TENTIVE

Sligro
Sligro Food Group

Research document

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Version

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1.1	03-03-2023	M.G. den Hollander	Finished work on the first sub-question for sprint 1.	Concept
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1.7	12-06-2023	M.G. den Hollander	finished the last research question and rewritten the research structure.	Complete

Table of contents

Introduction

During this graduation internship, there was an opportunity to work on an important assignment for Sligro, for which thorough research had to be conducted to ensure the best possible outcome. This document will provide all of the research subjects and outcomes.

First, the main question is described and the associated sub-questions are described. After this, each sub-question is worked out and describes what research methods were used, which include a combination of the Field, Library, and Workshop strategies. The Field strategy involved conducting interviews with key stakeholders and experts within the company to gather first-hand information on their processes and systems. The Library strategy involved reviewing relevant literature and documentation, while the Workshop strategy allowed for hands-on experimentation and prototyping.

Then the results of the conducted research will be presented, detailing the advantages and disadvantages of the company's current automation techniques, as well as outlining the most efficient and sustainable way to use automation within the company. This information will inform the conclusions drawn in the document, which will be based on a comprehensive analysis of the data collected through the research.

Throughout the research process, various sources have been consulted to ensure that the findings were accurate and comprehensive. These sources included articles, industry reports, company documentation, and expert interviews.

Overall, this document serves as a comprehensive account of the research conducted during the internship with Sligro. The findings and conclusions presented in this document are intended to provide a meaningful contribution to the relevant field of study, and it is hoped that they will be of value to those seeking a deeper understanding of the topic.

Main question & Sub-questions

To provide structure to the research, One main question has been formulated with corresponding sub-questions. The main question can eventually be answered by investigating and answering these sub-questions. The main and sub-questions are presented below.

Main question

For this research paper, the main question is:

- How does the implementation of a new robotic process automation technique ensure that automation is available as efficiently as possible?

Sub-questions

To answer this main question, several sub-questions were formulated and elaborated on for the company:

1. Which techniques are used by the company regarding automation?
2. What are the advantages and disadvantages of these used techniques?
3. What are the key processes and activities that need to be decomposed and analysed prior to implementing a new RPA technique?
4. What steps can be taken to increase the effectiveness of RPA in optimizing the current process and improving efficiency?
5. What is the most efficient and sustainable way to use automation within the company?

Research methods

In order to provide an answer to the above research questions, the DOT research framework (Figure 1) has been utilized. The DOT research framework helps with giving structure to applied research regarding ICT projects[1]. In addition, it helps to determine the most effective methods beforehand and avoid unnecessary research in the future. All of the used methods will be specified for each research question in the following chapters.
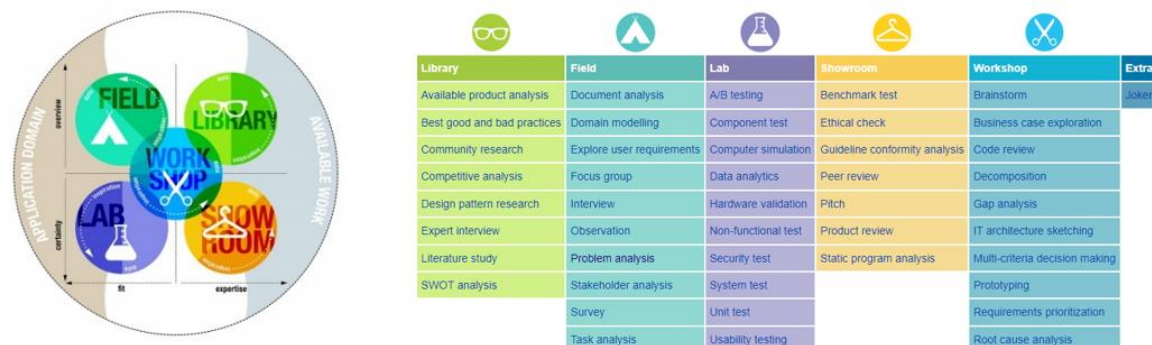

Library	Field	Lab	Showroom	Workshop	Extra
Available product analysis	Document analysis	A/B testing	Benchmark test	Brainstorm	Joker
Best good and bad practices	Domain modelling	Component test	Ethical check	Business case exploration	
Community research	Explore user requirements	Computer simulation	Guideline conformity analysis	Code review	
Competitive analysis	Focus group	Data analytics	Peer review	Decomposition	
Design pattern research	Interview	Hardware validation	Pitch	Gap analysis	
Expert interview	Observation	Non-functional test	Product review	IT architecture sketching	
Literature study	Problem analysis	Security test	Static program analysis	Multi-criteria decision making	
SWOT analysis	Stakeholder analysis	System test		Prototyping	
	Survey	Unit test		Requirements prioritization	
	Task analysis	Usability testing		Root cause analysis	

Figure 1 DOT research framework

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[1] ICT research methods. (2022, June 10). https://ictresearchmethods.nl/. Retrieved February 17, 2023, from https://ictresearchmethods.nl/Methods

1. Which techniques are used by the company regarding automation?

Research methods

The question of which techniques a company uses for automation is an important one that requires a detailed analysis of their current practices. To answer this question, two main strategies will be used: **Field** and **Library**.

The most effective approach would be to use the <u>interview</u> method to better understand the specific techniques used by the company. By arranging an interview with the Product Owner (PO), it would be possible to gain insight into the company's current practices and map out the various techniques being used. This information would then be used to inform further research and analysis.

In addition to the interview method, the <u>document analysis</u> method will be used to gather more information on the company's existing practices. The PO has indicated that the company possesses its own documentation on automation, and is willing to share this. By examining this documentation, it would be possible to gain a more comprehensive understanding of the techniques being used by the company.

Last but not least, a <u>task analysis</u> could come in handy to better understand the flow of automation that needs to be improved. This will help collect information about the tasks the RPA solution will need to perform.

By using the interview, document & task analysis methods, it would be possible to gain a thorough understanding of the techniques currently being used by the company for automation.

Results

Interview

At the beginning of the graduation internship, an interview with the PO at Sligro made it clear which techniques are currently being used to apply automation. During the interview, the PO shared insights into the techniques used at Sligro to automate their processes. This information provides a foundation for understanding how automation is implemented in the organization. To explain the used techniques, it is important to understand the basics of the system.

Sligro currently operates on a system called AS400. AS400[2] is a computer system developed in the late 1980s for companies to run applications and perform data processing. Despite its age, this system is still widely used by companies because it is considered secure, robust, and reliable. Figure 2 shows the graphical user interface of this system. For the scope of the project, it has been agreed that this research specifically focuses on the financial department at Sligro.

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[2] Wikipedia contributors. (2023, February 5). IBM AS/400. Wikipedia. Retrieved February 22, 2023, from https://en.wikipedia.org/wiki/IBM_AS_400

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MAIN                         Hoofdmenu IBM i
                                                    Systeem:    SLIGRO60
Kies een van de volgende mogelijkheden:

     1. Gebruikersfuncties
     2. Office-functies
     3. Algemene systeemfuncties
     4. Bestanden, bibliotheken en mappen gebruiken
     5. Programmeerfuncties
     6. Communicatiefuncties
     7. Het systeem definiëren of wijzigen
     8. Problemen verwerken
     9. Een menu afbeelden
    10. Opties voor AS/400 Information Assistant
    11. Functies voor IBM i Access

    90. Afmelden van het systeem


Optie of opdracht
===> _


F3=Afsluiten    F4=Aanwijzingen    F9=Terughalen    F12=Annuleren
F13=Information Assistant         F23=Beginmenu instellen
(C) COPYRIGHT IBM CORP. 1980, 2018.

