Increasing Proactive Healthcare: An Automated Approach Within Screening Process For Breast Cancer

Theresia Lundkvist
Abstract

Breast cancer is the most common cancer and 8,700 individuals in Sweden were diagnosed with breast cancer in 2021. Thanks to improved diagnostic methods and more effective treatment, nine out of ten women who develop breast cancer survive. The aim of the study was to assess the impact on the administrative time of healthcare professionals in the breast cancer screening process when the process is automated using Robot Process Automation (RPA). The study developed a process model of the screening process and a cost estimate of how much time could be saved by integrating RPA based on input from healthcare staff. The study used the methodology Design Thinking Method in conjunction with the methodology Case Study. The overall results of this study show that RPA can replace certain administrative tasks in the breast cancer screening process to reduce administrative time. It shows that the breast cancer screening process has the potential to be automated and the cost estimates show that an automated system could save between 30-80 hours of manual work per year. Further research is needed to determine how other screening processes can benefit from automating manual tasks with RPA and thus integrate RPA on a larger scale.
Acknowledgements

I would like to thank my supervisors Jonas Boström at CGI, Sundsvall, Sweden and Patrik Eklund at Umeå University, Umeå, Sweden for all the support during my Master’s thesis work. You have shown great interest in my study.

Jonas, you have been especially helpful in finding key people to talk to for my study and in teaching me the importance of customer relations in working as a consultant. Patrik, thank you for teaching me how to search for scientific literature and for being there to guide my work in the right direction.

A big thanks to all the people who took part in my study, both as interviewees and/or by helping me with information and opinions throughout the project.

And to my peer reviewer Ebba Gustafsson. Thank you for being there to discuss all parts of the study.
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1 Introduction

In 2021, 68,810 individuals were diagnosed with cancer, of which 32,795 were women and 36,015 were men. 75.3% of women and 77.6% of men are estimated to survive 5 years after receiving their cancer diagnosis. Since 1970, cancer incidence has increased by approximately 40% and a few decades ago, cancer diseases often meant death within a few years. People who get cancer today have a favourable prognosis [9].

Among women, breast cancer is the most common cancer and in 2021, 8,700 were diagnosed with breast cancer and among those 8,619 were women and 81 were men. 26% of women who get a cancer diagnosis get diagnosed with breast cancer. One in ten women at the age of 75 has had or currently has breast cancer. Thanks to improved methods for diagnosing and more effective treatment, the risk of dying from cancer has decreased. Almost nine out of ten women who get breast cancer survive [8].

In Sweden, there are 21 healthcare Regions. According to Socialstyrelsen, all 21 Regions in Sweden should offer all women between 40 and 74 years old a free mammography for breast cancer as a part of national screening [36].

Screening is an important part of the early detection of breast cancer. It is often detected before symptoms appear. During the screening process, a mammography is conducted. Socialstyrelsen recommends that women aged 40-74 should be invited for a free mammography every 1.5-2 years. Individuals in the screening process are called every 2 years to minimise the risk of detecting advanced cancer [3]. During the mammography, two or three images are taken of each breast, which in turn are then examined by a radiologist.

Today, a lot of manual work is required in the screening process. A big part of the manual work is repetitive and could potentially be automated. By automating the current system of the screening process the process could be more efficient.

In this study, the term automation is defined as "a process where there is no human interaction" [20] [17]. Robot Process Automation (RPA) is a digital robot that acts as if it were a human worker. The study has investigated how the current screening process could be automated by using RPA, and in particular, which parts of the process could be improved. A process model for the new system has been designed and the impact on the time taken by administrators is discussed.

1.1 Objective

The aim of this study is to examine the impact on administrative time for healthcare staff by automating a manual process within a screening process for breast cancer.

1. How can the integration of Robotic Process Automation (RPA) meet the specific
needs of medical secretaries, improving the efficiency of screening processes through automation, while maintaining quality care and prevention?

2. What would a process model of a streamlined RPA automated system of the screening process look like?

3. What effects on the administrative time of medical secretaries does the automation of the screening process have?
2 Theoretical Framework

The following chapter provides a comprehensive overview of several key areas within automation, cost assessment and process management. The automation section focuses on the definition of automation and provides an in-depth analysis of Robotic Process Automation (RPA) and guidance on implementing RPA. This is followed by a deep dive into process models and the design thinking methodology, which includes the empathy, definition, idea generation, prototyping and testing phases. Finally, related studies and work in these areas are reviewed to provide an informed and comprehensive context for the discussion ahead.

According to the Cambridge Dictionary, the definition of a process is "a series of steps and decisions involved in the way work is completed" [7]. A manual process is a process that is executed by a human. To be considered a manual process, the process can not involve any tools or machines that are automated.

Health and social care is information-intensive, and the content differs. Comparing clinical information in hospitals with data for the care of older people in old age is one example. Healthcare is not just about information but also about processes and "healthcare processes". These processes are not trivial to model, but they are recognised as important to model. 2009, The National Board of Health and Welfare (Socialstyrelsen) presented their first version of recommendations for modelling care processes in their "Nationell informationstruktur (NI)". In 2009, The National Board of Health and Welfare (Socialstyrelsen), the Swedish national health authority, exemplified recognition and non-triviality by presenting the first version of recommendations for modeling care processes in their "Nationell informationstruktur (NI)." Templates for healthcare and decision processes have been developed, but in a rather rudimentary form. In addition, process modelling tools and languages were not explicitly recognised. Since then, NI has been renewed and updated [34], but the NI reference models [35] published in May 2023 have not been significantly improved.

Socialstyrelsen continuously makes recommendations to the Regions, of which NI is one, with the aim of supporting regional efforts in the area of process modelling. It is far from clear that Socialstyrelsen has been successful in all aspects of process modelling. This paper presents a case study of process modelling within mammography in a medium-sized region, where suggestions and details are given about process modelling tasks, and in particular how to rely on particular tools and languages for process modelling. The Business Process Modelling Notation (BPMN) has been widely used [29]. It should be emphasised that, despite its name, BPMN is not exclusively designed for "business” processes. Rather, it is a process language that supports swimlane-style modelling, making it well suited for use in healthcare and related organisational structures.
2.1 Automation

Automation in the field of computer science involves the utilization of technology and software to perform tasks and processes with minimal human intervention. Today, automation plays a pivotal role across various industries, optimizing efficiency and accuracy by executing repetitive and time-consuming tasks, from software deployment and system maintenance to data analysis and decision-making, thereby freeing up human resources for more creative and strategic endeavours.

Automating a task or process does not mean replacing a human with a robot [2]. Automation is using technology to execute a task or process with as little human interaction as possible. It does not necessarily have to be without human interaction [17].

Digitisation is not to be confused with automation. Taking something physical or manual and converting it to be consumed digitally is digitisation meanwhile automation refers to streamlining and executing a sequence of various steps. Automation does not necessarily have to be digital, it can also be analogue [2].

