Bachelor Thesis

Impact assessment of Syntilio, a digital platform for extramural care organizations

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Preface

Dear reader,

In this document, I present the research for my thesis, which marks the final step in completing my Bachelor's degree in Industrial Engineering and Management at the University of Twente. This research was conducted in collaboration with Syntilio and focuses on assessing the impact of their digital platform on extramural care organizations. Through this study, I aim to enlighten the reader with an in-depth overview of my research findings and insights into the impact of digitalization in healthcare.

First, I would like to express my gratitude to my primary university supervisor, Mahak Sharma, and my secondary university supervisor, Ipek Topan. Their feedback and guidance have been of great value in improving the quality of this research. I have learned how to structure and write a scientifically well-organized rapport with their support. Despite the tight deadline I set for myself, their cooperation and flexibility made it possible to complete this thesis on time.

Additionally, I would like to thank the team at Syntilio, especially my company supervisor, Raoul Zaal. Their insights and expertise have been of great help during this research, and their input has played a big role in shaping the findings and insights of this study. The opportunity to delve into the healthcare sector, with company visits at a care organization and insights into Syntilio, has been incredibly valuable for me. The open and friendly atmosphere, combined with the willingness to share knowledge, has greatly contributed to the success of this research.

Obtaining my bachelor's degree has been a journey filled with challenges and rewards, but it has helped me to grow academically and personally. This thesis is a reflection of the skills and knowledge I have gained over the past years, and I hope that the findings contribute to a broader understanding of the impact assessment of digital healthcare solutions.

Finally, I would like to thank my friends and family for supporting me throughout my studies, especially during the writing of this thesis.

Pieter Hes
Enschede, February 2025

Management summary

This research was conducted at Syntilio, a health technology startup in Amsterdam. Syntilio focuses on reducing pressure on the healthcare sector by providing digital solutions for efficient and personal remote care. The central challenge addressed within this research is Syntilio's inability to quantify and communicate their impact on care organizations to stakeholders Therefore, the objective of this research was to develop a systematic and generalizable approach to measure Syntilio's impact, leading to the formulation of the following research question:

"How can Syntilio quantify its impact on extramural care organizations to effectively communicate its value to stakeholders?"

The Managerial Problem-Solving Method (MPSM) was followed to tackle this research question. Starting with an in-depth problem analysis, identifying the core problem and the relationships between the related problems. Based on this analysis, research questions were formulated to tackle each phase of the MPSM. The current situation was analyzed by comparing the state of a healthcare organization before and after Syntilio's implementation. The implemented platform was evaluated, providing an overview of Syntilio's operational and strategic advantages. Additionally, a literature review has been conducted to find a suitable framework for measuring the impact of Syntilio and how value is validated within the healthcare sector. The Technological, Organizational, and Environmental (TOE) framework was expanded by adding an Economic dimension, resulting in the **TOEE** framework. This framework has been identified as the most suitable framework for evaluating Syntilio's impact.

To ensure the validity and to analyze the drivers of the framework, interviews with stakeholders were conducted. Leading to the identification of 20 drivers across the dimensions of the TOEE framework. These drivers were prioritized by three experts using the Analytical Hierarchy Process (AHP), from which weights are assigned to tailor the framework to the research context. The experts were from multiple organizations, each with almost a decade of experience in the healthcare sector. KPIs were then assigned to these drivers to make them measurable, allowing for the quantification of Syntilio's impact. For these KPIs, a baseline and a follow-up score are measured, from which the improvement factor can be derived.

The framework is applied to the care organization where Syntilio is shortly implemented, resulting in an overall weighted impact score of 1,115. This indicates that Syntilio has an overall positive improvement of 11,5%, with the main impact scored on the driver's caregiver satisfaction, caregiver efficiency and strategic goals. The driver sustainability scored the lowest, next to drivers that could not be measured. Due to the absence of some baseline data and the short timeframe after the implementation process, the accuracy of the long-term impact assessment is limited. Therefore, it is recommended that Syntilio applies the same framework again six months after they complete the implementation process. After this period, the performance of the KPIs stabilized, and long-term improvements become visible. The framework offers a structured approach to measure Syntilio's impact not only in the current situation but also in future implementations. By applying the framework to multiple care organizations, broader insights into their impact are gained, and the generalizability is improved. It is recommended that baseline measurements are taken before the implementation and the assessment is done six months after the implementation to capture the long-term effects. Furthermore, to increase the reliability of the framework is recommended to increase the number of experts that do the AHP weighting process and the generalizability by input of stakeholders from multiple care organizations.

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AHP	Analytical Hierarchy Process
API	Application Programming Interfaces
TOE	Technology-Organization-Environment Framework
TOEE	Technology-Organization-Environment-Economic Framework
KPI	Key Performance Indicator
SUS	System Usability Scale
MPSM	Managerial Problem-Solving Method
IEM	Industrial Engineering and Management
TWB	Thuiszorg West-Brabant
MCDA	Multi-Criteria Decision Analysis

1. Introduction

This chapter introduces the bachelor research assignment. Starting with an introduction to the research company and elaborating upon the background of the problem in Section 1.1. The problem that the company is facing will be identified and visualized in a problem cluster in Section 1.2. Finally, the problem-solving approach, including the research phases and questions, is elaborated in Section 1.3.

1.1 Company context

Syntilio is an upcoming health technology startup founded in 2022. The company is located in Amsterdam and serves the healthcare sector in the Netherlands. Syntilio has dedicated itself to reducing the pressure on healthcare through digital solutions that facilitate personal and efficient remote care. They help remote care centralists to determine and mobilize unplanned care that is right for the patient and encourage collaboration between organizations and the entire formal and informal care network. Partnering with strategic partners Nedap, Salesforce, Growtivity and Nuts to enhance their performance and ensure seamless integration into the healthcare ecosystem.

Syntilio's market segment is the care and medical industry's remote care professionals and triage specialists, with organizations in elderly care, mental health and disabled care as target clients. Currently, the clients of Syntilio are healthcare organizations that provide planned and unplanned extramural care, these organizations operate outside of a hospital or care home and provide services such as home care and remote monitoring.

