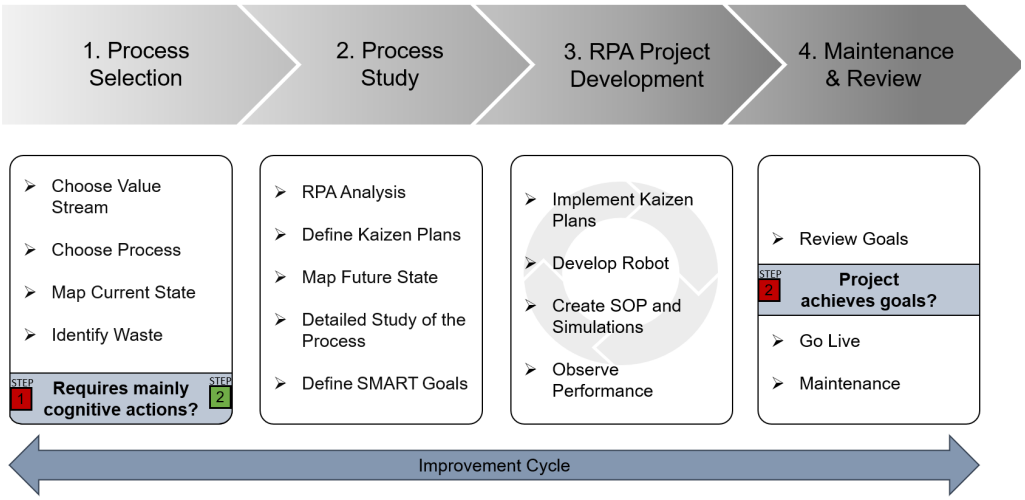

Figure 4: Lean RPA Framework - *Improvement Cycle*

Table 1: Analysis summary for the two assessed tools

Parameters	BP	UP
Functional Suitability	+	++
3rd Party Integration	+	+
Time Behaviour	+	+
Error-Proofing Mech.	+	+
Programming Skills*	-	+
Overall Usability	+	+
Training Courses	+	++
Robustness	++	-
Scheduling	++	-
Logs Quality	++	+
Re-usability	++	+
Performance on Df. IS	+	+
Price per robot	$18k	$6k

learn due to its complexity. Its price is the triple of UiPath's price, but that can be reasoned with the Scheduling feature, which allows robots to work 24/7 for processes that require it.

5.2. Lean RPA framework - *Improvement Cycle*

The demonstration for this sub-objective was performed inside a private Portuguese bank. The information gathering for the following subsections was done not only using indirect and direct observation but also reading documented processes, and questioning employees about their routine at work. RPA was already being used to tackle back-office tasks.

In this demonstration, processes will be modelled using BPMN due to its convenience on understandability and on simulations.

5.2.1 #1 Process

Step 1 - Process Selection

Choose Value Stream: Firstly, it was necessary to assess the value in the bank - banking services. For every bank service it's necessary to open an account. The ABC team is the responsible and seemed a good place to start. The bank has one clear objective: reduce as many FTE from ABC team as possible. The ABC team deals with new accounts and any alterations to accounts that may occur.

Choose Process: There were some chores stated as obnoxious and no one ever wanted to do it. The most cited process was the *DMIF Forms*[2] *Fulfilment*. This process consists of receiving the notification that some customer updated his/her DMIF form and proceed to manually update every form in every account the customer is inserted.

Map Current State & Identify Waste: The process is mapped in Figure 5. The activity in purple is the identified waste. Searching for new DMIF alterations can be considered as *over production*, since sometimes there are no alterations for that day, and time was just wasted in that activity.

Nonetheless, the whole process is mechanical and requires zero cognitive actions. This is directly mapped to the 8th waste of lean, *skill*.

Once settled, the project advanced to step 2 - process study.