2.1.1 Definition of automation

According to Integrate.io’s article ”Automate Data Management Processes,” automation is described as follows: "Data automation is the concept of taking manual tasks and processes, usually done by humans, and using software to automate them” [20].

IBM is helping their clients to solve their business problems by using the necessary technology and services [16]. The post titled ”What is automation?” defines automation as ”Automation is the use of technology to perform tasks where human input is minimized” [17].

In this study, automation is specifically defined as ”a process where there is no human interaction”. The definition is based on the two earlier mentioned definitions from Integrate [20] and IBM [17].

2.1.2 Robotic Process Automation (RPA)

Robotic process automation (RPA) is not to be confused with physical robots that are executing a human task [6], [38]. RPA is a digital worker or a robot and to use RPA no new system is needed. The robot works as if it's a human user and therefore no new implementations [10], [6]. Unlike traditional programming, RPA does not need to change the underlying code of the system. It acts as a user interface layer, performing tasks similar to a human user, making it less invasive and less dependent on the system’s internal logic. RPA is flexible and can be adapted to different workflows and systems without requiring a deep understanding of the system’s inner workings. This makes it possible to implement automation quickly and adapt it as needed.

RPA is a combination of different APIs and user interfaces that perform repetitive tasks, however, RPA does not store any data [6]. A common reason to use RPA is to free up human resources so that more complex and urgent tasks can be prioritized [18].

IBM’s Robotic Process Automation [15], with automation in the form of software robots or bots, is aimed at streamlining administration, minimising lag time and generally being part
of wider digitalisation efforts within organisations. IBM’s RPA can be seen as the "process counterpart" to IBM’s watsonx Orchestrate and is often used as information management and its analysis as information and processes are intertwined and one cannot function without the other.

Excerpts from IBM [14] highlights the potential to reduce administrative costs in healthcare by automating repetitive manual tasks that consume time and resources with RPA in Healthcare. It also highlights the acceleration of processes, such as triage, by automating routine tasks.

In the context of healthcare, the challenge is that existing systems are not easily replaced or upgraded, and regions must find ways to streamline processes without directly modifying these systems, as they do not have ownership rights. RPA offers a suitable solution because it works as a "plug-in" to existing systems, providing a "duct-tape" remedy that improves efficiency without requiring fundamental changes to the underlying infrastructure.

Three core capabilities must be included during RPA development according to Forrester. The three core capabilities are [18]:

1. Low-code capabilities to build automation scripts.
2. Integration with enterprise applications.
3. Orchestration and administration including configuration, monitoring and security.

There is a difference between RPA and Artificial Intelligence (AI) and Machine Learning (ML). An RPA system executes a task, whereas AI "thinks" and ML "learns" [18].

By using RPA's, human errors can be reduced and tasks can be done faster and more consistently compared to a human. It also removes mundane tasks and frees up time for the human that would have to execute the task [38][18].

RPA is an easy system to work with, even for non-technical people. This means that the person or persons who are developing an RPA do not necessarily have to be a developer [18][6]. Implementing RPA can also be cost effective compared to developing custom code solutions, which is important in healthcare economy [1]. Its rapid implementation also enables a rapid return on investment.

Implementing RPA in healthcare has the potential to improve efficiency, reduce costs, and enhance the quality of care by automating workflows and processes. RPA can also free up time for healthcare staff to focus on more complex and care-related tasks [31].

The result from the article titled "Robotic Process Automation (RPA) in Healthcare” features the authors R. Swetha, P. Pavithra, S. Prathiksha, and S. Selvakannmani shows that RPA may free up healthcare workers. In the article, the authors also state that workers may lose their jobs as RPAs take their place [30]. In the article, the authors also state that, as with all new technology, RPA has various challenges, but it also has the potential to replace monotonous human tasks.

RPA have two main security risks, data leakage and theft, but there are ways to prevent the risks. By restricting access, centralized management of team credentials, ensuring accurate and reliable log generation by the RPA platform, effective change management practices and data encryption, the risk of implementing RPA in healthcare can be significantly reduced [30].
2.1.3 Guide to RPA Implementation

Even though there is no one-size-fits-all approach to implementing an RPA solution there are certain steps to follow for making an RPA implementation easier [32]. The steps to use as guidelines when implementing an RPA solution are:

1. Define the following problem: First a business problem is defined. By answering the two questions, a deeper understanding of the problem and how RPA can best be integrated into the organization.
   (a) What are the goals for implementing RPA?
   (b) What specific pain points are they looking to alleviate?

2. Identify processes that can be automated using RPA: The second step in implementing RPA identifying which processes in the organization can be automated by using RPA. The identifying is often done by close examinations of the organization’s businesses. However, it is important to keep in mind that not all processes are suitable for being automated since some tasks will be better executed by humans.

3. Assess the feasibility of automating each process: As a part of the third step, evaluations about the feasibility of automating the process or processes defined in the earlier step.

4. Develop a business case for each process: The next step is developing a business case for each process that has the potential to be automated. This makes it easier to estimate the cost of the potential implementation of RPA, but also the possible benefits of an automated process.

5. Create an implementation plan: During the fifth step, a plan for the implementation is created. When creating the plan, the following questions are to be considered:
   (a) What tasks will be automated?
   (b) Who will oversee each automation project?
   (c) What resources will be required?
   (d) What is a realistic timeline given these constraints?

6. Product initiation and Proof of Concept development: This is the phase that develops the business case for RPA. Further, a Proof of Concept is built to show actual results of concepts and theories.

7. Implementation and deployment: The last step is where the RPA is deployed and works in the same system as the humans.

2.2 Cost Estimation

Cost estimating is the process of historical data and quantitative models. Cost estimation is used to predict the future cost of a product, program, task, or process based on the available information. There are some guidelines for creating a good cost estimation.

- A good cost estimate must be based on historical data.
- It should have clear and transparent assumptions.
• The estimate should account for uncertainties and risks in the program plan.
• The estimate should be easily understandable and auditable.
• It should support independent validation.

These guidelines lead to a more reliable, transparent, and useful cost estimation that can assist organizations in making informed decisions and managing their projects and programs more effectively [27].

In a study (Ekman et al., 2021) published in the journal BMC Health Services Research, a cost estimation of informal health care in Sweden was conducted [11]. The study shows that through cost estimation and identifying and quantifying different cost factors, a deeper understanding of how informal care affects society can be studied.

2.3 Process model

A process model is a way to graphically visualize a process and is often used to represent and analyze a process. The process model is a description of a flow of work or activities that leads to a specific goal and the goal of a process model is to answer why, how, whom and how a specific process works [5]. A common reason for creating a process model is to represent and analyze a series of activities [4].

Terminator, Activity, Decision, Arrow, Connector and Swimlanes are common elements while modelling [19].

• Activity: The work that an agent or a person can perform. When developing a process model an activity is represented by a rectangle [5], see Figure 1. An example of an activity is sending an email or assembling product components.

Figure 1: Shape of the symbol for an activity in a process model.