The concept and the technology are not new, but this combination in the healthcare sector is an innovation. The platform uses CRM and ITIL technology, and these service management tools have already been proven to work in multiple sectors. Syntilio adjusted the systems to the specific healthcare sector. Previously, all systems in the healthcare sector provided the health itself, but not for the management within the healthcare system. The healthcare sector has its own characteristics, therefore, this is the background of the problem addressed in the next subsection.

1.1.1 Background of the problem

The healthcare sector is one of the most conservative markets, they often prioritize human-centered traditional care methods because they are familiar and viewed as more personal. As a result, many of these organizations' operational inefficiencies are due to a slow digital transformation and limited technological adoption.

There are several reasons for this conservatism and resistance to digitalization. These reasons include cultural reasons, adopting technology in the healthcare sector can be seen as depersonalizing patient care. Financial reasons are also included, there are limited budgets for care organizations. In general, they have technology contracts for multiple years, and the process of integrating a new technology can require a lot of resources. A consequence of the slow digitalization is the lack of automation and digital tools in the daily operations of healthcare organizations. While the care organizations fear a lower quality of care because of technology, there is an adverse effect. As a result of the fragmented information and labor-intensive administration process, there is less time for the caregiver to provide quality care for the patient. Syntilio is founded to answer these digital challenges and help organizations implement digital tools and automation in their daily operations. The current digital situation for care organizations and how Syntilio contributes will be elaborated upon in Chapter 2.

1.2 Problem identification

Two years ago, Syntilio was founded, they had an idea and a vision to relieve the pressure on healthcare organizations by offering a platform where personalized hybrid care is possible. In the past two years, they have developed their solution for this problem and found the first healthcare organization that recognized their solution and where they could implement the platform. They are moving to the next development phase by implementing their product at the care organization, validating their product market fit. While moving to the next phase, new problems arise for Syntilio, which are elaborated on within this chapter.

1.2.1 Identification of the action problem

Syntilio is still working on its product market fit, they have developed a product that they believe is valuable for healthcare organizations. The first organization recognized the value of their product and signed to implement their platform. At this moment, Syntilio's solution only works on paper, but in practice, they are uncertain of their product performance. With no case of a fully implemented product, it is hard to validate their product performance. They think that their product positively impacts the care organization, but in what areas and with numbers is unknown. The missing validated product performance has other effects, the areas of product development are unclear. With no insights into the product performance, the overview of the areas with low product performance and the areas that should be prioritized in product development is lacking. Furthermore, the success of Syntilio's vision is unclear, this will be confirmed with validated product performance.

Additionally, without product validation, Syntilio is struggling to attract new investors. In general, investors want to know what the results of using Syntilio are, so they can decide whether to invest in the company. To grow, Syntilio needs capital to improve its operations, product and to do acquisitions. The capital is raised from investors, so it is important to attract and secure them.

Next to investor acquisition is client acquisition also a problem for Syntilio. The healthcare organization where Syntilio is implemented right now is an early adopter that is taking the risk of implementing Syntilio with no earlier implementation success. The healthcare sector is a conservative sector, resulting in a hard client acquisition without concrete proof of Syntilio's added value. The care organization where the platform is implemented may see a change in the key performance indicators they monitor, like employee productivity or the number of cases that need to be handled. However, the client retention rate will also be affected when Syntilio cannot present validated results of their platform.

The root cause of the problems that are occurring originated in the lack of hard results of Syntilio's impact on care organizations. Because they have no overview of the quantified improvement of implementing Syntilio, problems arise in their client and investor acquisition with the effects of problems in acquiring funding and growing as a company. As well as a lack of focus on their research and development process and a lack of confirmation of achieving their vision.

The focal point of this thesis revolves around the identification of the quantified impact of Syntilio. With the quantified impact, they can communicate their value to stakeholders and have a good understanding of their product performance, areas of product development and the success of their vision. The flow of the identified problems is illustrated in a problem cluster in Figure 1, which highlights the relationships between the problems.