Step 2 - Process Study

RPA Analysis & Define Kaizen Plans: Searching for new DMIF alterations is something RPA can easily do. However, the robot was not able to screen-scrape the new answers from the form. This

[2]DMIF Forms are forms that ask customers about their financial experiencie. It's obligatory to be fulfilled for every account and always up-to-date.

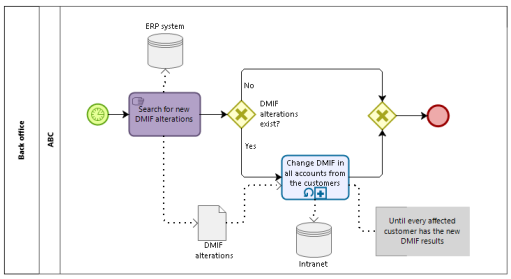

Figure 5: Original DMIF Forms Fulfilment process

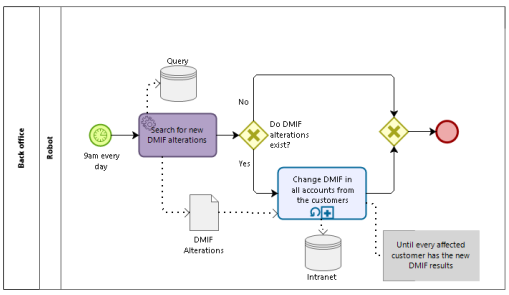

Figure 6: Finished DMIF Forms Fulfilment process, with Lean RPA

was not a satisfactory solution, since it couldn't remove any waste. Knowing RPA current capabilities and limitations, the IT department was contacted to know if there was a database with the answers. It was affirmative, but would take some time to give access to the robot.

The process could not stop working whilst being changed. Thus, the defined plan was to start with the implementation described previously. This way, workers would not waste time searching, because the robot would send an email with the information if there were any alterations. Whenever IT would give access to the database, the rest of the project could continue.

Map Future State & Detailed Study of the Process: The future state is mapped in Figure 6.

The activity "Search for new DMIF alterations" is still considered waste, since there might be no new alterations since the last check. However, it is now attributed to the robot which takes seconds to do. Also, if there are new DMIF alterations, it instantly proceeds to do it.

Define SMART Goals: The robot must be able to perform one instance of the process - from the searching to one DMIF alteration -, in less than five minutes. It's also intended that the *DMIF updates are performed in every customer's account, within twenty-four hours of the original alteration*, from the customer. Additionally, after the final project goes live, the *ABC team can no longer interact with the normal flux of the process.*

Once settled, the project advanced to step 3 - implementation.

Step 3 - RPA Project Development

Implement Kaizen Plans & Develop Robot, Create SOP and Simulation & Observe Performance: First, the ABC team started getting emails from the robot, about any DMIF alterations. With those emails, ABC used the information to update the DMIF.

As soon as the IT department gave access to the database, the rest of the project was developed within one week.

Step 4 - Maintenance & Review

Review Goals: The first and last goal were met, as detailed later in next subsection. For the second goal, it was also met by merely running the robot every 24 hours. Thus, there was no need to regress to step 2.

Go Live & Maintenance: The process went live. This generates logs that are useful for further maintenance (and to obtain results for evaluation).

The first process using the cycle was then seen as completed, and more processes were on the queue for RPA.

5.2.2 #2 Process

Step 1 - Process Selection

Choose Value Stream & Choose Process & Map Current State: The DMIF Forms Fulfilment process reminded ABC team of another search they need to make every day unfailingly.

The bank possesses three types of passwords for accounts. When a customer requests for missing password or wants to change one, a request is generated on the bank's intranet. The ABC team is then responsible for searching new requests and returning them to the customer.

Identify Waste: The identified waste on the process was the *skill* waste, since searching for password requests is direct and mechanical.

This process requires cognitive actions to attribute passwords, however searching for passwords requests is direct and rules-based. Therefore, this sub-process progresses to step 2.