• Events: Different happenings during a process. These events are Start, End and Intermediate Events [5]. Events are represented as rounded rectangles, see Figure 2.
• Decision: A point in a process where a decision or choice has to be made \[23\][19]. Diamonds represent a decision in a process model, see Figure 3. When a customer has to choose between two activities "sending an email" and "making a call" is an example of a decision.

• Connector: Links different parts of a process (is not necessarily sequential) \[23\][19]. An arrow is an example of a connector and in process modelling an arrow shows the direction of the flow in a process model \[23\][19]. Figure 4 shows what one type of arrow in a process model looks like.

• Swimlanes: Graphical method that is used in process modelling. These swimlanes divide the process into sections or "lanes," each representing different units such as departments or roles. This structure clarifies different responsibilities so that a clear overview of how various entities interact within the process is provided. Using swimlanes enhances communication and understanding and modelling complex business processes with multiple different actors and responsibilities is easier \[24\].
Developing a process model can be challenging. The first guideline when developing a process model is using as few elements as possible to minimize error probability. It is also important to try using only one start and one end event. During the development, it is important to remember to model as structured as possible. This guideline is important because an unstructured model has a higher risk of including errors. Structured models tend to be easier to understand than unstructured models. Models that have fewer OR elements are less likely to contain errors, therefore, avoiding OR elements is recommended [26].

Within health and medical informatics, it was recognised as early as 1995 that ”one of the major tasks of medical informatics is the modelling of processes” [13]. Later, as languages and tools were provided and developed, BPMN became an integral part of the process modelling adopted by the medical informatics community [25].

This work fits well with this tradition of process modelling in health and social care, and there are several BPMN tools available for developing process models. Microsoft Visio, IBM Blueworks and Camunda are some of the most common tools used to develop a process model. The Camunda tool was used in this thesis.

2.4 Design Thinking

A common problem-solving method is Design Thinking where the focus is on generating innovative solutions. To arrive at the solution, understanding what the user’s needs, exploring different possible solutions, and testing and refining ideas are important steps during the method. The method is an iterative process and consists of 5 different phases, see Figure 6 [12] [21]. Re-iteration of these phases can be an important part of Design Thinking.
Figure 6: The figure illustrates the Design Thinking method, which consists of five main phases: Empathy, Definition, Idea Generation, Prototyping and Testing. By emphasising the user’s needs and experiences, this method provides a framework for creative problem solving in design. The process is iterative, allowing for exploration, iteration and refinement to create innovative and user-centred solutions.

2.4.1 Empathise

In the empathising phase, information is gathered to understand the users [12] [21]. Research and/or observation is carried out to gain an in-depth understanding of, among other things, the users’ needs and their involvement.

Data can be collected in various ways, and interviews are a common tool used to gain a deeper understanding of users’ needs. During interviews, only one participant is present, but several interviewers and secretaries may be present during the interview [22]. There are three types of interviews, fully structured, semi-structured and unstructured. The aim of a semi-structured interview and an unstructured interview is to explore the interviewee’s comments thoroughly, opportunistically seeking additional insights and a deeper understanding [22], which is an important part of the empathising phase.

A semi-structured interview has a mix of pre-planned questions and themes or questions to guide the interview. There are two different types of questions, closed and open-ended. A closed question gives the respondent a limited number of options for answering the question. The advantage of using closed questions is that it is easy to analyse the answers as they can be tabulated. In addition, statistical methods can be used to show the distribution of answers. Open-ended questions, on the other hand, are questions that seek answers, opinions or other feedback. This type of question is often used when the interviewer wants answers that go deeper and explore a topic [22].

An unstructured interview is based on a known list of topics or questions to guide the interview [22].
2.4.2 Define

All the research and/or observation is summarised and a problem is defined \([12][21]\). The focus is not on how the problem should be solved.

Personas can be used to create fictional user profiles based on insights from user surveys. This helps to personalise and better understand users’ needs and goals. Personas are fictional, detailed representations of the characteristics and behaviours of target users \([28]\). It typically includes a name and an image to symbolise this fictional character. A persona also includes a narrative description to make it seem like a real person and to create a compelling story that details the persona. When developing a persona, it is useful to consider the following guidelines:

1. Decide the purpose.
2. Collect data via example interviews or focus groups.
3. Analyze the collected data and identify trends.
4. Identify archetype users.
5. Create persona profiles.

2.4.3 Ideate

The phase where new ideas are generated \([12][21]\). During this phase, it is more than welcome to brainstorm a number of crazy, creative ideas.

Brainstorming sessions are often held in focus groups. Focus groups are an alternative to regular interviews in which several participants can easily gather a wide range of different opinions at the same time. There is no hard and fast number for the optimal size of a focus group, but a suggestion is 5-12 people per group. The risk of using only one focus group is that it may be unresponsive or unrepresentative, so it is recommended to use two or more. If sensitive or controversial issues are discussed during the interview/discussion it may not be appropriate to use the focus group \([22]\).

2.4.4 Prototype

During the fourth phase, it is time to turn the ideas from the previous phases into prototypes and/or models \([12][21]\).

Paper prototyping is a quick and inexpensive method of creating rough sketches or simple models on paper to demonstrate a design idea. In design thinking, it is useful for creating a visual representation of process models. It is inexpensive and allows for quick changes and iterations. Creating simpler paper prototypes makes it easier for the team to understand and communicate the process. Its ease of use makes it an excellent tool for gathering early feedback from users before moving on to more advanced prototyping or implementation \([33]\).

2.4.5 Test

The testing phase is where the potential solution is tested on the real problem \([12][21]\). During this part, feedback from users is gathered.
In the testing phase of Design Thinking, Proof of Concept can be used to demonstrate technical feasibility and test the practical functions of the solution. It helps to gather technical feedback, validate the feasibility of the proposed idea and support decision making by demonstrating the potential of the solution in practice.
3 Methodology

3.1 Case presentation: The Breast Cancer Screening Process

This qualitative study had elements of a case study. The case study took place in a medium-sized Region with less than 500,000 inhabitants. The Region is responsible for ensuring that there is good health care for everyone and that the conditions for good health are created for all the inhabitants of the Region. One of the processes that the Region carries out is breast cancer screening, where 24,000-28,000 women between the ages of 40 and 74 are screened every year with the aim of detecting breast cancer as early as possible. The women get screened every two years. Mammography screening are carried out both in hospitals and on mobile units that travel between different towns in the Region. The process requires a lot of administrative time, such as booking and sending out appointments to all women.

Today, the screening process starts with a medical secretary. The medical secretary makes an appointment for a mammography and sends a reminder to the patient. The patient can reschedule or cancel the appointment herself via 1177, but it is also possible to reschedule or cancel the appointment by telephone. During the appointment, a mammography is performed, taking two or three images of each breast. The images are reviewed by two different radiologists. The patient is then contacted with the results, either "nothing found" or "selected for further investigation". Being selected for further investigation does not mean that abnormalities will be found, but it may mean that the images need to be taken again or that an additional examination will be carried out. If any abnormalities are found, the medical secretary will schedule a new appointment and send a reminder to the patient. If "nothing found", the person receives a health letter stating that nothing was found.