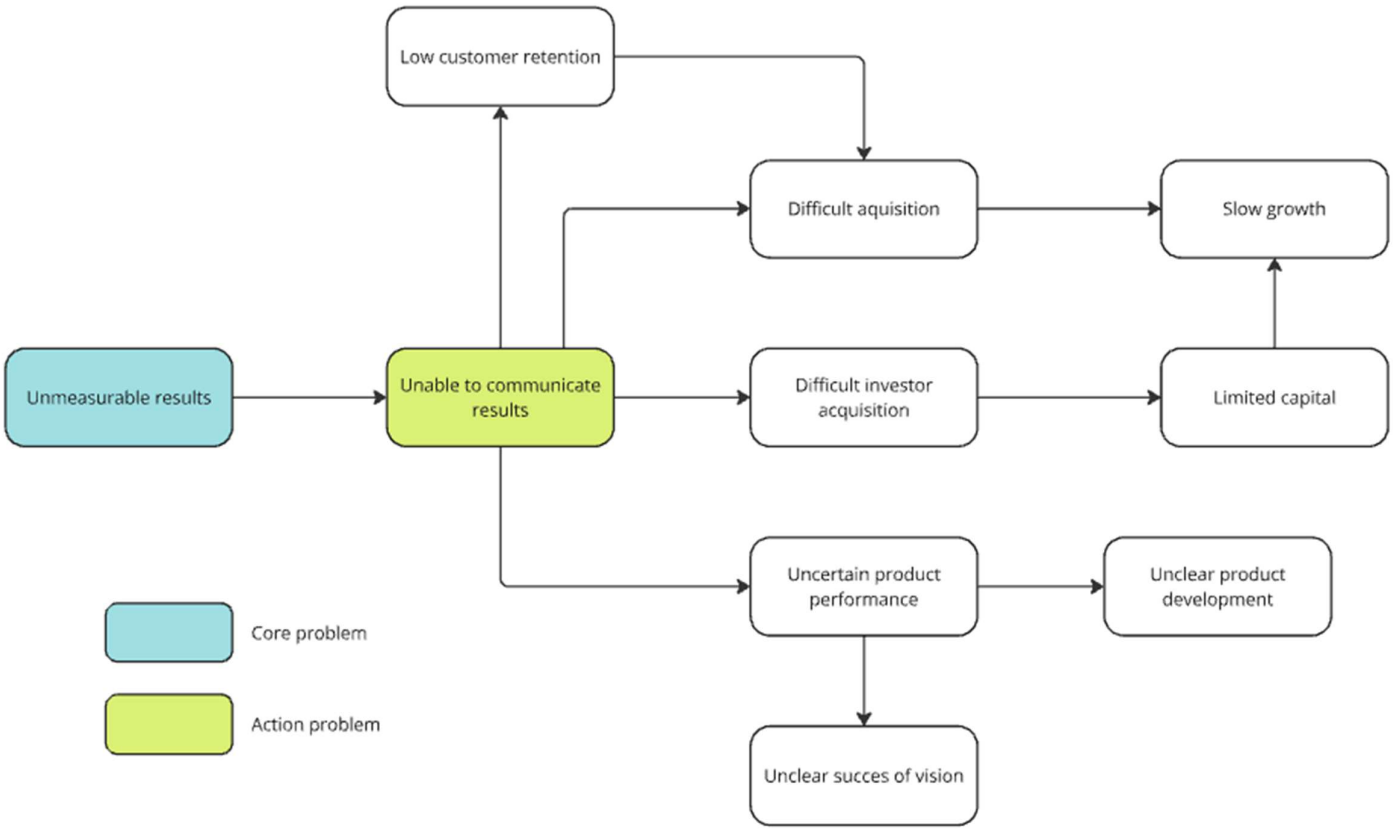

Figure 1: Problem Cluster of Syntilio

Now, defining the norm and reality in measuring Syntilio's impact. The reality is that Syntilio does not have a systematic approach to measure its impact, relying primarily on qualitative feedback from healthcare organizations. As a result, a quantified impact is lacking, making it difficult to communicate clear and measurable outcomes to stakeholders. The norm is that they have a systematic and measurable framework to quantify their impact. This allows Syntilio to communicate results objectively and effectively to stakeholders.

1.2.2 The core problem

With a defined action problem, the core problem for this thesis can be defined. Based on interviews with employees of a client of Syntilio and Syntilio itself, the problems are identified. The problems and their causes and effects are visualized in the problem cluster, as shown in Figure 1.

To find the core problem, follow the chain of problems back to those without direct cause. The problems without direct cause that the researcher can influence are the core problems (Heerkens & Winden, 2016). As can be seen in Figure 1, the core problem is defined as the following:

"Syntilio has no systematic approach to measure the impact of their platform on care organizations."

1.2.3 Scope

To ensure the practical applicability of this research, the study focuses on measuring the impact of Syntilio on unplanned extramural care at care organizations. Care organizations can offer both intramural healthcare and extramural healthcare. There is one client for whom Syntilio is partially implemented at the moment, this is a care organization that provides planned and unplanned extramural care. The scope of this research will focus on that type of organization because this is the only data available. Furthermore, Syntilio is used to deliver unplanned extramural healthcare, this is also the scope of the research. For unplanned care, a centralist is necessary to identify the urgency of the request and what type of follow-up is necessary, this process happens on Syntilio's platform. Next to that, the impact can be better identified since the handling and travel time are higher, and the impact of remote care is greater.

1.2.4 Relevant stakeholders

In order to create a valid and comprehensive framework to measure the impact of Syntilio, input from the stakeholders is essential. The stakeholders are the individuals or groups who can affect or are affected by the achievement of the organizations' objectives (Mitchell et al., 1997). According to the definition and conducted interviews, these are the stakeholders of Syntilio.

1.2.4.1 Stakeholder 1

The first stakeholder is Syntilio, they built and run the platform and know their system best. Their opinion is important to what all the features of the platform are and what their intention behind it is. They can align the framework with the platform's features and capabilities. Their opinion on the important drivers will be a first draft version that can be verified and adjusted by their clients.

1.2.4.2 Stakeholder 2

The second stakeholder is the centralist, who uses the platform daily. The platform and its features are, in principle the main system they use. Their expertise in the triage process and how the follow-up is integrated into the system is crucial to defining the drivers of the platform. How the CareHub supports its workflow and handles the different events is very important to make the added value measurable. The centralists also used the previous platform so they can point out the advantages of Syntilio.

1.2.4.3 Stakeholder 3

The caregivers are the third stakeholder, they are on the receiving end of the platform. Cases that are handled by the centralist will be sent to the caregiver to do the follow-up. They also use the platform to search for client information, medical rapports, and medical device events. So they can give input into the type of information they receive and how Syntilio adds value to this process. Especially the consequences of the centralists' handling that can differ because of Syntilio.

1.2.4.4 Stakeholder 4

The board of directors is the fourth stakeholder, they can contribute to how the platform is aligned with the strategic goals of the company. The motivation is why they chose to switch from the old platform to Syntilio and how they envision this in the future. So, can the drivers include the motivation and strategic advantages next to the operational advantages. Furthermore, can a manager give a good estimation of the resources needed for each platform and if there is any change in the organization’s utilization, profit or employee satisfaction.

1.3 Problem-solving approach

In this section, the research approach to tackle the challenge at Syntilio will be elaborated upon, the research objectives and key questions guiding this study are outlined. The main research design is given, including the research objectives and the corresponding sub-questions. The data collection methods to tackle the research questions are given, and how they are applied is elaborated upon. Furthermore, the validity and reliability of the research will be discussed by explaining how these concepts are taken into account within this research.

1.3.1 Research design

The aim of this research is to find a solution for the core problem that is found in Section 1.2.2. Hence, Syntilio can communicate its technology's measurable impact to its stakeholders. This can be formulated as the following main research question:

RQ: “How can Syntilio quantify its impact on extramural care organizations to effectively communicate its value to stakeholders?”