Step 2 - Process Study

RPA Analysis & Define Kaizen Plans: Since the robot was able to search effectively for the DMIF Forms Alterations in the last process, this sub-process is the same procedure but for another type of request.

Map Future State & Detailed Study of the Process: Sending Passwords will now begin its flow with the robot. The robot sends an email for ABC with the requests from the past twenty-four hours,

and the team continues the original flow accordingly.

Define SMART Goals: This sub-process *should take no longer than one minute.* Additionally, *every request should be completed in the following twenty-four hours* (on weekdays).

Step 3 - RPA Development Project

Implement Kaizen Plans & Develop Robot & Create SOP and Simulation & Observe Performance: This sub-process was developed straightforwardly since it only needed to run a query, obtain the results, build a table with the necessary information and send it to ABC, by email. This can become a standard methodology for upcoming similar processes/sub-processes.

Step 4 - Maintenance & Review

Review Goals: The first goal was met, as stated later in the next subsection. The second goal was also met. By sending an email to ABC with all necessary details, it's easier for the team to know how to carry on.

Go Live & Maintenance: The process went live. This generates logs that are useful for further maintenance (and to obtain results for evaluation).

The second process using the cycle, this time simpler but useful, was completed.

5.2.3 #3 Process

Step 1 - Process Selection

Choose Value Stream & Choose Process: According to the first process and bank intentions, ABC team is still the chosen value stream. The ABC team consists of 4 members, and every working hour there must be at least 2 members validating documents. This is because every operation related to accounts requires it. Thus, the next process should be one to relieve this burden.

One of the most prominent processes in the bank is the "Accounts Opening". This sub-process consists of a Portuguese customer entering in one of the bank agencies and proceeding to the open an account with the commercial person. After this, the commercial person sends all documents back to ABC team to validate basic information on them and to open the account.

Map Current State & Identify Waste: The original state is mapped abstractly (high-level) in Figure 7.

In the Figure 7, the waste is represented in purple in the Commercial lane. "Contact customer for missing documents" and "Receive missing documents" are activities of *over processing* and *defects* waste. The commercial person is obligated to repeat the action of digitalising documents and sending them to ABC. The orange activities are the *skill* type of waste.

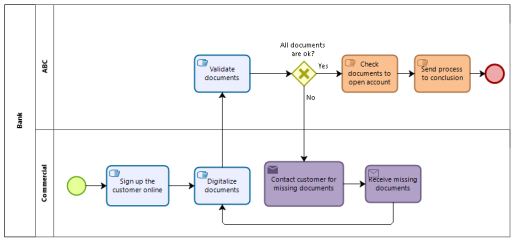

Figure 7: Original "Accounts Opening in the Agency" process

Despite the marked waste activities, there's also *inventory* waste. The bank keeps every document, even what's not necessary to open an account or the customer stops sending the remaining documents, being idle.

Although the commercial part requires cognitive actions, validating documents is straightforward since it's only necessary to read the document and check if it conforms with the rules. Therefore, the project advanced to step 2.

Step 2 - Process Study

RPA Analysis & Define Kaizen Plans: Applying straightforward RPA development to the process would entail ABC's verification for every account, due to today's OCR low reliability. This would not be practical nor reduce any waste. However, checking documents and sending the process to conclusion is accessible for RPA and reduces some working time on ABC team members.

Nonetheless, the process flow needs modifications.

Map Future State & Detailed Study of the Process: The future state is mapped in Figure 8. The most significant change is in the Commercial lane, instead of the Robot.

The commercial checks with the customer for the necessary documents before starting signing up. If the customer doesn't bring the mandatory documents, then it's informed by the commercial person on the missing documents and how to proceed with the signing up.

Afterwards, the robot just needs to open the account by checking the documents and send the opening process to conclusion. As seen, the ABC team is now spared from this process.

Define SMART Goals: This process needs to reduce its average time by half, to spare one FTE. Additionally, after the final project goes live, *the ABC team can no longer interact with the normal flux of the process.*

Once settled, the project was meant to advance to step 3. However it didn't progress any further. The Lean RPA results presented in the next section are obtained through simulation.