3.2 Implementation of Design Thinking on the breast cancer screening process

Within the realm of method implementation and the process of designing a process model, the Design Thinking Methodology is the chosen approach in this study. In this qualitative research, a case study is conducted based on the case presentation to gain a deeper understanding of the breast cancer screening process. The study has been divided into five phases, some of which have several iterations. Figure 7 shows an overview of the phases and iterations throughout the research.

The first phase was an iteration between Empathize and Define. In the first iteration of the first phase, Empathize, related literature was identified followed by an interview. Based on the interview, a process model was developed to visualise the current process as a part of the Define phase.

The second iteration involves ensuring the right flow with a follow-up interview followed
by an update of the process model of the current system.

The third phase, Ideate, was a brainstorming session where ideas for possible solutions were discussed. The brainstorming was followed by an interview to find different, where possible solutions were discussed.

The two last phases were carried out in two iterations. In the first iteration, a process model of the automated system was designed, followed by a test where the design was tested. In the second iteration, the process model was updated and a proof of concept was developed and tested.

**Figure 7:** A comprehensive overview of the Design Thinking Method and its phases during this study. The figure illustrates the iterations between the five phases and what was done during the phases.

### 3.2.1 Empathize: Interview with medical secretary (First Iteration)

The first phase in the Design Thinking method is Empathize. During the Empathize phase, a semi-structured interview was conducted with a medical secretary to gain an overview of the current screening process. The interview lasted about an hour. Before the interview, the medical secretary was informed about the purpose of the study, followed by asking for consent to use the obtained information. In the interview, both closed-ended and open-ended questions were asked.

The interview started with informal talk to make the participant comfortable. The informal talk was then followed by easy questions about where the medical secretary is working and what tasks are done in the position of medical secretary. The questions in the first part of the interview are presented in Table [I]
Table 1 Questions asked during the first part of the interview.

<table>
<thead>
<tr>
<th></th>
<th>Question</th>
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<tbody>
<tr>
<td>1</td>
<td>Where do you currently work?</td>
</tr>
<tr>
<td>2</td>
<td>What is your current job and responsibilities?</td>
</tr>
<tr>
<td>3</td>
<td>Are you involved in the screening process?</td>
</tr>
<tr>
<td>4</td>
<td>How would you describe the purpose of the screening process?</td>
</tr>
</tbody>
</table>

The second part of the interview focused on questions about challenges, routines and risks during the screening process. This part was primarily to get a broader understanding of the screening process before asking about specific tasks and getting details, see Table 2 for the questions that were asked during the second part of the interview.

Table 2 Questions asked during the second part of the interview.

<table>
<thead>
<tr>
<th></th>
<th>Question</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>What are the most common challenges or problems that can arise during the screening process?</td>
</tr>
<tr>
<td>2</td>
<td>Are there any specific procedures, protocols, or guidelines that must be strictly followed during the process?</td>
</tr>
<tr>
<td>3</td>
<td>How is information related to screening documented and archived?</td>
</tr>
<tr>
<td>4</td>
<td>Are there any risks or security aspects that need to be addressed during the process?</td>
</tr>
</tbody>
</table>

In this part of the interview, questions about the different steps in the screening process were asked. Questions regarding collaborations between different departments and which persons are involved were also questioned, see Table 3.

Table 3 Questions asked during the third part of the interview.

<table>
<thead>
<tr>
<th></th>
<th>Question</th>
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<tbody>
<tr>
<td>1</td>
<td>Can you describe how the screening process looks, preferably from identifying individuals to be screened until the patient completes the screening?</td>
</tr>
<tr>
<td>2</td>
<td>Could you identify who or which roles are responsible for each step in the screening process?</td>
</tr>
<tr>
<td>3</td>
<td>Are multiple departments/people/services involved in a screening process?</td>
</tr>
</tbody>
</table>

In the fourth part of the interview, the participant was asked to estimate the time needed for each of the previously mentioned tasks. The logistics of how appointments are sent out to individuals and statistics on the number of appointments sent out and attendance were also asked. The interviewee was also asked about the number of medical staff involved and how the workload could be reduced. In Table 4 the questions asked in part four of the interview are shown.
Table 4 Questions asked during the fourth part of the interview.

<table>
<thead>
<tr>
<th></th>
<th>Question</th>
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<tbody>
<tr>
<td>1</td>
<td>Could you estimate how much time each sub-process takes for you or any of your colleagues in the screening process?</td>
</tr>
<tr>
<td>2</td>
<td>Do you know how many individuals are invited for screening per year, and what percentage actually completes the screening process?</td>
</tr>
<tr>
<td>3</td>
<td>Are multiple departments/people/services involved in a screening process?</td>
</tr>
<tr>
<td>4</td>
<td>Is there anything that you believe would facilitate your work regarding screening? If so, what?</td>
</tr>
</tbody>
</table>

The last part was to wrap up the interview with a question about suggestion on additional people to interview and a request to do observations during practical work. The interviewee was also given opportunity to add any information that had not been brought up during any of the earlier questions, see Table ??.

Table 5 Questions asked during the last part of the interview.

<table>
<thead>
<tr>
<th></th>
<th>Question</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Is there anyone else you think would be good to talk to in order for me to learn more about how the process works?</td>
</tr>
<tr>
<td>2</td>
<td>Would you be okay with me observing you for a short period at your job related to screening?</td>
</tr>
<tr>
<td>3</td>
<td>Is there anything else you would like to add?</td>
</tr>
</tbody>
</table>

3.2.2 Define: Process model - Current system (First Iteration)

Based on the interview, a process model was developed for the current system to summarize the information gathered in the earlier phase. The first step was to create a flow, to ensure that the flow and the tasks were in the right order, which was developed on paper and then in Canva. The next step was to answer the question of who is responsible for which task, and what department has the responsibility for each task.

The process model is developed with Camunda’s tool for developing process models [39]. A process model was used to identify and define the problems in the current system. By identifying the task performed by humans, this served as a basis for defining the problems within the current system.

3.2.3 Empathize: Follow up interview with medical secretary + department manager (Second Iteration)

During the second iteration of the phase Empathize, a semi-structured follow-up interview of approximately one hour was conducted with the medical secretary to ensure the process and gain a deeper understanding of the user and the screening process. The time taken by the medical secretary to complete various tasks was observed.

As in the initial encounter, the medical secretary was provided information about the rules
for the interview and consent to use information afterwards, followed by a recapitulation of
the topics covered in the preceding interview. In Table ??, the first part of questions that
were asked during the follow-up interview is represented.