To address this question, the research follows a structured problem-solving approach according to the Managerial Problem-Solving Method (MPSM) steps. This methodology is commonly used within the study IEM, it is a systematic approach to solve complex practical problems. MPSM is a combination of a systematic approach to doing research on the topic and a creative approach while looking for a solution (Heerkens & Winden, 2016).

As visualized in Figure 2, the MPSM methodology consists of seven phases. These phases are followed sequentially, but when necessary, it is always possible to return to a previous phase and review the initial completed phase. Each phase has a different research objective and will have corresponding sub-questions to tackle the research objective. The first and second phases, problem identification and solution planning, are already tackled in this chapter. The purpose of the other phases will be explained and tackled in the upcoming chapters.

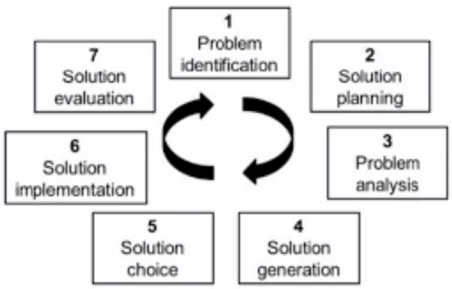

Figure 2: The MPSM cycle

1.3.2 Problem-solving approach phases and research questions

The objective of each phase of the MPSM is elaborated, and their corresponding sub-questions are given in this section.

1. First phase: defining the problem

In the first phase the goal is to get sufficient knowledge about the problems Syntilio is facing, to be able to identify the core problems and subproblems that go along with it. While gaining knowledge about the problem, the relationship between the problems and the motivation why this problem should be solved. This phase is already completed in Section 1.2 of this report.

2. Second phase: formulating the approach

In this phase, are all the steps of the methodology separated and a plan is made to complete each phase. A structured overview is made, including the research objective and research questions needed to complete each phase. This phase is completed in this section.

3. Third phase: analyzing the problem,

Within this phase of the MPSM, an analysis of the current situation is made to get a good insight into the problem. To goal is to get a better understanding of the business process of Syntilio, the objective of their product and who is affected by the implementation. Next, the care organization where the product is implemented is analyzed, including what product they used before the implementation of Syntilio and their operations. The analysis of the current situation is reported in Chapter 2. Based on the findings of the current situation, a literature review that serves as a theoretical foundation for suitable frameworks and value validation will be conducted in Chapter 3. The sub-questions that align with this research objectives are defined as:

SQ1: "What specific technology does Syntilio provide, and how does it benefit care organizations?"

SQ2: "How is value validated within the healthcare sector?"

SQ3: "What frameworks are suitable to measure the added value of the technology?"

To be able to tackle these questions, different forms of research are needed. Starting by understanding the technology that Syntilio offers is partially documented within Syntilio. This information will be analyzed, and all the technology specifications will be identified. Next, multiple interviews will be conducted at Syntilio to identify more about the technology and how it will be implemented. There will also be interviews and observations at the care organization where Syntilio is implemented to identify the current situation before the implementation and the technology's added value.

When the current situation is mapped and Syntilio's technology is identified, knowledge should be gathered on how value is validated in the healthcare sector and what frameworks can be used to measure the value of new technology. This will be gathered by a literature review, starting with creating knowledge of how value is created in the healthcare sector and, simultaneously, what characteristics are considered the most valuable. Lastly, another literature review will be on the frameworks suitable to measure Syntilio's technology's added value. A framework will be a systematic way to quantify the value when its structure supports the situation in which it is applied. In this review, multiple frameworks are analyzed for their suitability to identify the framework that will be used as building blocks for the impact of Syntilio.

4. Fourth phase: Solution Generation

The fourth phase entails combining all the gathered information in the previous phase and implementing this in the framework to create a realistic estimation. The framework will be picked based on the review of the literature found in phase 3, combined with the input of the stakeholders of Syntilio. To generate a systematic solution that suits the context of Syntilio perfectly, the framework needs to be tailored to this situation. The related sub-question is:

SQ4: "What is the most suitable framework, and how can it be customized by identifying the relevant drivers within the specific context of this research?"

The approach to solving this sub-question starts with qualitative interviews to identify the elements that are affected by the implementation of Syntilio. This is a combination of interviewing the stakeholders at Syntilio, the care organization and personal observations at the care organizations. An overview of all the elements will be created, and this will then be discussed with the same stakeholders to ensure their validity. Simultaneously, with literature are elements identified that are relevant to impact this situation. The findings of the literature and the interviews will be compared to create a valid framework that contains all the relevant drivers that are impacted.

5. Fifth phase: choosing a solution

In this phase, the chosen framework will be adjusted to Syntilio's situation. To make this concrete, all the stakeholders' information, literature, and data from the previous phases will be combined to create a perfectly suitable framework for this situation. Therefore, the framework needs to be tailored to the situation of this research. This objective will be accomplished by the sub-question:

SQ5: "How can the framework be tailored to the specific context of this research?"

The elements need to be weighted to tailor a framework that contains all the relevant elements to the context of this research. This process needs to be completed by experts who know the context of this research and can translate this into weights.

Therefore, the experts will conduct an analytical hierarchy process (AHP), who will prioritize the framework's dimensions and elements. The prioritization can then be translated into weights to tailor the framework to the research context.

6. Sixth & seventh phase: implementing and evaluating the solution,

With a perfectly suited framework for the context of this research, the framework can be applied to quantify the impact of Syntilio. To quantify the impact, KPIs should be assigned to the drivers to measure that driver's impact within the framework. When this process is completed, a baseline and a follow-up score can be measured, from which the impact can be calculated and analyzed. The related sub-questions are:

SQ6:" What KPIs can be assigned to the framework's elements to make it measurable?"

SQ7: "Where is the most measured impact when the software is implemented at care organizations?"