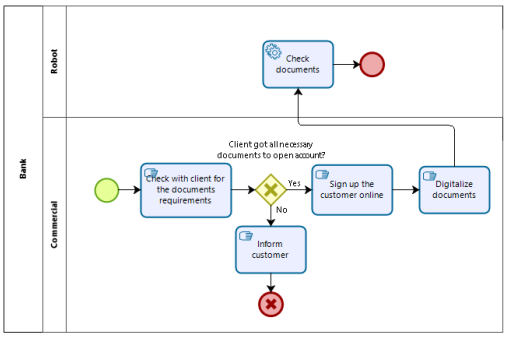

Figure 8: Accounts Opening in the Agency process, with Lean RPA

5.3. Collection of RPA/Lean RPA Results

To collect RPA results, the *only* RPA processes were designed and simulated for twenty-two days (one month). This was also used to collect Lean RPA results from the #3 Process.

The Lean RPA results were collected on the field for one month. Every time the robot would run a certain process (or sub-process) it generated a log with what was done and the processing times.

5.3.1 DMIF Forms Fulfilment Results

Table 2 shows the obtained results from the DMIF Forms Fulfilment process. The written values are the number of minutes wasted on the process, per weekday. Keep in mind that the average of DMIF alterations is four, but this is not a reliable value since the process is initially triggered by the customer and therefore is not constant.

Table 2: DMIF Forms Fulfilment process time results, in minutes per day, without waiting time

Team		Original	RPA	Lean RPA
ABC	Avg	27	19.5	0
	Min	15	0	0
Robot	Avg	-	0.11	0.76
	Min	-	0.08	0.08

5.3.2 Searching for Password Requests (sub-process) Results

Table 3 shows the obtained results from the automated sub-process "Searching for Password Requests". This table doesn't include a column "Process w/ RPA" because investing in automation for a sub-process as simple as this one would not be rewarding. This was only automated because of the lean approach.

Table 3: Searching for Password Requests sub-process time results, in minutes per day

Team		Original	Lean RPA
ABC	Avg	15	0
Robot	Avg	-	1

5.3.3 Account Opening Results

Table 4 shows the obtained results, in the real field (original) and simulation (RPA & Lean RPA), from the Account Opening process. The written values are the minutes wasted on the process, per every new account. Minimum values are ignored for Lean RPA due to the absence of work repetition.

Table 4: Account Opening process time results, in minutes per new account, without waiting time

Team		Original	RPA	Lean RPA
Com	Avg	32	32	36
	Min	27.5	27.5	-
ABC	Avg	12.5	7.87	0
	Min	7.25	5	-
Robot	Avg	-	1.76	0.7
	Min	-	1.76	-

6. Evaluation

This chapter is connected to the "Evaluation" activity of the Design Science Research Methodology.

It follows some of the evaluation criteria proposed by [15], such as *Efficacy, Generality* and *Validity* from the ***Goal*** dimension, and *Utility, Fit with Organisation, Harnessing of Recent Technologies* from the Consistency with organisation criterion, from the ***Environment*** dimension.

6.1. #1 Sub-Objective - RPA Tools Assessment

The bank had already bought a RPA license - UiPath. However, the bank's reasons correspond to the results of the assessment. It was due to its price and overall appropriateness and usability. Therefore, the assessment reaches the *validity* criteria, as it matches with the bank choices.

6.2. #2 Sub-Objective - Lean RPA Framework

Regarding *generality*, it determines how general is the artefact. It's necessary for the proposed framework to have a broader range of possible processes to act on to. The framework was validated in the bank and there were no barriers in any phase. However, it's not possible to guarantee that the evaluation is entirely positive on this criterion because it needs to be tested on more realities.

Table 5: Average time difference (in hours) in one month for each process, without waiting time.