MA     A                                            20/007
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Figure 2 GUI AS400

Sligro uses specific tools to automate tasks that would otherwise require an employee to do them every time. Some examples of these tasks include checking for financial mutations, handling errors caused by missing files needed for reports, or converting data from spooled files to PDF files that need to be stored on the appropriate department's drives. They have these tasks performed by a so-called "robot". This robot is simply a type of software recorder that executes the steps one by one on the AS400 itself. While the definition is called a robot, it is important to note that there is no AI/machine learning behind it.

As previously mentioned, the company uses so-called spool files. This comes from the technique of "spooling"[3], in which data can be temporarily stored for later processing. A spool file is a type of temporary data storage that contains data that is queued for processing on a computer system. This can be compared to the operation of a cassette tape. Figure 3 shows what a spool file might typically look like. In principle, anything can be stored in a spool file, but the spool files used during this internship mainly consist of financial data. Due to the sensitivity of the data, no example of such a financial spool file will be given.

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[3] International Business Machines Corporation (IBM). (2021, April 14). Spooled files. https://www.ibm.com/. Retrieved February 22, 2023, from https://www.ibm.com/docs/en/i/7.1?topic=concepts-spooled-files-output-queues

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                    EEN SPOOL-BESTAND BEKIJKEN
Bestand . . . . :    QPJOBLOG              Pagina/regel :   1/1
Stuurtekens . . :    _____              Kolommen . . :   1 - 78
Zoeken . . . . :     _____
*...+....1....+....2....+....3....+....4....+....5....+....6....+....7....+...
 5770SS1 V7R4M0 190621                     Taaklogboek
   Taaknaam . . . . . . . . . :   NPADEV000B   Gebruiker . . . . :    HOLLA
   Taakbeschrijving . . . . . . :   DBATCH      Bibliotheek . . . :    QGPLS
BERICHT-ID TYPE                   SEV  DATUM    TIJD           VAN PGM
CPF1124    Informatie             00   09-03-23 11:58:11,440119 QWTPIIPP
                                  Bericht . . . . :   Taak 780230/HOLLANDM/
                                   11:58:11 in subsysteem QINTER in QSYS.
                                   11:58:11.
CPF9801    Escape                 40   09-03-23 11:58:11,463268 QLICKOBJ
                                  Naar module . . . . . . . . :    ALC220CL
                                  Naar procedure . . . . . . :    ALC220CL
                                  Instructie . . . . . . . . :    7000
                                  Bericht . . . . :   Object T#QQ780230 in
                                  Oorzaak . . . . :   object T#QQ780230, ty
                                   gevonden.  De naam van het object, de n
                                   object is onjuist.  Als er geen bibliot
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Figure 3 Example spooled file

To dive deeper into the automation tool, the current documentation provided by the company was examined. From this, it was revealed that the tool is provided by a software vendor called Kofax. Kofax[4] is a company that specializes in Robotic Process Automation (RPA) and offers tooling such as recording software. Officially called information-capture software, it serves as a type of screen recorder in the case of Sligro, enabling actions to be automated. Kofax has a design studio, as seen in Figure 4, which makes it very easy to automate processes based on a graphical user interface. On this platform, all robots can be viewed, and all the steps that the robots make are recorded.

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[4] Kofax. (n.d.). Kofax RPA. https://docshield.kofax.com/. Retrieved February 22, 2023, from https://docshield.kofax.com/RPA/en_US/11.0.0_qrvv5i5e1a/help/kap_help/c_welcomegeneral.html
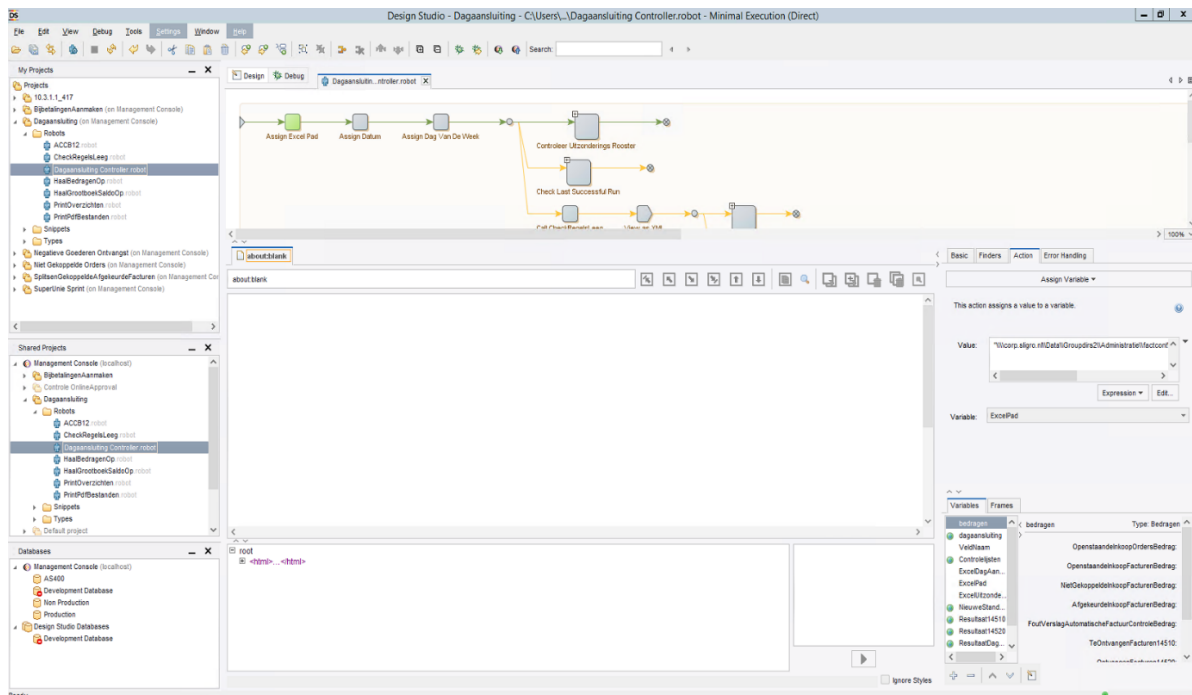
Figure 4 Kofax Design Studio

In addition to Kofax's design studio, the robots also need to run at specific times. For this purpose, there is a special scheduler tool called the Kapow Management Console. As shown in Figure 5, the robot that is studied during this internship is set to run every Monday between 7 and 8 in the morning, and every Tuesday to Sunday between 7 and 7:30. In this console, the robot can also be manually started if it does not start on its own.