To accomplish the objective of the research questions, the findings of the interviews with stakeholders will be combined with the theory to assign KPIs. A consequence of the limited implementation of Syntilio is scarce data availability; therefore, an analysis is necessary to find possible drivers' measurements. When all the KPIs are assigned, the framework will be applied to the care organization. First, to measure the score of the old system they use, and second, to measure the score with Syntilio. The difference in these scores is the impact of Syntilio, which will be analyzed to see where the most impact is made.

A summary of all the research questions with their respective data gathering method and research population is given in Table 1.

Research Question (RQ)	MPSM Phase	Data Gathering Method	Research Population	Covered In
RQ1: "What specific technology does Syntilio provide, and how does it benefit care organizations?"	3	Interviews & Internal Observations	Stakeholders & Company Database	Chapter 2
RQ2: "How is value validated within the healthcare sector?"	3	Literature reviews & Internal Observations	Company Database & Academic Database	Chapter 3
RQ3: "What frameworks are suitable to measure the added value of the technology?"	3	Literature reviews	Academic Database	Chapter 3
RQ4: "What is the most suitable framework, and how can it be customized by identifying the relevant drivers within the specific context of this research?"	4	Outcomes of RQ 1,3 & Literature reviews & Interviews	Academic Database & Stakeholders	Chapter 5
RQ5: "How can the framework be tailored to the specific context of this research?"	5	Expert Opinion	Experts	Chapter 5
RQ6:" What KPIs can be assigned to the framework's elements to make it measurable?"	6	Internal Observations & Questionnaire & Expert Opinion	Company Database, Company Visit & Experts	Chapter 6
RQ7: "Where is the most measured impact when the software is implemented at care organizations?"	7	The outcome of RQ 4,5,6	-	Chapter 6

Table 1: Summary of Research Questions and their Data Gathering Method

1.3.3 Research Data Collection Method

1.3.3.1 Interviews

The data collection method of interviews is a qualitative research method that aims to achieve an in-depth understanding of a situation (Cooper & Schindler, 2013). In-depth interviews were used to gather data for this research during the data collection stage. The interviews will be face-to-face conversations with stakeholders at Syntilio and the care organization where Syntilio is implemented. They work with the platform daily and know all the features, advantages and disadvantages in detail. Hence, they are the perfect candidates to gain further knowledge about the platform and what impact it can have. The interview is processed on the following points:

A) Content analysis

The interview responses are systematically analyzed to identify the recurring themes and create an overview of the key insights and stakeholder perspectives on the platform and its use. The interview transcript can be coded to determine the frequently occurring subjects or the interview can be summarized to extract the main essence of the interview. The main essence of the interview is summarized in the content analysis that will be used for further research.

B) Validating responds

The collected data will be cross-verified to enhance the reliability of the conducted interviews. The content analysis of the interviews will be compared to identify the common viewpoints and the discrepancies between the stakeholders. The commonly identified points are aligned with the literature insights and the observations to ensure consistency and validity.

C) Informed consent form

All participants signed an informed consent form outlining the study's purpose, their voluntary nature of participation, consent, the extent of data confidentiality and where the information will be used. They could withdraw at any stage and were fully informed about the research. This consent form ensured ethical compliance and protected the participant's privacy to the extent they intended.

1.3.3.2 Internal Observations

Internal observations are also a qualitative approach that aims to achieve an in-depth understanding of the situation, this approach is used within the analysis stage of the research project (Cooper & Schindler, 2013). It will act as a method to gain further knowledge about Syntilio, the care organization where the platform is implemented. The observations will contain knowledge about the process, behaviors and events around the CareHub gained. For example:

1 **System & workflow observations:** Direct observations at the care organization where Syntilio is implemented, followed by an assessment of how Syntilio is used daily by the Centralist. Starting with the observations of the Centralists, for what operations they use the platform to tackle their daily operations. Next, what features are valued by the centralists, and what do they dislike. This method generates first-hand knowledge that reflects the real opinion of the stakeholders very well.

2 **Work-related conversations:** This method is about gaining information about the companies or processes by being included in every day office conversations. For example, conversations between Syntilio and the care organization where they are implemented, about the implementation process and what they did (not) like about this process. These conversations provide insights about how the platform performs in real-case organization settings, which provide great unfiltered knowledge.

3 **Company Notion database:** The company has granted me access to their Notion company database, which contains information about their product, strategies, mission and vision and competitors. This database serves as a centralized knowledge source, which contains structured documentation of the general company knowledge. So, general knowledge can be acquired via the database, which can be used as a basis to understand Syntilio, its operations and possible points of impact. For example, their products are on this database with all the features, technical specifications and benefits, which can be used as an initial draft for the technological drivers to cross-reference.

1.3.3.3 Literature reviews

The literature review is a data collection method that involves the systematic gathering, analysis, and evaluation of existing research, theories, and frameworks relevant to this study. For this thesis, the literature review will act as a key source to gather relevant knowledge and perspectives from experts that can be used for solution generation and validation. The steps of a literature review are:

1. **Finding relevant literature**
    - Identify the main objectives of the literature review and establish relevant inclusion and exclusion criteria.
    - Select reliable academic databases, peer-reviewed journal articles and academic books relevant to the literature review's main objectives.
    - Create a research strategy that uses key concepts, related terms/synonyms and relevant search queries.
    - Gather a broad selection of literature that is related to the research objectives.

2. **Selection process**
    - Create an overview of the found literature and check for duplicates.
    - Apply the inclusion and exclusion criteria to the found literature, and make sure that all the articles are valid from which to extract information.
    - Check the titles and the abstracts of the remaining literature and exclude all literature that is irrelevant.
    - Choose the most relevant literature to use for this literature review.

3. **Analyzing selected literature**
    - Read the chosen literature in depth and analyze it to determine the accuracy and validity of the findings.
    - Extract the relevant theories, findings and conclusions from the chosen literature that contribute to the research objective.
4. **Discussion**
    - Evaluate the findings of the literature on consistency with other literature and if it is inbound or outbound with the thesis.