<table>
<thead>
<tr>
<th>Table 6</th>
<th>Questions asked during the follow-up interview.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Can you go through the process quickly again?</td>
</tr>
<tr>
<td>2</td>
<td>How many individuals are invited for screening per year?</td>
</tr>
<tr>
<td>3</td>
<td>How many of them actually attend the screening?</td>
</tr>
<tr>
<td>4</td>
<td>How many are called in for further investigation?</td>
</tr>
<tr>
<td>5</td>
<td>How many of them attend the further investigation?</td>
</tr>
<tr>
<td>6</td>
<td>More precisely, how does it work when invitations are sent out?</td>
</tr>
<tr>
<td>7</td>
<td>Is it okay if I could time how fast it goes for a more accurate mapping?</td>
</tr>
<tr>
<td>8</td>
<td>Who is responsible for the dispatching/invitations?</td>
</tr>
<tr>
<td>9</td>
<td>Which department does what (according to the process model)?</td>
</tr>
</tbody>
</table>

To supplement the follow-up interview with the medical secretary, an unstructured interview
was conducted with the department manager. During the interview, the flow of the process
was discussed to ensure that the flow of the process was right and that all parts of the process
were included.

3.2.4 Define: Process model - Current system (Second Iteration)

The second iteration of the development of the process model of the current system was
based on the follow-up interviews. The process model was updated, missing tasks were
added, and tasks that were wrongly a part of the first process model were removed.

As the last task in the define phase, the problem of the system is defined. Identifying the task
that is executed by humans, served as a foundation when defining the problems within the
current system. The identified tasks and a compilation of interviews formulate and defend
the problem.

3.2.5 Define: Cost estimation (second iteration)

As a part of defining the problem formulation, cost estimations were conducted. These cost
estimations were done to determine the amount (in hours) of manual work of administrative
staff involved in the screening process. The cost estimations were based on the observations
and statistics from the mammography department.

\[ Ba_{\text{screening}} + Sa_{\text{screening}} + Ba_{\text{selection}} + Pa_{\text{selection}} + Sha_{\text{selection}} + Shl \]  

(3.1)
• Ba (= Booking appointments)
• Sa (= Sending time for appointments)
• Pa (= Printing booked appointments)
• Sba (= Sending booked appointments)
• Shl (= Sending health letters)

The duration of each step within the selection phase is estimated in the calculation. The estimated times are specifically allocated in the equation as follows:

\[ Ba_{\text{selection}} + Pa_{\text{selection}} + Sba_{\text{selection}} \] (3.2)

Two different estimated times were used, one from the medical secretary and one from the department manager. The medical secretary estimated the total time for 3.2 to 1 minute and the department manager estimated the total time for 3.2 to 5 minutes.

### 3.2.6 Ideate

During the Ideate phase, brainstorming sessions were used to explore which parts and tasks within the current system had the potential to be automated. In addition to brainstorming, discussions were held with a business analyst involved in process modelling about which parts had the potential to be automated. Finally, discussions were held with RPA developers. The main reason for talking to the developers was to find out what they thought was feasible and what may not be possible or reasonable.

### 3.2.7 Prototype: First prototype (First Iteration)

In developing the process model of the automated process, the modelling guidelines mentioned in section 2.3 have been followed. The process model has been developed at the Camunda platform for shared development of process models [39]. Figure 8 shows the first prototype of the first process model.

As the first step of developing the automated process model, a swimlane for the individual was created. The tasks and decisions for the individual were put into the swimlane in the order they were executed and connected with connectors to show the flow in the process for an individual.

The second swimlane created was the swimlane for mammography. All tasks that are a part of the current system were added to the mammography swimlane in the order they are executed. Additionally to the current system, the task of checking for error messages was added to the automated process model. When all tasks were in the right order in the swimlane, connectors to connect the tasks were added to show the flow and relations between tasks.

The next swimlane to create was the swimlane for the Robot Process Automation (RPA). In the RPA swimlane, there are three processes. One for booking and requesting sending out appointments to all women who turn in to have a mammography, another for sending out "healthy letters" and the third to book appointments and request sending out appointments to all the individuals who have been selected. Connectors between the tasks belonging to the same process were added to connect and illustrate the flow between the tasks.
After these three swimlanes were created and developed, connectors between the three different swimlanes were added. In parallel with the adding connectors, three additional swimlanes are created, Data, Surgery and External Company. In the Data-swimlane different databases were created to enable the RPA to execute its tasks. The surgery department receives referrals from the mammography department and the External Company receives requests to dispatch bookings and sends times for appointments to the individuals.

In the last step of developing the prototype, colour coding of the task was added. Additionally, a swimlane with colour legends was created.

3.2.8 Test: Design (First Iteration)

It is recommended to have 5-12 participants in a focus group. There were three participants in this focus group, one RPA developer, one Business Analyst and consultant manager were present. During the test, the design of the process model was discussed. The topics discussed during the focus group were

- Start and endpoints
- Connections between swimlanes
- Colour coding

As part of the research into the impact of an automated system, a comparison was made between the current system and the automated system. The calculations focused on determining the time differences required between the two systems.

3.2.9 Prototype: Finale prototype (Second Iteration)

Based on the discussion/testing/evaluation the RPA swimlane was divided into multiple smaller processes and therefore separate swimlanes. All connections to an external company for sending out letters to an individual were removed. The decision regarding the status of the individual is made by a medical doctor, but the following steps in the journal update is made by the RPA. The RPA checks for updates when an individual’s journal is updated and checks whether the individual is healthy or selected for further investigation or cancer.

The mammography swimlane was also changed. The tasks were divided into several smaller processes and therefore individual swimlanes. In the mammography swimlane new tasks were added. The new tasks were a task that called upon one of the smaller processes. In this version of the process model, the mammography swimlane and all processes executed at the mammography department are only communicating with the databases.

For all swimlanes, a brief explanation of the start time, end time and purpose of the process has been added.

Figure 9 shows the first prototype of the first process model.

3.2.10 Test - Proof Of Concept (Second Iteration)

As a proof of concept, an RPA process was developed in Ui-Path Studio [37]. The chosen process to test was RPA: skicka friskbrev where an RPA is iterating through a list and
confirms the individual's status and sends an email to the individual representing a healthy letter.

Two Excel documents were used to represent the list of individuals receiving a health letter and the individual's journal. In the proof of concept, the following steps were implemented.

1. Open Excel.
2. Iterating through persons who are healthy and will receive a "healthy letter".
3. Open individual journal.
4. Confirm status "healthy".
5. Send a healthy letter as an email to an individual.
6. Remove from the list of those who are healthy and will receive a "healthy letter".
7. If status is not confirmed, an error message is sent.
4 Results

This section summarises the results of the three objectives. First, it examines how the integration of Robotic Process Automation (RPA) can be adapted to streamline screening processes for medical secretaries while maintaining care and prevention efforts. Next, a process model of a potentially automated screening process is presented, from initial to final prototype. Finally, the results of a cost estimation are presented, highlighting the impact of automation on the administrative time of medical secretaries. These results provide insight into the impact of automation on the workflow.

4.1 Q1 - Can RPA meet specific needs of medical secretaries, increase efficiency and maintain quality care and prevention?