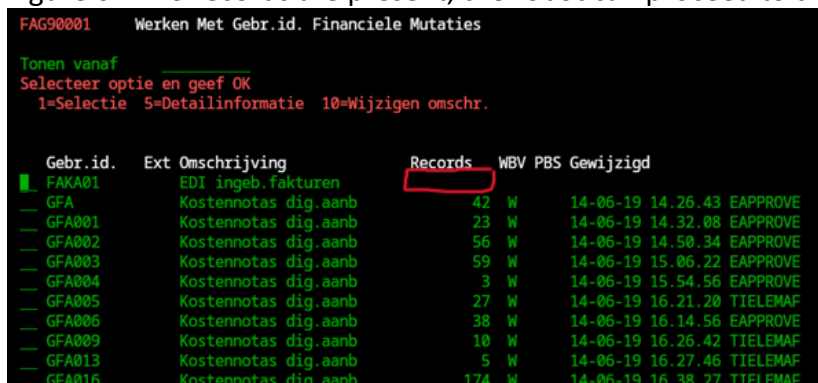| Active	Name	Project Name	Job Count	Next Run	Previous Run	Interval	Total Runs	Delete	Edit	Run / Stop	Errors	Robot Errors
✓	Elke 15 minuten op maandag tussen 700u en 800u	Dagaansluiting	1	2023-03-20 07:00:00	2023-03-13 07:45:02	Cron: 0 0/15 7 ? * MON	120			▶	0	0
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	Elke 15 minuten op maandag tussen 6:30u en 7:00u	Dagaansluiting	1	2023-03-20 06:30:00	2022-10-10 07:38:47	Cron: 0 30/15 6 ? * MON	2			▶	NA*	NA*

Figure 5 Kapow Management Console

Task analysis

To gain a better understanding of all the tasks performed by the robot, a task analysis was conducted to examine all the steps the bot executes on the AS400. The steps could be derived from the design studio. As said earlier, the robot runs every Monday between 07:00 and 08:00, and every Tuesday to Sunday between 07:00 and 7:30. It runs for exactly fifteen minutes. Originally, it ran for 10 minutes, but because the tasks became larger, it had to be extended to 15 minutes, otherwise, the bot would stop before all the tasks were completed.

The tasks performed by the bot are as follows:
- Logging in on the AS400.
- Checking for any unprocessed financial mutations. The robot accomplishes this by verifying whether certain records are empty or non-existent. This can be seen in Figure 6. If no records are present, the robot can proceed to the next task.

Figure 6 Empty Records

- If there are any unprocessed financial transactions, the robot will send an error message via email to the responsible parties (see Figure 7). The robot will then continue to check every 15 minutes between 7:00 and 8:00 a.m. to see if the records have been processed. If the outstanding records are not processed by 8:00 a.m., the robot will need to be manually restarted or the tasks will have to be done manually.

Figure 7 Error handling

- Once all financial mutations are processed, the robot moves on to "printing" necessary documents. It's important to note that these documents are not actually printed by a physical printer, but are converted to spool files on the server. Some

examples of printed documents include outstanding purchase orders and purchase invoices. Once this data is converted, the robot can move on to the next step. An example of this step can be found in Figure 8, where such a document is printed.

Figure 8 Printing documents

- In this step, the robot retrieves data from the previous step and places it in an Excel document. By setting up rules, the robot knows exactly which line in which spool file to search for the correct data. Figure 9 shows that the numbers in the Excel document are obtained from various overviews, with the highlighted blue lines being the list overviews from which the robot precisely retrieves the data, and the light orange ones being the calling procedures.

OVERZICHTEN CONTROLELIJSTEN 2022

Datum	Saldo afgekeurde inkoopfacturen	Saldo niet gekoppelde inkoopfacturen	Foutverslag	Totaal	Saldo openstaande inkoopfacturen
16-aug-22					
17-aug-22					
18-aug-22				0,00	
19-aug-22	BST071P-4	BST071P-2	BST421P	#WAARDE!	BST071P-1
22-aug-22				0,00	
23-aug-22	ACCC07	ACCC05	ACC10S	#WAARDE!	ACCC03
24-aug-22			JOBSCDE	#WAARDE!	

Figure 9 Moving data from physical file to Excel

- In the final step, the robot digitizes several lists from a spool file to a PDF file and then is sent to the hard disk of the appropriate department. Specifically, this concerns the lists "Outstanding purchase invoices" and "Overview of outstanding purchase orders". Figure 10 shows the result of this action.

Figure 10 Digitized files sent to the right department

Activity diagram

To provide a clear overview of all the tasks mentioned above, an activity diagram has been created using the principles of Lucidchart[5]. This diagram, which can be found in Figure 11, visually represents the flow of the robot's activities from start to finish. By using this diagram, it becomes easier to understand the different steps involved in the process and how they are connected. The diagram serves as a helpful tool for those involved in the development and maintenance of the robot, allowing for a better understanding of the entire process and facilitating any necessary adjustments or improvements.
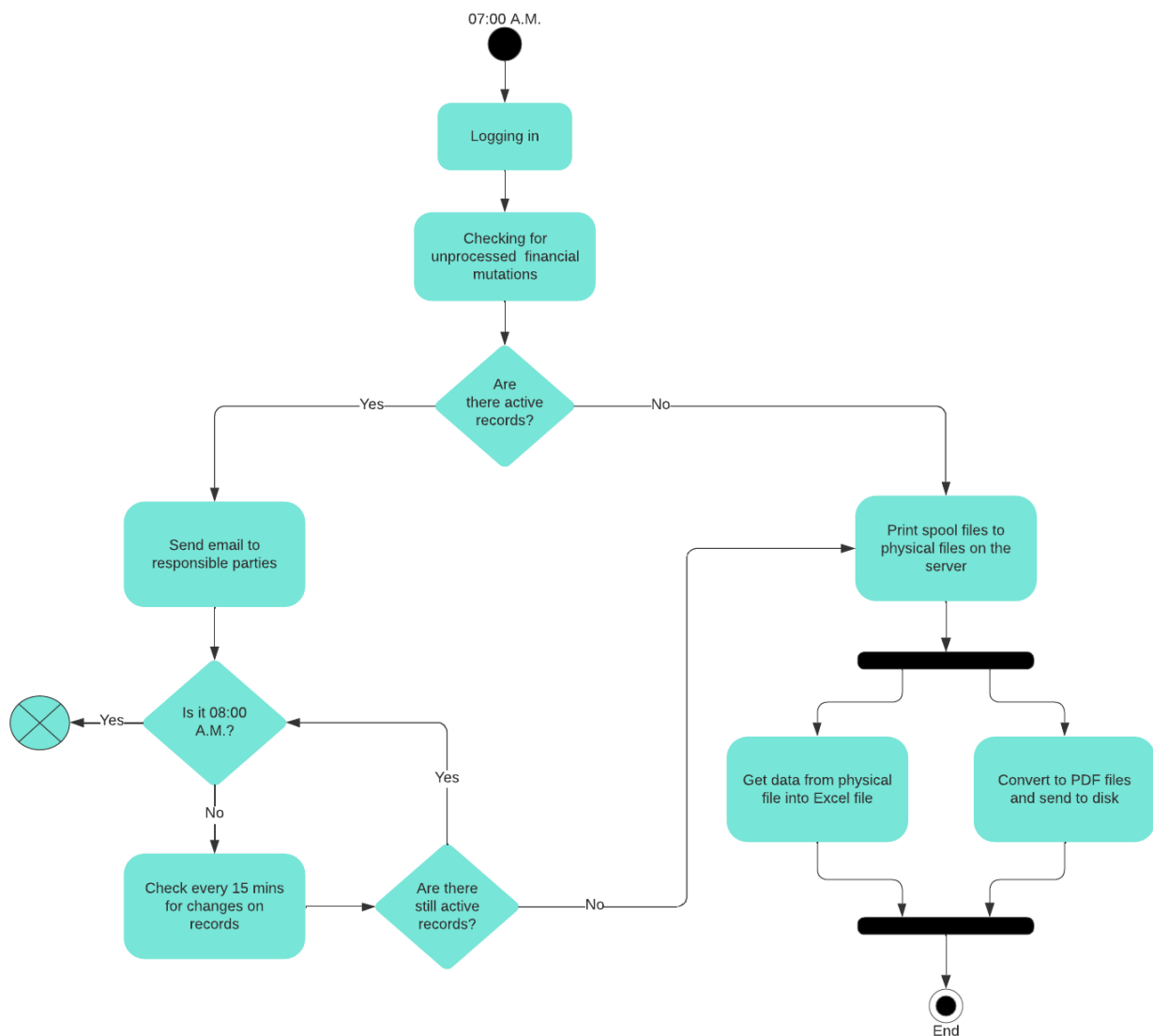