1.3.3.4 Expert Opinion

Expert opinions are of significant importance in this research, and their input is essential to finding a reliable solution validated in this research environment. An expert is an individual who is exceptionally knowledgeable about the issues that are discussed (Cooper & Schindler, 2013). In this case, the CEO of the company that created the platform that is researched is very knowledgeable about the platform and the market he is trying to establish. Or the senior community nurse who is the head of the community nurse department where the platform will be implemented. The steps to establish expert opinions as input for this research are outlined in the following steps:

Identify and contact the expert

- Choose an expert who is exceptionally knowledgeable in the field of unplanned extramural healthcare platforms.
- Establish contact with the expert, discuss the research objectives and seek willingness to use their opinion as input for the research.
- Prepare the questions and make sure there is a clear overview of all the relevant subjects that need to be discussed.
- Conduct and process the interview as discussed within the data collection method interviews.

1.3.3.5 Questionnaire

Quantitative research methods are methods that attempt precise measurements of something, which is necessary to quantify the impact of Syntilio. Therefore, a questionnaire is created with statements that are evaluated by experts on a 5-point Likert scale to convert the subjective expert opinions into a numerical score for analysis. The statements have a favorable or unfavorable attitude towards the subject, and the expert can agree or disagree with the statement (Cooper & Schindler, 2013). Because of the limited implementation, the questionnaire has two types of scores. First, the expert will evaluate statements regarding the platform twice, for the old system and Syntilio. These scores are the baseline score and the follow-up score, from which the improvement factor can be calculated. Second, the other statements cannot be evaluated for the old situation and, therefore, will only be evaluated for the situation with Syntilio. In this case, the neutral score of three is the baseline score, and the questionnaire score will be the follow-up score, from which the improvement factor is calculated. This way, the drivers can be measured quantitatively, and the performance of Syntilio can be measured against the baseline score. The questionnaire statements are elaborated upon in Chapter 6.

1.3.4 Validity and Reliability

Validity and reliability are of high importance for any research, and it is essential to produce trustworthy results that can be used for policy development or future studies. Both concepts will be explained to ensure that this research is valid and reliable, and how this is applied to this research will be elaborated on.

1.3.4.1 Validity

Validity refers to the extent to which a test measures what it is intended to measure. According to Cooper & Schindler (2013), validity can be divided into two types: internal validity and external validity, both of which are essential for this research.

Internal validity ensures that the conclusions drawn about demonstrated experimental relationships truly imply causation. Two investigative approaches will be applied to validate Syntilio's technology and make unbiased assessments of whether their software provides added value. First, interviews will be conducted at Syntilio and at the company where their platform is implemented. These interviews will allow stakeholders to identify all relevant drivers for the platform. To ensure the research's validity, choosing the appropriate stakeholders is crucial. Therefore, multiple stakeholders will be identified and assessed based on their relevance. Their input will then be compared with the perspectives of other stakeholders and existing literature to ensure validity. Second, the identified drivers will be validated through literature research to determine whether they apply in this context and imply causation. Finally, the developed framework will be reviewed by experts to verify that all drivers are relevant and, more importantly, to establish their priorities.

External validity refers to the extent to which the research findings can be generalized and applied to other settings (Cooper & Schindler, 2013). Ensuring external validity is a key consideration throughout this thesis. In-depth interviews with stakeholders from multiple companies will be conducted to ensure a broad perspective. Because data from multiple organizations serve as input for the framework, it is expected to apply to care organizations in general. The knowledge gained from these interviews must be evaluated for its generalizability to ensure it can be applied to other care organizations. In principle, if the insights align with the technological innovation of the TOEE framework, the findings should be valid for application in other organizations that provide similar types of care. However, variations may exist in how different organizations prioritize key value elements, potentially leading to slight differences in scoring.

1.3.4.2 Reliability

Reliability has to do with the accuracy and precision of a measurement procedure according to (Cooper & Schindler, 2013). If the research is replicated, the same findings will be achieved. According to (Saunders et al., 2019) when considering reliability, the distinction between internal and external reliability can be made. The internal reliability refers to the consistency of the research. Especially during the interviews that are conducted, it is important to be uniform in the questions and the method to analyze and evaluate the answers. The input of multiple stakeholders will be used to ensure that the research is considered reliable. When multiple stakeholders give similar input for the research, the precision will increase. A 5-point Likert scale will be used for the answers to ensure an evaluative comparison can be performed that can be used to measure the quantitative questionnaire KPIs. Resulting in comparable answers and quantifiable data for the research.

External reliability refers to the consistency of the results when the research is conducted by another researcher. A requirement of the framework used in this research is that it should apply to all care organizations with the same type of care. This results in a very specific evaluation of whether certain value elements are only valuable for the care organization that is interviewed or if they are generalized to all organizations. The framework should yield consistent results when applied to similar organizations, provided that the same methodology and conditions are maintained (Ceteris paribus). However, it is based on interviews that can only be conducted once, and how questions are interpreted depends on the person. Part of the framework will be measured using a questionnaire containing statements. These statements will be applied before and after the implementation of Syntilio and are reliable to apply to other organizations assuming the same conditions. Another student with the same IEM background at the University of Twente, another student should be able to replicate the research and obtain similar results (Ceteris paribus).

1.3.5 Limitations

The limitations that may arise during this research will be discussed in this section. Starting with the data gathering, a significant part of the input for this research is gathered through interviews with key stakeholders. These interviews provide valuable insights, but they also introduce potential limitations. The stakeholders may have very different opinions and perspectives, which can lead to bias in the data. When the stakeholders have a personal bias about certain dimensions in the framework, this bias can possibly interfere with the framework's weighting process.

Another limitation is the availability of data, the technology that is studied has not yet been fully implemented. There is one care organization where a part of the technology is implemented, they will implement the entire technology in the upcoming period. This may result in assumptions and projections that are not entirely like the actual situation. Accurately measuring the key performance indicators that are linked to the drivers is also challenging. Some KPIs can not be quantified because the technology has not yet been implemented, which results in modelling for the data or having no quantified value.