Process	Original Process	Process w/ RPA	Process w/ Lean RPA
1. DMIF Forms Fulfillment	9.9	7.15	0.28
2. Searching for Password Requests	5.5	-	0.37
3. Accounts Opening in Agency	326.3	305.3	269.1

After applying the solution in the bank and getting positive results from the teams involved, the bank will continue using it for its processes' improvement. Consequently, the framework passes the following evaluation criteria: *utility* and *fit with organisation*.

Finally, it arose from the necessity to approach a new technology - RPA - in a different way than the companies have approached. Thus, the framework *harnesses recent technologies*.

6.3. Primary Objective

To recall, the primary objective for the proposal was to understand how much more effective and efficient Lean RPA is, comparing to RPA.

Regarding the *efficacy* criterion, which is the degree to which the artefact produces its desired effect, the table 5 supports the primary objective evaluation.

Table 5 represents the three processes presented in Demonstration (section 5), on monthly average processing time difference. The following table doesn't take into account the waiting time each process has. It's assumed one month equals to 22 working days, that the new accounts average is 20 per day and the average of DMIF alterations is 4 per day.

The sum of all the time saved using Lean RPA instead of normal RPA equals to little over six working days of one FTE for one month (27.39%). Although only three processes were studied, the bank naturally has way more manual and rules-based processes, more specifically the back-office department. Continuing the automation journey, reducing FTE will be organic to the bank. It's adequate to assert that, in these cases, *Lean RPA was more efficient and more effective than RPA*. Efficient because the processes reduced their processing time, and effective because changing processes taking into account RPA current capabilities will reduce any runtime mistakes.

7. Conclusions

Using Design Science Research Methodology, this work proceeded to explain the problem found with the typical RPA implementations and objectives. Being RPA a lightweight technology it is a quick automation that may fix some problems, but its value is being undervaluing by organisations.

To try to prove it, a primary objective has been defined: to understand how much more effective and efficient Lean RPA projects were in comparison to RPA projects.

Primarily, it was necessary to assess an RPA tool. Blue Prism and UiPath were used and put to test. It was concluded that although BP is more robust and reliable, UiPath is the most correct choice for RPA starters due to its functional appropriateness and price. Secondarily, to obtain Lean RPA results, creating a framework to follow its steps was essential. The framework has incremental activities aiming for the participation of everyone involved since the beginning of the project.

To culminate, after applying the first two sub-objectives, the outcome was evaluated with the gathered results. The framework was applied in one bank for three processes and the results were mostly positive. Despite the organic time reduction that RPA projects already secure, every process had a significant reduction on time comparing RPA and Lean RPA. It was also successful concerning its utility since the referred bank has continued following the activities.

Concerning the two asked questions in section 2 (Research Problem): *How can RPA take advantage of a continuous process improvement approach?* and *What is its impact?* Lean RPA takes advantage of a continuous improvement approach by automating and changing processes (and sub-processes) that would not be approached by simply RPA projects since it doesn't fit the typical process choice. The studied processes were of easy and secure development and implementation, whereas other complex processes would take way longer. Due to its price, fast development and effectiveness, Lean RPA projects can change the way processes flow inside an entire an organisation with the right improvements and right thinking on the processes modelling and execution. It does not leverage the overall cost by much, since it uses basic ideas and takes advantage of internal teams help, that already know the processes and workflows.

To conclude the DSRM, the activity Communication is covered by the respective dissertation and this paper, that communicates the results.

7.1. Limitations

This work was limited in terms that it should be tested more and on different realities. Additionally, the proposed Lean RPA framework is not a standalone tool.

7.2. Future Work

The Lean RPA framework needs to be evaluated for its understandability for the users. Future efforts are also required for an improved framework, such as merging Lean with Six Sigma.

Acknowledgements

I'd like to thank my parents for the support. Thank you to my supervisor. To my friends: thank you for never failing to make me laugh. To Pedro, thank you for always believing in me. And finally, thank you to everyone that I met through the development of this work.

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