Figure 11 Activity diagram of the robot

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[5] UML Activity Diagram Tutorial. (n.d.). Lucidchart. Retrieved February 23, 2023, from https://www.lucidchart.com/pages/uml-activity-diagram

Conclusion

The research conducted on Sligro's automation techniques provided valuable insights into the company's practices. Through interviews, document analysis, and task analysis, a comprehensive understanding of the automation tools and processes employed by Sligro was achieved.

The interviews with the Product Owner revealed that Sligro uses a software recorder from Kofax RPA, referred to as a "robot," to automate tasks within the AS400 system. These tasks include checking for financial mutations, error handling, document printing, data extraction into Excel, and digitizing files into PDF format.

The examination of documentation uncovered that Sligro utilizes Kofax's software, specifically the Design Studio for process automation and the Kapow Management Console for scheduling the robot's operations.

Task analysis provided a detailed breakdown of the robot's activities, which involve logging in, checking for unprocessed mutations, error handling, document printing, data extraction, and file digitization.

2. What are the advantages and disadvantages of these used techniques?

Research methods

Analysing the advantages and disadvantages of the company's automation techniques is a crucial step in understanding the current state of automation and identifying potential areas for improvement. To answer this question, several strategies will be used, including **Field** and **Library** methods.

This sub-question can partially be answered by the interview of the previous sub-question. That interview can provide valuable insights into any problems or issues that the PO may have encountered with the current automation techniques.

Additionally, the <u>best good and bad practices</u> method can be used to evaluate the effectiveness of the company's current automation techniques. This method involves analysing the company's existing practices and comparing them to industry best practices. By doing so, it is possible to identify areas where the company is excelling or struggling with its automation techniques.

Furthermore, the <u>problem analysis</u> method can be used to investigate why the company believes that its automation techniques are not currently optimal. By examining the underlying issues and challenges, it may be possible to identify specific solutions and strategies for improvement.

By combining these methods with the information gathered from the previous sub-question, it is possible to provide a comprehensive analysis of the advantages and disadvantages of the company's current automation techniques. This analysis can inform potential strategies for improvement and help the company to optimize its automation techniques to better meet its needs.

Results
Interview

This sub-question was partly answered by the interview conducted in the first sub-question. That interview revealed that the robot does not always work properly. Sometimes, the robot needs to be manually started instead of working automatically every day. It is still unknown why the robot does not start on its own, and it requires extra unnecessary work from the staff to manually start the robot. Additionally, looking at the activity diagram from the first sub-question in Figure 9, it can be seen that when there are still active unprocessed financial transactions, the robot should send an email to the appropriate people so that these transactions can be processed. If this is still not done after 8 am, then the robot stops completely with its process, and the robot will need to be manually started again later, or the "dagaansluiting" needs to be made manually. This is more related to the process than to the disadvantages of the technology used but is still essential to remember for the prototype that will be developed for Sligro.

Kofax RPA provides several advantages to businesses that need to automate their processes. One of these benefits is its user-friendly design studio, which allows for easy mapping of all the necessary steps the robot needs to perform on the AS400 via a user interface. This studio functions as a software recording tool that saves the company time by eliminating the need to write scripts.

The user-friendly interface of the Kofax RPA design studio makes it possible to create robots easily, without requiring extensive technical knowledge or expertise. The recording tool automates the process, eliminating the need for manual intervention, which results in a more efficient process.

Additionally, Kofax RPA enables Sligro to save a considerable amount of time and money. By automating several steps in the process, the solution eliminates the need for manual data entry, which can be tedious and prone to errors. Automation saves time, as robots can perform tasks in a fraction of the time it would take humans to complete them. The solution also reduces costs by minimizing the need for human intervention, which again reduces the risk of errors and the need for additional resources. This solution saves about 4 full-time employees' work, which would otherwise have to perform these tasks manually according to the PO.

Overall, the Kofax RPA solution is an effective tool to automate their processes. The user-friendly design studio, coupled with the software recording tool, simplifies the automation process and eliminates the need for extensive technical knowledge. The automation of several steps saves time, money, and prevents errors making it a valuable investment for improving their processes.

Best good and bad practices

To better understand the pros and cons of the used techniques, it's important to compare them with those applied by other companies. This creates room for potential improvements since it has been proven to work at other companies. That being said, it is important to note that copying the exact same process/practice may not always be the best approach. Each company has unique requirements and challenges, and it is important to tailor the technology to fit those specific needs. However, taking inspiration from successful implementation in other companies can provide valuable insights and ideas that can be applied.

Prior to implementation, choosing the wrong platform can be considered a bad practice[6]. This is often the case when companies lack knowledge about the processes that need to be automated, but it can also be driven by cost considerations. As a result, they end up with a platform that does not fully meet their requirements, or they choose a vendor that does not provide sufficient support to their customers. It seems that this is not the case with Sligro. The vendor provides support, and the platform seems to meet all of the company's requirements. The only problem is that it has not received any maintenance from any of the involved parties, which can cause problems to occur.
In addition to other bad practices, it is also possible that the processes that need to be automated are not optimally configured. This is also the case with the "dagaansluiting" robot when looking back at the activity diagram. It can be seen that the process simply stops when there are still active mutations, while the company would prefer error messages to be built in and the robot to continue with its tasks. In this case, the process is also not optimal.

When implementing Robotic Process Automation (RPA), it is important to follow good practices to ensure success. One such practice is creating a process design document, which makes the processes transparent by outlining the steps, time estimates, and all scenarios that can occur in the process. Sligro has taken this into account by outlining scenarios and steps in their process design document.

Another important practice is building in error handling and logging for each workflow[7]. Error handling saves a lot of time in debugging problems, and logging provides valuable information for troubleshooting. While Sligro has implemented logging in their RPA, they could improve error handling as the robot sometimes fails to start its tasks without indicating the issue.

This comparison highlights that the process can be improved by adjusting the steps that the robot performs, and that error handling should be better utilized in the future. By implementing these good practices, RPA can be optimized, leading to more efficient processes and significant time and cost savings.

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[6] Kaur, J. (2022, December 15). Understanding Best Practices of RPA and its Challenges. XenonStack. Retrieved March 15, 2023, from https://www.xenonstack.com/insights/best-practices-of-rpa-implementation
[7] Cullen, K. (2022, December 13). Eight best practices for RPA developers. www.cai.io. Retrieved March 14, 2023, from https://www.cai.io/resources/thought-leadership/eight-best-practices-for-rpa-developers

Problem analysis

To ensure that all problems with the current techniques are clear, a problem analysis has been performed. Through this analysis, there is certainly a thorough understanding of the problems that exist, which helps in developing an effective solution. According to the research framework, this analysis can be carried out by asking questions such as Who, What, Why, When, and How. In this way, the problem with the robot will be presented below:

Who: Who has this problem?
In this case, the problem at hand belongs to Sligro, specifically their IT department because they manage the robot and all of the systems, but it indirectly affects the Finance department for which this robot was created.