Size and scope, about the generalizability. There is one client where they are implementing the full technology. This is why the input is taken from that company. This company has a specific care structure, resulting in a framework that applies to organizations with the same care structure. This can be a limitation in generalizability because the framework is built with input from experts in a single organization. This organization offers a specific type of care with a specific operational structure, and the experts will probably have a common organizational opinion. As a result, the findings may have limited general applicability to care organizations that offer a slightly different type of care or provide care by another operational structure. It is possible that some drivers of the framework do not apply to another type of care organization, which results in an inaccurate output of the framework.

In conclusion, while possible limitations may interfere with the successful result of this research, I aim to mitigate these limitations and provide valuable contributions to Syntilio and the field of science. With these limitations acknowledged beforehand, error-informed choices for the research could be made and prevent the limitations from becoming reality.

2. Context analysis

This chapter provides insight into the services that Syntilio offers to care organizations. The situation at care organizations before Syntilio is implemented is described in section 2.1. Section 2.2 elaborates on all the services that Syntilio provides. Then, the operational and strategic advantages of Syntilio will be elaborated upon in section 2.3.

2.1 Situation before Syntilio's implementation

An interview was conducted with a centralist at Thuiszorg West-Brabant (TWB) to map the previous situation at a care organization before Syntilio's implementation. Thuiszorg West-Brabant is a care organization that provides planned and unplanned extramural care. The System of Syntilio is used by the centralist to receive incoming unplanned care requests, do the triage and start the correct follow-up procedure. At the time of the interview, Syntilio was partially integrated, which means that some centralists use the platform for a certain type of event. The other centralists still use the old platform until everything is implemented correctly and all centralists can transfer to the CareHub of Syntilio.

At TWB, they use the database Nedap in combination with Taskmaster to keep track of the statistics. When a call comes in, they ask for the client's name and date of birth, which they use to search the database for the client's details. Once they have the client's details, they can search for their care plan, (informal) care contact number, recent events and follow-up. All the information they look up will open in different tabs on their computer, which they must navigate to handle the event. During busy periods, the centralist has many tabs open for different clients, and it is easy to lose the overview. Next to that, do they have to document every event, what type of event it is and how it is handled. This documentation is done from scratch, which means they start with the name of the client it is about and all other details. This results in many copies and pastes from tab to tab to create a good overview, which is an error-sensitive process.

An important process of the centralist is to triage care for an incoming event, this process is now dependent on the centralist. They do the process off the top of their head, when there is a doubt about handling an event, they search for the triage plan online. Overall, most triage protocols are basic knowledge, but in case of an uncommon event, is there a book or a website where they can search for the protocol. This is an extra application they must also open, resulting in extra tabs to navigate through. Most centralists navigate through all the tabs, but some use a notebook to make notes and write down things. Resulting in a lot of different places where information is stored and a messy overview.

All communication with the centralist is done by phone, the clients can call the centralist, or they are called by Altide for Medido (medicine dispenser events). In general, are they less important, and can they interfere with the other urgent calls. For example, when Altide calls about a medicine dispenser that has lost its power and cannot send an event about the medicine status to the centralist. But in the meantime, a client calls with an urgent medical request, resulting in a caregiver that has to travel to the client to supply that need. In that case, the client has to wait to be heard because the centralist is on the phone with the medicine dispenser company. Consequently, it is hard to mediate through calls on the level of urgency when there are multiple calls.

When the centralist concludes that follow-up is necessary, they will start by estimating the urgency level of the event based on the type of event. If possible, it will be a note for the planned care visit to the client, or the client will be called (video). When this is not possible, will they call a planned caregiver to make a detour to visit the client, and when the level of urgency is really high, they send someone from the emergency care team to the client. Communication between these stakeholders happens in their groups via WhatsApp, email, Nedap's chat portal, or phone calls.

2.2 The technology of Syntilio

The vision of Syntilio is to reduce the pressure on healthcare and to make care more efficient and personal. They offer an innovative platform designed to support the regional cooperation of the care network and enable hybrid and fully remote care next to onsite care. All care processes are centralized at the platform, helping to streamline the triage and care process. Their commitment to making care more efficient results in more room for personal care and accessible care for those who need it. The main products of Syntilio are the CareHub and the DataHub, which will be further elaborated upon.

2.2.1 The CareHub

The CareHub is fundamentally a platform that enables various healthcare systems to integrate seamlessly to create a 360° view of the client and optimize care delivery. Effective regional cooperation centralizes care coordination on the platform, enabling tools and platforms to communicate and collaborate across healthcare providers. Medical devices are also part of this integration, enabling continuous client monitoring. An alert will be sent to the centralist when the client's device signs are not within the margin, allowing the caregivers to act proactively instead of reacting. For a visual representation of the CareHub, Figure 3 displays the platform's homepage. where all open cases are listed in the taskbar. Additionally, the homepage provides an overview of daily tasks and relevant statistics, which create a good overview for the centralist.