The current screening process for breast cancer contains multiple tasks where RPA has the potential to be integrated. Based on the process model of the current system, the tasks that has the biggest potential to be automated are:

- Booking appointments
- Sending appointments
- Booking appointments for individuals who are selected
- Sending appointments for individuals who are selected
- Sending referral
- Sending healthy letter

Implementing the tasks in the list above would drastically reduce the amount of manual work currently performed by administrative staff and would relieve some of the workload on administrative staff. There is however one exception where administrative staff requires engagement, and that is when specific individuals are requiring manual processing to be scheduled and receive an appointment. The most common reason for manual processing is that individuals have protected identities.

The implemented proof of concept of the process RPA: skicka friskbrev indicates that RPA is capable of performing the above tasks.

4.2 Q2 - Design of Process model

To answer the second objective, a process model was developed. Two prototypes were developed during the development process. The following sections show the two process models with a descriptive text for each prototype.
4.2.1 First prototype

Figure 8: This figure shows the first prototype of process model. In this prototype illustrates how the screening process could look if RPA was integrated. The process model consists of seven swimlanes one of which is a color legend. A larger version of the same figure can be found in the appendices, see Appendix A.1.

The first prototype contains seven swimlanes where one is the colour legend and the swimlanes are: Individual, Mammograf, RPA, Data, Kirurg and Externt företag, see Figure 8. In the swimlane Individual, the flow for the individual is shown. There is no communications between the individual or any other swimlane, except for if an individual wants to reschedule the time for the appointment. If an individual wants to change the time for the appointment, there are communications between the swimlanes Individual and Data.

In the swimlane Mammografi, the flow of the task executed at the mammography department, is shown. This swimlane is communicating with both RPA, Data and Externt företag. The first prototype start with handling potential error messages, and specifically booking and sending appointments that the RPA was not allowed sending. A nurse or a doctor is then executing a mammography that follows by a review of the mammograms taken during the appointment. The doctors are categorizing the individuals either healthy or selected. The next steps is executed by a medical secretary that checks if there are any error messages. If there are any error messages they are handeld manually, both healthy letters and booking and sending time for appointment for individuals that has been selected for further examinations. In the next step, an investigation of if the individual has cancer of not, followed by a review of the investigation. The result is either healthy or cancer, and if the results shows cancer, the RPA swimlane takes over. However, if the result is healthy, and error messages are showing, a medical secretary is handling them manually and sending the healthy letter (friskbrev) to the individual.

RPA is the third swimlane where task are executed and consists of several smaller processes with the goals:

- Booking and sending appointments
- Booking and sending appointments for individuals who are selected
- Sending referral
- Sending healthy letter
In the first small process, the RPA is generating a list of women who will get an appointment for a mammography. The RPA is iterating through the list and if the individual has no remarks, the first free slot is booked, otherwise, an appointment with regard to the remark is booked. After booking slots, a request of sending the times for appointments to the women are made, and if no problem occurs, the process ends. In the case where an error occurs, an error message is sent to the user (mammography department).

The second process is letting the individual know the result of the mammography. For the individuals that are categorized as healthy, a health letter is sent out. The individuals that are categorized as selected, the RPA is booking a new time for further investigation and requesting sending out the times for the further investigation. If the RPA encounters any problems with either sending healthy letters or booking a further investigation, an error message is sent to the mammography department.

Like for the earlier process, the goal of this process is letting the individual know the result from the further investigation. The individuals that are categorized as healthy, gets a health letter is sent out to them. For the individuals that has cancer gets a referral. In the case of the RPA encountering any problems, the problems gets send as an error message to a user at the mammography department.

In the swimlane Data, databases with women between ages 40 to 74 years old, time bookings, lists of individuals getting selected and lists of individuals getting a health letter is illustrated. The swimlane Kirurgi, only one has one task, receiving referrals. As for the swimlane Externt företag, has three tasks. The first is sending the physical letters with the appointment for the mammography, the second is sending healthy letters to the individuals, and the last task is sending letters with the time for further investigation.

### 4.2.2 Final prototype

![Final prototype of the screening process model](image)

**Figure 9:** Final prototype of the screening process model. In this version, the mammography swimlane has been divided into several sub-swimlanes, just as the RPA swimlane now consists of several sub-swimlanes. A larger version of the same figure can be found in the appendices, see Appendix A.2
In the final prototype of the process model, both the mammography swimlane and the RPA swimlane have been divided into several small sub-swimlanes. The flow for the individual looks the same as in the first prototype. In this version, explanations have also been added to each swimlane that describing the purpose of that particular process. It has also been added what triggers the process and what terminates it.

4.2.3 Swimlane: Individual

![Figure 10: Swimlane Individual. This figure illustrates the flow for individual in the screening process.](image)

In the automated process, the flow of the individual is the same as for the current system. In this process model, the individuals’ swimlane is one process, see Figure 10. All women between 40 and 74 get a booked appointment every second year and thereafter each individual has to decide whether to go or not. If the individual decides to go, the decision about time has to be made and if the time is right the individual is going to the booked appointment. In the second case, if the time does not fit, the individual can change the time by logging on to 1177 or by making a phone call. For the next step, the individual attends an appointment and undergoes a mammogram. The answer from the mammography is either "healthy" or "selected". If the answer is "healthy", the individual will get a "healthy letter" and a new time for a new mammography within 24 months. If there are any uncertainties about the individual they getting selected and a decision on whether to go or not has to be decided. If the individual decides to go, an investigation to see if it is cancer or not is looked into. In this step, the answer is either "healthy" or "cancer". The answer healthy means that the individual will get a "healthy letter" and get a new appointment within 24 months. In the case of cancer, the individual gets a referral and further treatment is done at a different department.

4.2.4 Swimlane: Mammography

The final developed automated swimlane for Mammography contains the same task as in the current system. In the final process model, the Mammography swimlane consists of 6 smaller processes. The flow of the processes is shown in the big Mammography swimlane, see Figure 11.

![Figure 11: Swimlane Mammography Department. In this figure, the task executed in the Mammography department are shown in the right order.](image)

The first task is Boka med manuell handläggning. If any bookings need to be done manually, the medical secretary executes the process. The booking involves accessing the calendar for all booked appointments finding an available time and then reserving that slot, followed by sending the appointment to the individual, see Figure 12. The next task is
handling and sorting error messages. A mammogram is conducted followed by a review of images from the mammogram. These two tasks are executed by either a medical nurse or a medical doctor, see Figure 13. From the mammogram, the individual is either healthy or selected. Bookings, sending out appointments and "healthy letter are manually executed if needed, see Figure 15.20. "Utredning och granskning" is the next sub-process where an investigation is done and reviewed to determine whether the individual is healthy or has cancer, see Figure utredning och granskning. If the individual is healthy and needs manual processing, the process friskbrev med manuell handläggning is executed. In the second case, cancer, a transition to a cancer process occurs.
4.2.5 Robotic Process Automation - RPA

In the final process model, five sub-processes have been developed. All of these sub-processes are executed without any human interaction, see Figure 16 for an overview of the flow of the sub-process.