What: What is the problem?
The problem at hand is that the robot is not functioning properly. Specifically, it sometimes fails to initiate the tasks it needs to perform at the designated time and needs to be manually started. Additionally, the robot stops its process when there are still outstanding financial transactions to be processed. Furthermore, there is a lack of error handling when the robot encounters certain problems, such as missing documents that it needs to check.

Why: Why is it a problem?
It is considered to be a problem by the company because the robotic process automation they have implemented is not functioning as it should. It takes time to maintain and manually restart the robot, it costs money because it comes from a software vendor, and it requires resources on the server where the robot is hosted on. It is important to note that this is the first robot written for Sligro approximately 10 years ago and has not received any maintenance since then. Additionally, it is considered very frustrating when the robot fails to report any error messages, causing the user to go through a lot of hassle to determine where the problem occurred.
Overall, the robot's malfunctioning creates inefficiencies and costs for the company, and the lack of error handling makes it difficult for the IT department to quickly resolve issues.

When: When does the problem occur?
The problem occurs when the robot is supposed to start automatically at 7:00 am. Sometimes, the robot does not start its process at all, or it crashes during tasks it needs to perform, but it can also get stuck when required documents are missing. The robot works every Monday between 7 and 8 in the morning, and every Tuesday to Sunday between 7 and 7:30. It runs for exactly 15 minutes in that period. This duration was extended from 10 minutes to 15 minutes because more tasks were added. If the robot takes longer than the pre-set time, the process also stops.

How: How does the problem arise?
To identify how the problem occurred, it is important to dive into the logging of the robot and look for unusual events. The PO shared a .csv file containing all the robot's logging from the past few months. Since this is a massive file with 7000 log lines, a specific date was selected when the robot got stuck on a particular process to better search through the logs.

This narrowed it down to approximately 140 log lines to investigate. As shown in Figure 12, Excel was used to search for error messages in the log lines to make it easier, and 3 important things were identified.

In this particular case, the robot appears to be experiencing problems with a specific exception called "IncorrectValueIssue." This exception is causing the robot to get stuck, preventing it from completing its assigned task. It is unclear what is causing this exception or how it can be resolved.

Furthermore, the red section highlights that the robot appears to have stopped altogether after encountering the previous exception. This suggests that the robot may not be able to recover from such errors and may require manual intervention to resume its operations.

The fact that the robot attempted to execute the process three times on the same day suggests that the issue may be persistent and not just a one-time occurrence. This could indicate a more significant problem with the robot or the process it is trying to execute.

Finally, the blue section indicates that the process itself is experiencing problems. It is unclear what these problems are, but they may be related to the issues the robot is encountering.

Figure 12 Robot logs

Together with the product owner, the design studio of the robot was reviewed to check the steps that the robot follows, but it was not possible to identify exactly why the robot is getting stuck. There is no clear explanation for why the robot sometimes stops on its own without providing any useful information about the issue. Kofax, the vendor of the RPA platform, was contacted to see if they can provide an explanation for this error message.

It took a few weeks before they came up with an explanation, but it comes down to the fact that the robot cannot find a file in the location indicated for it. The value "IncorrectValueIssue" apparently indicates that there is an incorrect value because the file does not exist where the robot is searching for it. Unfortunately, this cannot be sent as a proper error message to the people who need to solve it.

Conclusion

In conclusion, the research has provided insights into the advantages and disadvantages of Sligro's automation techniques. The advantages include a user-friendly design studio, time and cost savings, and increased efficiency. However, there are challenges related to unclear robot malfunctions, lack of error handling, and process limitations. These issues hinder the seamless functioning of automation. It is crucial for Sligro to address these challenges to maximize the benefits of automation and overcome its limitations. By resolving robot malfunctions, implementing effective error handling mechanisms, and refining the automation process, Sligro can enhance its automation techniques and achieve improved efficiency in its operations.

3. What are the key processes and activities that need to be decomposed and analysed prior to implementing a new RPA technique?

Research methods

It is important to map out all the processes and activities that the RPA solution must perform. To achieve this, two main strategies are used: **Library** and **Workshop**.

Specifically, <u>document analysis</u> is used to examine the documentation provided by the company to identify all the processes. Additionally, <u>decomposition</u> is used to break down the complex system into smaller parts, ensuring its maintainability and robustness.

Lastly, it is important to conduct <u>requirements prioritization</u> to prioritize which requirements need to be implemented first, which will ensure smooth execution of the final research question.

Results

Document analysis

For the first research question, the activities and processes that need to be automated were identified through interviews and a task analysis of the robot. Additionally, it is important to review the available documentation from the company to ensure that there are no processes or activities overlooked. To avoid repetition from the first research question, the activities are summarized below, which clearly show what the RPA solution should be able to do.

The process that will be automated is called "dagaansluiting," which is a specific process set up for the finance department of Sligro. It is the only process that the robot currently executes and will be the only process that the RPA solution will automate itself. The process involves creating various reports related to financial transactions, rejected and outstanding purchase invoices, and other relevant financial information. These reports help the department create a clear overview of its finances, making this process crucially important.

The activities in the process are listed below in chronological order:
1) Checks:
    a) Checking for unprocessed financial transactions
        i) ID "GOON001" should not contain any records
        ii) ID "FAKA01" should not contain any records
        iii) ID "FAKA02" should not contain any records
        iv) ID "AUTF01" should not contain any records
    b) Error handling if there are unprocessed transactions from the records above
2) Printing of documents:
    a) Printing of outstanding purchase orders
    b) Printing of outstanding purchase invoices
    c) Printing of unlinked purchase invoices
    d) Printing of rejected invoices

3) Retrieval of data:
   a) Processing in Excel tab "dagelijkse aansluiting"
      i) The balance of rejected purchase invoices
      ii) The balance of unlinked purchase invoices
      iii) The error report
      iv) The balance of outstanding purchase invoices
   b) Processing in Excel tab "14510 Te Ontv. Fakt."
      i) The balance of invoice control
      ii) The new balance of account 14510
      iii) The balance of outstanding purchase orders
   c) Processing in Excel tab "14520 Ontv. Fakt."
      i) The balance of approved invoices
      ii) The new balance of account 14520
      iii) The balance of outstanding purchase invoices
4) Digitizing lists:
   a) Converting to .pdf and sending the "BST071" list
   b) Converting to .pdf and sending the "BST028" list
   c) Renaming both lists and placing them in the correct folders

The details in this process are quite technical and specific, but to summarize this, the four main steps in this process; the checks, printing of documents, retrieving data, and digitizing lists, must also be able to be performed by the RPA solution. This list will help to set up the requirements for the RPA solution. It is important to note that out of step 3, only the "dagelijkse aansluiting" will be created. This has to do with time and prototyping limitations. All of the other tabs will work in the same way as the "dagelijkse aansluiting", so nothing will be missed.

Decomposition

A functional decomposition has been created for the process that the robot performs. "Functional Decomposition is the process of breaking (or decomposing/splitting) a bigger/complex task into its simpler constituent parts in such a way that the original/main function can be constructed (recomposed) from those parts"[8] (*Learn About Functional Decomposition | Chegg.com*, n.d.). This approach is based on the document analysis carried out in the previous chapter, which provides an overview of the process and its functionalities. An alternative solution must be able to execute these functionalities as well. The functional decomposition is based on the principles of the DOT framework, and its outcome can be seen in Figure 13.
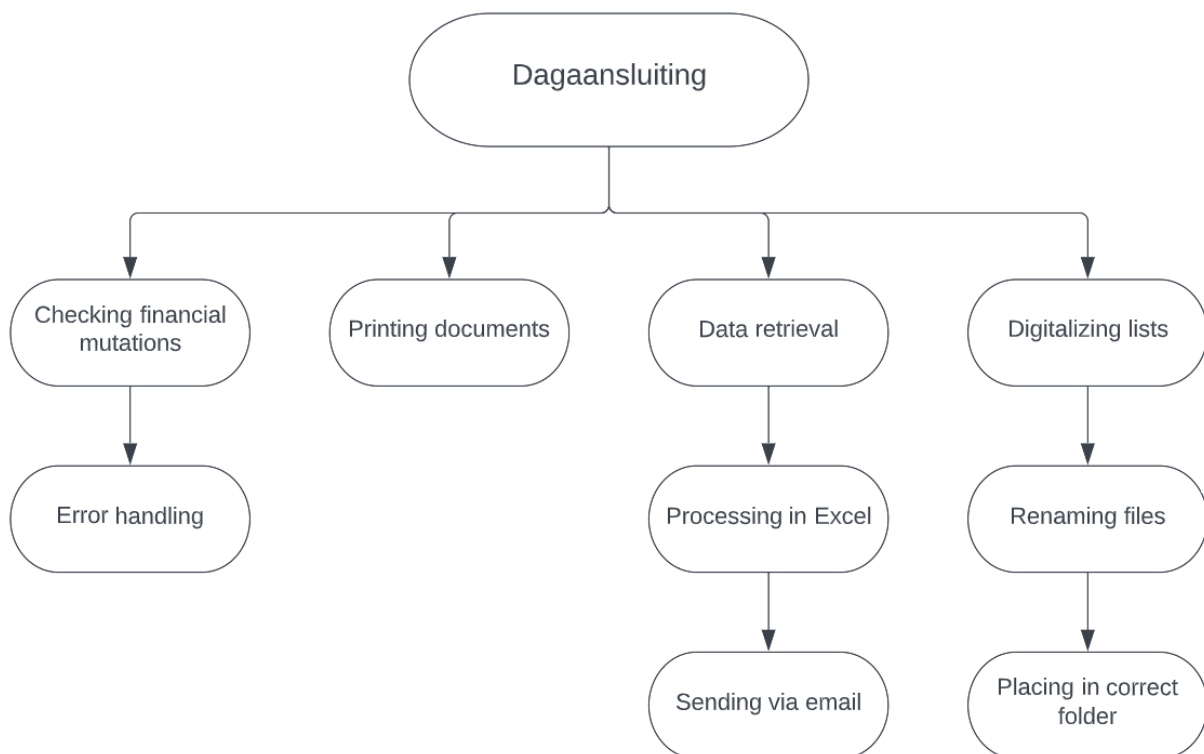
Figure 13 Functional Decomposition Diagram

Requirements prioritization

To determine which requirements should be implemented first for the RPA solution, it is important to make a list of all the requirements. For this purpose, an analysis document has been created which can be found in this portfolio. These requirements have been gathered through interviews and observations, providing a good understanding of the needs. To prioritize these requirements, the well-known MoSCoW-method[9] has been utilized.

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[8] Learn About Functional Decomposition | Chegg.com. (n.d.). Chegg.com. Retrieved March 30, 2023, from https://www.chegg.com/learn/topic/functional-decomposition

[9] Wikipedia contributors. (2022, December 20). MoSCoW method. Wikipedia. Retrieved March 22, 2023, from https://en.wikipedia.org/wiki/MoSCoW_method

Conclusion

Through document analysis, the activities and processes requiring automation were identified, specifically focusing on the "dagaansluiting" process which is vital for Sligro's finance department. The activities within this process were listed, including checking for financial mutations, printing of documents, data retrieval, and digitizing lists.

By using functional decomposition, a breakdown of the process functionalities was achieved, providing valuable insights for developing an alternative RPA solution. The outcomes of this research question were incorporated into the analysis document, which can be found in the portfolio. The MoSCoW method was utilized to prioritize the requirements, ensuring that critical requirements are implemented first.

4. What steps can be taken to increase the effectiveness of RPA in optimizing the current process and improving efficiency?

Research methods

The question of how automation can improve efficiency within the company is a complex one that requires a thorough analysis of the current state of automation and potential steps/strategies for improvement. This question can be approached with the answers to the previous sub-question, because of the disadvantages of the current way of automation. These disadvantages can be examined, and help identify areas where optimization is needed and the current process can be improved which helps as a preparation for the final research question. The strategies used for this question are **Field** and **Lab**.

In this case, additional <u>document analysis</u> could be used to gather more information on how automation is currently being utilized and where there may be room for improvement. By examining this, it may be possible to identify areas where automation could be optimized to improve efficiency and productivity.

Finally, it is important to conduct a <u>system test</u> on the current system so that any errors in the process can be identified, and a clearer picture can be formed of how improvements can be made with a new technology. The test can identify any issues or bugs that the current technique has, which could provide valuable insights into the areas that require improvement.

Results

Document analysis

By examining the available documents from the company and results of previous research questions it is now clear that there are several areas in the robotic process automation to improve effectiveness. When the effectiveness of the robot is inspected, it is clear that it simply does not always perform optimally. Next to that, it is difficult to debug problems and it is indicated that error handling is not customizable. This indication suggests that it is wise to look at other solutions to improve efficiency.

To address these issues, several possible steps can be taken to increase the effectiveness of RPA in optimizing the current process and improving efficiency. First, it is important to identify and address any technical issues that may be preventing the bot from performing optimally. This may involve upgrading software or hardware or developing new scripts or programming techniques to improve performance.

Ensuring that the RPA software remains up-to-date is essential for efficient performance. Although software updates are possible, the Kofax design studio unfortunately has limitations that affect error handling capabilities. During the system test, the need for hardware upgrades becomes evident.

In addition, it may be useful to explore other approaches to automate the current process which will include error handling and problem solving. The company could benefit from

seeing other techniques in action which can also perform the tasks that the robot performs. As long as it helps make the current process more effective, and is more reliable. Because of this, an MVP will be created that will run next to the robot, to compare how they both handle their tasks. This could prove that there are other more viable solutions possible for Sligro. The last research question will address this MVP.

Another important consideration is the sustainability of using automation within the company. This involves not only optimizing the performance but also ensuring that it is integrated smoothly into the existing process and that it can adapt to changing requirements over time. The process has one flaw at this moment which makes automation a bit more difficult. That flaw is that the process currently stops when there are still active financial mutations after 8 in the morning. When there are active financial mutations, the report for the "dagaansluiting" can't be created which means the whole process comes to a stop. As that is not the ideal outcome, there will be advice written down in the Advice document about this topic.

System test

A system test plays a crucial role in identifying areas for improvement within the RPA implementation at the company. Through thorough analysis of the process and insightful discussions with the product owner, it became apparent that certain enhancements could be made. However, to ensure a comprehensive evaluation and avoid overlooking any potential issues, conducting a system test is also important.