The sub-process RPA: boka och skicka kallelse för screening is executed weekly. The goal of the process is to book appointments and send out times for booked appointments to individuals in the database. The robot generates a list of those to be called for the mammogram, fetches the list and iterates through it. If there are objections or remarks, an appointment is scheduled, considering those but if there are no objections or remarks, the first free slot in a chosen interval is reserved. The next task for the robot is to request to send out the times for the appointments to the individuals. If an error appears or an individual needs manual processing, the individual is added to a list for manual handling. Otherwise, the individual’s status is updated and removed from the list of those to be called for the mammography and the sub-process is ended.

In the sub-process RPA: beslut utifrån Mammografi a robot is monitoring when a mammogram is conducted and a review from a medical doctor is received. The robot monitors the database for individual journals and when an update is made, the robot identifies whether the individual is healthy or selected. If the individual is healthy, the robot adds the individual to a list of those who will get a "healthy letter". If the individual’s status is selected, the RPA-process RPA: Skicka kallelse selekterad is started. Figure 17 shows the flow of tasks executed in the sub-process.

The third sub-process is called RPA: Skicka kallelse selekterad is executed when the sub-process RPA: beslut utifrån Mammografi has found an individual that is selected.
Booking an appointment and sending out the time for the appointment is the goal of the subsection. The robot’s first task is to book an appointment for the selected individual followed by requesting the time for the appointment. If everything goes as planned, the individual’s status is updated, but if an error occurs, an error message is noted to be handled manually. See the flow of the sub-process in Figure 18.

After a further investigation and review of the investigation is done the sub-process RPA: beslut utifrån utredning is started. The robot identifies whether the individual is healthy or has cancer. If the individual is healthy, the individual is added to a list of those who will get a “healthy letter”. In the case of cancer, the individual is sent a referral and the sub-process ends. see Figure 19 for the order in which the tasks are executed.

The last sub-process of the RPA-processes is called RPA: skicka friskbrev. This process is a weekly run with the goal of sending out a "healthy letter" to all the healthy individuals. The robot’s first task is to generate a list of healthy individuals, then fetching and iterating through it. A request to send the “healthy letter” is made. If any issues appear during the process, the error is noted and handled manually. Should the robot encounter no issues, the robot removes the individual from the list, and the process is concluded. In Figure 20, the flow of the sub-process of sending out "healthy letters" is illustrated.
4.3 Q3 - Cost Estimation

Table 8 shows two estimates of the amount of manual work involved in breast cancer screening per year. In the calculations in the medical secretary’s column, function \(3.2\) is 1 min/person, and in the department manager’s column, function \(3.2\) is 5 min/person.

In a year in which 24,000 women receive a booked appointment, the estimated time required is between 39.08 and 68.33 hours.

If 28,000 women receive a booked appointment, the calculations range from 45.60 hours (medical secretary’s estimate) to 79.72 hours (department manager’s estimate).

For the automated process, the idea is to have zero hours of manual work. This means that at least 39.08 hours of administrative time can be saved each year by implementing an automated process design as shown in Figure 9.

<table>
<thead>
<tr>
<th>Booked appointments</th>
<th>Medical secretary</th>
<th>Department manager</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 000</td>
<td>39.08 (h)</td>
<td>68.33 (h)</td>
</tr>
<tr>
<td>28 000</td>
<td>45.60 (h)</td>
<td>79.72 (h)</td>
</tr>
</tbody>
</table>

The costs for mailings to 24,000 individuals range from 3,600 SEK to 92,640 SEK, depending on the fluctuating number of individuals with digital mailboxes each year. The cost 3,600 SEK is if all 24,000 getting an appointment has a digital mailbox, and 92,640 SEK is if...
all women gets the time for appointment by letter. For 28 000 individuals, the costs range between 4 200 SEK and 108 080 SEK, where the lower sum is if all appointments is send by digital mailbox and the higher sum is if all appointment is being sent by physical letter.

**Table 8** Cost estimation for sending time for a booked appointment digitally and physically.

<table>
<thead>
<tr>
<th>Booked appointments</th>
<th>Physically</th>
<th>Digitally</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 000</td>
<td>92 640 (SEK)</td>
<td>3 600 (SEK)</td>
</tr>
<tr>
<td>28 000</td>
<td>108 080 (SEK)</td>
<td>4 200 (SEK)</td>
</tr>
</tbody>
</table>
5 Discussion

Assessing the impact on administrative time for healthcare staff by automating a manual process within a breast cancer screening procedure using RPA was the primary focus of this study. The objective was to investigate how an integration of RPA can help the administrative staff and study the impact of the integration. It also looked at how to design a process model of an automated process. As a result of the study, tasks that have the potential to be automated using RPA were identified, a process model of an automated process using RPA was developed, and the amount of time that could be saved was calculated.

The methodology used was the Design Thinking Method with elements of a case study and the overall findings of the study indicates that RPA can replace certain tasks in the screening process of breast cancer and administrative time can be saved. The process models design has been developed and design decisions have been made after focus group testing of the design.

5.1 Q1 - Can RPA meet specific needs of medical secretaries, increase efficiency and maintain quality care and prevention?

The study of the system was carried out by interviewing two people with different roles in the department. This provided detailed information about the work tasks and the order in which they are carried out within the screening process. Different people in the administrative team may have different experiences of the same process or task. Interviewing several individuals in the administrative staff may have resulted in a larger and more accurate process model of the current system.

As this study investigates the implementation of RPA in a healthcare system, it is important to consider the challenges associated with the management of sensitive healthcare information. In this study, mockup data was used in a PoC to demonstrate that RPA can perform tasks such as traversing lists, sending emails and modifying lists by deleting, ensuring that the right person receives the right information and that people are correctly placed in each list.

The most time consuming task is the non digital task of booking and sending appointment times to selected individuals. This means that just by integrating the same process for booking and sending appointments to individuals who are selected as in the first step of the process, administrative time could be saved. However, just because the PoC shows that RPA is suitable for replacing the identified manual tasks, it does not mean that there are no other automation solutions that could replace the identified tasks.

Implementing an RPA system would not change the individual experience, so the quality of patient care would remain unchanged and consistent.
5.2 Q2 - Design of Process Model

During the development of the process model, several design choices has been made. When the process model was developed, the guidelines mentioned in selection 2.1.3 was followed. Beyond the guidelines, the majority of the design choices taken has been from the discussions during focus groups and interviews.

The target group for this process model is the Mammography department at the hospital. However, the focus group used when discussing the design of the process model was partly developers and individuals with a lot of knowledge of software developing. If the focus group had consisted of individuals with no or less knowledge of software development the design of the process model may have been different.