The objective of the system test is to manually initiate the robot and subject it to various scenarios. The aim is to validate the successful execution of all activities identified during the document analysis phase. This contains testing both good and bad flows, such as simulating the absence of a required document in the process. Unfortunately, the company has indicated that the robot is not currently operational in the test environment, thereby rendering a complete system test not possible, because testing in the production environment is not allowed. This limitation will be addressed and highlighted in the upcoming Advice document.

Regarding performance considerations, the product owner reassured that the hardware infrastructure is more than capable of supporting the robot's operations effectively. However, an issue arose on Tuesdays when a separate process with significant resource demands was scheduled, resulting in the robot experiencing crashes. To overcome this challenge, a resolution was implemented by rescheduling the resource-intensive process to earlier on Tuesday mornings. This adjustment ensured that the robot's operations remained stable and uninterrupted.

Due to the unavailability of the robot in the test environment, the scope of the current system testing was limited to verifying the proper execution of steps within the Kofax Design Studio, as seen in Figure 4. From walking through these steps, no underlying issues could be found. Unfortunately, this restricted testing scope prevented the examination of both good

and bad process flows. While this is regrettable, it underscores the importance of addressing the unavailability of the robot in the test environment.

In summary, while the system test was unable to be fully conducted due to the unavailability of the robot in the test environment, efforts were made to assess the functionality within the Kofax Design Studio. The limitations encountered underscore the necessity of rectifying the robot's unavailability to conduct a comprehensive evaluation of the system's performance under various scenarios. These insights will be documented in the upcoming Advice document, emphasizing the importance of conducting thorough testing to identify areas for improvement and ensure the robustness of the RPA implementation at the company.

Conclusion

To increase the effectiveness of RPA in optimizing the current process and improving efficiency, several steps can be taken based on the research findings. Firstly, it is important to address technical issues that hinder the robot's optimal performance by upgrading the software or implementing new scripts or programming techniques. Exploring alternative approaches to automation that provide better error handling and problem-solving capabilities can also improve efficiency.

Additionally, sustainability should be considered by integrating automation smoothly into the existing process and ensuring adaptability to changing requirements over time. The flaw in the current process that halts automation when active financial mutations occur after 8 a.m. should be addressed and recommendations will be provided in the advice document. Although a complete system test was not possible due to the unavailability of the robot in the test environment, efforts were made to validate the execution of activities within the Kofax Design Studio, emphasizing the need to fix the robot's unavailability for thorough testing. These insights will be documented in the advice document.

5. What is the most efficient and sustainable way to use automation within the company?

Research methods

This last sub-question will determine the most efficient and sustainable way to use automation within the company and combine the knowledge from all previous questions into an implementation of RPA in the process. Next to that, two main strategies will be used: **Library** and **Workshop**.

One way to approach this question is to use the business case exploration method, which involves analysing the costs and revenues associated with various automation options to identify the most viable solutions for the company. This approach can help to identify the most cost-effective and efficient method(s) of implementing automation.

Another effective method is prototyping, which involves creating a minimum viable product (MVP) to demonstrate the best way of automation applicable to the company's operations. This approach allows for hands-on experimentation and testing to identify the most effective automation solutions.

In addition, it may be beneficial to hold an expert interview with the company's RPA specialist to gain valuable insights and support for this sub-question. This can help to ensure that the proposed prototype is aligned with the company's current automation capabilities.

Results

Business case exploration

To demonstrate the possibility of an alternative automation approach for the company, a business case exploration was conducted, analysing the costs, benefits, and risks associated with the current robot as well as the potential of adopting an alternative solution. This evaluation aids in the decision-making process of whether to continue using the current automation method or explore an alternative.

The business case exploration involves an assessment of various factors related to the existing robot, such as implementation costs, licensing fees, maintenance expenses, and the return on investment (ROI) achieved through its deployment. Additionally, the benefits derived from the current automation system, such as increased efficiency, reduced errors, and time savings are noted.

Simultaneously, the exploration considers the potential benefits and risks associated with an alternative automation approach. This includes examining the costs of implementing the new solution, any additional licensing or development expenses, and the anticipated benefits, such as improved performance, enhanced scalability, or enhanced compatibility with future technologies and processes. Moreover, the potential risks and challenges, such as integration complexities are analysed.

By conducting this business case exploration, decision-makers can gain a comprehensive understanding of the financial implications, advantages, and potential risks of both the

current automation method and the alternative approach. This analysis facilitates an informed decision regarding whether to continue with the existing automation system or pursue the adoption of an alternative solution.

COSTS

Kofax RPA:

To begin with, an assessment was made of the current technology at Sligro to compare it with the alternative solution. The company provided invoices for the licenses they need to pay, which amounts to approximately €18,000 annually. Additionally, the average cost to build a robot (i.e., automate a process) is €3,500 per process.

Alternative RPA:

The alternative solution is developed as a C# Console application, and further details about this program can be found in the following chapter. This application contains one-time creation costs and potential maintenance costs. The time taken to develop the prototype was tracked, resulting in approximately 30 days of research and development. Assuming an 8-hour workday, this totals 240 hours. The average hourly rate of a C# backend developer[10] was used which is €24,14 to calculate the creation cost. The total creation cost comes down to around €5,780 on average.

In addition, there may be maintenance costs, but these are not overly intensive. They involve tasks such as modifying one or more SQL statements or upgrading the .NET framework. Since these activities are infrequent, a maximum of 10 additional hours per year has been estimated. Calculating with the previous hourly rate, this amounts to approximately €241.

Thus, the total costs for the alternative solution in the first year amount to €6,035. It is important to note that this relevant to automating one process. When considering the automation of other processes, it is possible that requirements may be adjusted to meet customer needs.

BENEFITS

Kofax RPA:
- Kofax RPA provides a Design Studio that allows users to visually program. However, it has been indicated that the company prefers to outsource this aspect and only uses the Design Studio to guide the robot's steps.
- Human actions are automated, resulting in fewer errors along the way.
- Automation saves time by freeing up human resources.

Alternative RPA:
- Implementing the new technology brings several new benefits. One key advantage is that the management will be in-house, eliminating the need for ongoing contact with

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[10] Nationale Beroepengids. (2023, February 9). Salaris Backend Developer: Hoeveel verdient een Backend Developer? Retrieved May 26, 2023, from https://www.nationaleberoepengids.nl/salaris/backend-developer

the vendor on this matter. During the internship, the company expressed some dissatisfaction with the vendor's customer service.

- Another benefit is that the alternative solution is built using C#, making it a highly flexible program that can be customized based on Sligro's changing requirements.
- Similarly, human actions are automated, reducing the occurrence of errors.
- The automation also saves time by freeing up human resources.
- Sligro has developers with C# knowledge, making it more easy to maintain this alternative in-house.
- C# can be considered future friendly with its strong community support and cross-platform compatibility.

Overall, both Kofax RPA and the alternative RPA offer benefits such as reduced errors, time savings, and the automation of human tasks. However, the alternative RPA provides additional advantages, such as in-house management and flexibility for customization. Last but not least it is also considered future friendly.

RISKS

Kofax RPA:

- Scalability Challenges: While Kofax RPA may be suitable for automating specific processes, there could be challenges when it comes to scaling up the automation efforts across the entire organization. It is important to assess whether the solution can handle increased workload and complexities as the requirements for automation expand.
- Vendor Dependency: Implementing Kofax RPA creates a reliance on the vendor for ongoing support and updates. This could pose a risk if the vendor experiences financial difficulties, changes their business strategy, or fails to provide timely and effective support.
- Total Cost of Ownership: While the initial costs of implementing Kofax RPA may seem reasonable, it is essential to consider the long-term total cost of ownership. This includes ongoing licensing fees, maintenance costs, training expenses, and the need for dedicated resources to manage and maintain the RPA system.
- Technological Obsolescence: The rapidly evolving nature of technology means that RPA solutions can become outdated relatively quickly. There is a risk that the chosen solution may not keep pace with emerging technologies, leading to potential compatibility issues and the need for frequent updates or system replacements.

Alternative RPA:

- Development Complexity: Building a custom C# application for automation requires a skilled development team and expertise in C# programming. The complexity of designing and implementing the application can lead to potential challenges and delays in the development process.
- Reliance on Internal Expertise: There is a risk of dependence on a small number of individuals who possess the required expertise. If these individuals leave the organization or their availability becomes limited, it can pose challenges for ongoing

application support and development. That is why documentation is a crucial step in development.

RETURN ON INVESTMENT

Kofax RPA:

By automating the process using Kofax RPA, it is estimated that approximately a whole working day is saved in performing all the steps and gathering data for the dagaansluiting report. With 253 working days in 2023[11], the annual time savings would amount to 8 hours per day * 253 days * €24.14/hour = €48,937.04.

To calculate the ROI, the time savings are compared with the costs associated with Kofax RPA. The costs include annual licensing fees of approximately €18,000 and an average cost of €3,500 to build a robot for each process.

Considering the time savings of €48,937.04 and the costs of €18,000 + €3,500 = €21,500, the ROI for Kofax RPA would be (€48,937.04 - €21,500) / €21,500 * 100 = 127.3%.

Alternative RPA:

By automating the same process using the alternative solution, it also saves €48,937.04.

To calculate the ROI, the time savings are once again compared with the costs associated with the alternative RPA. The costs for the first year include the one-time creation cost of €5,780 and estimated maintenance costs of approximately €241. Thus, the total costs for the first year would be €6,035.

Considering the time savings of €48,937.04 and the costs of €6,035, the ROI for the alternative RPA would be (€48,937.04 - €6,035) / €6,035 * 100 = 711.4%.

Please note that these ROI estimates are based on collected information and assumptions. The actual ROI may vary depending on specific circumstances and additional factors.

Prototyping

Based on the findings of the previous research, a prototype has been developed to demonstrate to the company that automation can be done in alternative ways. The business case exploration shows that an alternative approach can be more cost-effective while still being easy to maintain. The prototype has been developed using multiple techniques, which will be fully described in the Implementation document. A Design document has also been prepared to provide a complete overview of the architecture of the prototype.

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[11] Working days in year 2023 in Netherlands. (2023, January 1). netherlands.workingdays.org. Retrieved June 9, 2023, from https://netherlands.workingdays.org/workingdays_holidays_2023.htm

Expert interview

During the course of the project, several productive discussions were held with the company's RPA expert to ensure that the developed solution met the company's expectations. These insightful conversations shed light on the alignment between the prototype and the desired outcomes. One notable advantage of the chosen approach is the development of a custom-made program using the C# programming language, which offers extensive customization options. This decision empowers Sligro to tailor the program precisely to their specific requirements, making it a highly flexible solution.

The customizability of the program is a significant strength, as it allows for easy adaptation to evolving business needs. By using C# and its set of programming tools, the developers at Sligro have the knowledge and expertise required to effectively maintain and enhance the application over time. This ensures the long-term sustainability and scalability of the solution. Additionally, the availability of in-house expertise on C# contributes to streamlined communication and collaboration between the development team and other stakeholders within the organization.

The choice to develop a prototype as part of the project is a commendable decision. This approach offers several advantages. Firstly, it serves as a visible proof of concept, demonstrating the achievability and effectiveness of the proposed solution. The prototype acts as a visual representation of the program's functionalities, enabling stakeholders to gain a comprehensive understanding of its capabilities.

Also, by creating a prototype, valuable insights and feedback can be gathered early in the development process. This approach allows for adjustments and improvements based on user experiences and requirements. The time invested in developing the prototype ensures that Sligro can thoroughly evaluate the benefits and implications of adopting this solution. Importantly, should the decision be made to continue with the current RPA approach, the investment in time and effort remains justified, as the prototype serves as a valuable learning experience and foundation for future improvements.

On the other hand, if the organization chooses to transition to the custom C# application, the potential for automation within Sligro expands significantly. The flexibility and scalability of the program allow for the automation of various processes across different departments, optimizing efficiency and freeing up valuable human resources. The documented codebase of the application further strengthens its maintainability and facilitates knowledge transfer within the organization. With proper documentation, future modifications, updates, and troubleshooting can be carried out more effectively, reducing potential risks and minimizing downtime.

Conclusion

The research showed that the most efficient and sustainable way to use automation within the company is by adopting a custom C# application as an alternative RPA solution. This approach offers cost-effectiveness, flexibility, scalability, and future compatibility. It provides in-house management, customization options, and reduces reliance on external software vendors. The return on investment for the alternative RPA solution is higher compared to the current method. The prototype development process validated the achievability and effectiveness of the proposed solution. Overall, implementing a custom C# application as an alternative RPA solution is the recommended approach for efficient and sustainable automation within the company.

Conclusion of the research

Now that the complete research has been conducted, this final chapter presents the conclusion to the main research question based on the answers to all sub-questions. The conclusion can be found below.

"How does the implementation of a new robotic process automation technique ensure that automation is available as efficiently as possible?"

The implementation of a new robotic process automation technique can ensure efficient automation availability through a series of key findings. Firstly, by understanding the techniques used by the company, such as the utilization of Kofax RPA software and the robot's activities within the AS400 system, a foundation is established for further analysis.

Examining the advantages and disadvantages of the current techniques highlights the benefits of the user-friendly design studio, cost and time savings, and increased efficiency. However, challenges related to robot malfunctions, error handling limitations, and process constraints had to be addressed to optimize automation's seamless functioning and maximize its benefits.

Identifying the key process and activities requiring automation which is the "dagaansluiting" process, allowed the possibility to create an alternative RPA solution tailored to the company's needs. These activities include checking for financial mutations, printing of documents, data retrieval, and digitizing lists

To enhance the effectiveness of RPA in optimizing the current process and improving efficiency, steps such as addressing technical issues, exploring alternative automation approaches with better error handling, and ensuring sustainability through integration and adaptability are necessary. Recommendations for resolving the flaw that disrupts automation when active financial mutations occur after 8 a.m. is outlined in the advice document.

Furthermore, considering the most efficient and sustainable way to use automation, the research suggests adopting a custom C# application as an alternative RPA solution. This approach offers cost-effectiveness, flexibility, scalability, in-house management, and customization options. It reduces reliance on external vendors and provides higher return on investment compared to the current method. The prototype development process validates the achievability and effectiveness of this recommended solution.

In conclusion, by addressing the identified challenges, implementing technical improvements, exploring alternative automation approaches, and adopting a custom C# application, the implementation of a new robotic process automation technique ensures efficient and sustainable automation availability, optimizing the process and improving overall efficiency within the company.

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