An alternative design could have been involve extensive use of multiple ‘if’ statements, which may be possible given that many of the processes are similar; for example, sending letters. No matter if the individual is in the early stage of the process and getting an appointment for a mammography or if the individual is selected and getting an appointment for further investigation, an letter with a time with the appointment will be sent out. An alternative process to the result from this study could look like:

- Generate list of individuals who should receive booked appointments
- Check status on individual (mammography or selection)
- Book an appointment depending on the status
- Send out time for appointment depending on status to individual

When considering the introduction of automation, process models are an invaluable resource. They clarify how existing processes work and show where automation can be implemented seamlessly. By using such models, you can easily identify areas for improvement and see how different process steps interact. It also allows you to test different automation scenarios before implementation, minimising potential problems and optimising the outcome.

The process model developed during this study was developed with the help of RPA developers. In the best case scenario, the model would have been developed with the participation of both the developers and the target group to ensure that both parts understood and were able to follow the model.

5.3 Q3 - Cost Estimation

Although the cost estimates in this study are a mixture of estimated and observed data, the calculations provide a deep understanding of the manual work required in the screening process. As shown in the study by Ekman et al. [11], these estimates and the identification and quantification of different cost factors facilitate a deeper exploration of the impact of informal care on society.

The time saved significantly impacts screening processes for breast cancer. However, breast cancer screening is just one among several screenings, each involving thousands of individuals receiving appointments. Implementing this method across multiple screenings could potentially result in substantial time savings overall.
The article "Robotic Process Automation (RPA) in Healthcare" [30], highlights the potential of RPA to replace repetitive tasks in healthcare. The results of the present study indicate that the implementation of RPA in the specific screening process studied can save time required in administrative work.

The study focused on breast cancer screening, but the discussions and interviews conducted during the study raised the idea of exploring the possibilities of implementing similar methods in other healthcare processes. These could include areas where repeat bookings are required, or where the sending of appointments and healthy letter is common.

5.4 Methodological Considerations/Validation of Methodology

The Design Thinking Methodology is often used to capture user needs despite the absence of a specific user in the context. In this study, this methodology provided a way of understanding the intricacies of the administrative staff’s responsibilities.

It has proved highly effective in gaining a comprehensive overview of the system, delineating specific tasks, generating potential system designs, followed by iterative prototyping and careful testing. Its inherent strength lies in its iterative nature, allowing researchers to revisit aspects that were initially overlooked, or to secure and validate critical elements.

The interviews contributed to a deeper analysis than if the study only relied on surveys, for example. However, it would have been beneficial to have access to interviews with more staff involved in the process, not just administrative staff, to investigate whether they also have tasks that could be automated. Interviewers were appropriate in the Empathize and Ideate phases.

As this study investigated a concept, the Test phase may not have been a perfect fit. What could be tested was the design of the process model and a PoC, but it was not possible to test how the new process would work when integrated. The study therefore made hypothetical assumptions about how much administrative time would be required in the automated process.

Additional observations would have been useful or asking participants to measure their own time executing different tasks. This would have provided additional data for calculations of how much time is currently spent on administration in the breast cancer screening process. Individuals work at different speeds and this variation could have enriched the observations.

Involving several people, preferably with different roles within the process, could have provided different perspectives. Tasks that are performed manually, but not executed by a medical secretary could have been identified and solutions for automating them using RPA explored.

5.5 Implementations Considerations

Prior to implementation, it is beneficial to conduct a SWOT analysis to critically review the internal strengths and weaknesses of the system and identify external opportunities and threats. It is also strategic to develop and execute a POC to empirically validate the functionality of the system before going live. At the same time, it is crucial to define the overall
purpose of automating administrative tasks and to carefully assess how this can benefit the Region or the final stage of the current process.

Determining the purpose of automating administrative tasks is critical and involves a careful analysis of the specific goals and benefits that automation is expected to deliver. This includes defining the exact tasks to be automated and the expected results of that automation. This could be to reduce manual work, improve accuracy, increase efficiency or create a more streamlined process. An effect of reducing manual work does not have to mean that a service disappears, it could also mean that time is freed up for an employee to have lunch and/or a coffee break.

When assessing the benefits to the Region, it is important to consider the overall positive impact that automation can have on the whole system or organisation. This can include productivity improvements and time savings, reduced staff costs, increased accuracy and reliability of the process, or even improved quality of patient care. Clearly defining and quantifying these benefits can help to justify and support the decision to implement automation at a Regional level.

Prior to the development of the process model, creating personas could have provided clarity on the intended users of the model. Having created personas of the individuals interviewed in the Empathize and Define phases would also have been beneficial, although the outcomes during the initial phases may not have drastically changed. The design of the process models may have been different.
6 Conclusion

Healthcare staff face enormous workloads with intense schedules and demanding working conditions, limiting valuable time for direct patient contact. Increasing administrative burdens often take focus away from the important work of caring for and supporting patients, creating a challenge for them to balance administrative and caring work.

Medical secretaries today perform tasks that have the potential to be automated by RPA. This study has developed a process model to illustrate how RPA can be integrated into the process and what data RPA can potentially replace. An automated system can save between 39-80 hours of administrative time per year within the breast cancer screening process alone.

This study, like previous studies, shows that RPA has the potential to streamline healthcare processes. It also shows that cost calculations can be used to estimate how much time can be saved with an automated process.

In the absence of much research in this area, this study contributes to the understanding of how RPA can be used in healthcare, and in particular how it can be used to replace manual administrative tasks. I do not know where this should be, but in some places it may be that it is not a medical secretary who performs these tasks, but it may be a nurse. This is particularly important in order to free up nurses’ time to spend with patients.

The Design Thinking Method provided a deep insight into what the process looked like in the selected Region. However, what was missing, and what would have contributed to an even deeper understanding and insight, was to interview more medical secretaries and other staff involved in the process.

Examine breast cancer screening processes in different Regions to identify potential integration points for Robotic Process Automation (RPA), which can streamline administrative tasks and reduce staff workload. In addition, examine other healthcare departments to identify tasks and processes where RPA implementation can free up time for staff to spend more time with patients.

The study highlights the potential of RPA to automate the breast cancer screening process in the specific Region studied. The implementation of RPA offers several opportunities for automation. As a result of this study, it will be further explored how Regions can benefit from automated screening processes through RPA and what strategies can facilitate implementation. This study is a first step in considering the integration of RPA into the existing system.

6.1 Future Work

For further research, studying mammography departments in different Regions could provide comparative insights. In addition, studying different departments or screening proce-
dures within the same or different Regions would provide a broader understanding of how RPA could help automate manual tasks within different types of screening processes.

Examining other mammography departments in different Regions provides a comparative analysis and can provide insights into different approaches and the effectiveness of different methods. Studying other departments or screening procedures within the same or different Regions provides a diverse view of how similar procedures can vary and adapt to different needs and resources. It contributes to a deeper understanding of different applications and how they can be optimised to improve outcomes.
References


A First Appendix

A.1 First prototype

Figure 21: First prototype of the RPA automated system.
A.2 Final prototype

Figure 22: Final prototype of the RPA automated system.