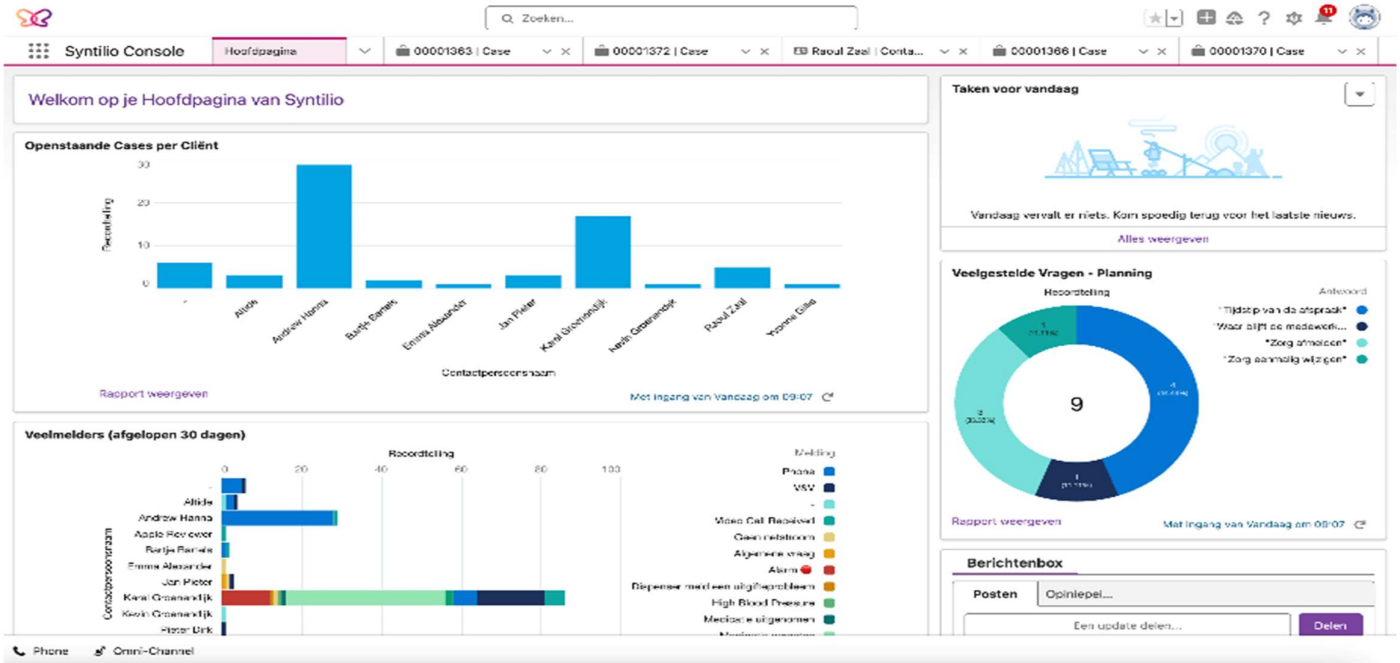

Figure 3 The CareHub of Syntilio

The triage process can also be integrated as a workflow into the platform by introducing customizable dynamic protocols. The correct protocol will pop up when an event occurs, and the centralist can follow the decision-making process. This will result in a custom recommendation based on the specific client conditions, groups or events. In this design, the data from past client events is incorporated so the centralist can make an informed decision and minimize the risk of error. This results in a better prioritization of events, so the specialist can efficiently manage cases and coordinate appropriate follow-up actions. With the protocols integrated into the platform, the handling of events will be uniform for all specialists, and more informed decisions will reduce the risk of errors in the triage.

Effective regional cooperation between healthcare providers leads to shared access to client data and a more unified approach to delivering care. The data of healthcare systems and health devices is translated to APIs (Application programming interfaces), so they communicate with each other through the CareHub. Communication tools such as SMS, email, secure messaging and video calls are included, enabling care providers to communicate directly with clients. Next to that, client engagement also increases, a configurable client portal for self-service allows clients to schedule appointments and communicate directly. The CareHub has mobile accessibility, so caregivers can access and manage critical data on the go and improve overall efficiency.

All the changes that happen in the CareHub are logged, including by who they are made and at what time. This happens for the events and API calls to and from external systems as well, resulting in very effective help from software engineers in case of an error. But even more beneficial for care organizations that the logged information will automatically be used to generate rapports, reducing manual input and errors for the administration. The platform has streamlined digital workflows for efficient client onboarding and offboarding, minimizing manual on and offboarding errors and improving the employee experience.

Within the CareHub, advanced AI and algorithms are in place for real-time data filtering and analysis. Some of the events are already filtered as no follow-up is necessary or can be handled automatically by the system, resulting in fewer events for the specialist. Because of this, data analysis will also automate alerts and recommendations to pop up so the workflow is supported. Medical and care assets are also managed centrally on the platform with constant real-time tracking and maintenance scheduling to ensure asset availability.

2.2.2 The DataHub

The DataHub is the spine of Syntilio's service, offering centralization, integration, and processing of healthcare and technical data, enabling healthcare providers to access client data across their care network. At its core, the DataHub take the ECDs (Electronic Client Dossiers), EPDs, GP Systems, telemonitoring apps and medical devices and uses APIs to integrate and synchronize the data at the platform across the healthcare providers. The API-first approach ensures that integration with existing and future healthcare systems and assets is possible. The DataHub is also available as a Software as a Service (SaaS model) for quick deployment and lower costs.

Specific characteristics apply to the DataHub and what it is specifically designed for. First of all, the DataHub is of scalable architecture and designed for high reliability and availability with a cloud-native. Next to that, it is very secure, the data integrity and privacy are ensured by end-to-end encryption, GDPR compliance and role-based access control. Because client data is very privacy sensitive, it is important that it is very well encrypted and no data can leak, that is why everything is according to the GDPR, ISO and NEN standards. Third, the DataHub is very interoperable, it supports many healthcare data formats, healthcare information building blocks and custom APIs. Lastly, errors will be easily located in the monitoring analytics dashboard, where all changes in the system are logged.

2.3 Operational and strategic advantages

The following operational and strategic advantages were found based on the interviews at TWB. Starting with the operational advantages, the biggest advantage is the system overview. While creating an overview, there are no more multiple tabs that each show a part of the information, but all information is centralized together into one system. Especially during busy periods with consecutive events is more organized, with only different tabs per case instead of a tab per client information. Next, the client information can be copied with one click of a button, making it easy and less error-sensitive. When a client calls, will their number automatically be recognized, and will the name and ID of the client pop up. Also, is it possible to extend the graphs of the client data, like the number of events or the frequency a client calls, to see if there are common occurrences.

Additionally, an advantage is that not all Medido events require a call to the centralist, but it is communicated as a new case in the Syntilio platform. Many of the Medido calls are waste calls, so a contradicting event occurred for the initial event. If this happens within the set time limit, the event can be deleted, and no follow-up is necessary. Especially in busy periods, this is an advantage because the centralist does not need to have a phone call conversation for low-priority events when there is also a high-priority event calling. This will help prioritize and handle events based on urgency.

The partial automatic administration of events is also a feature that saves time and leads to more accurate reporting. Furthermore, the built-in triage protocols lead to faster, more uniform and more accurate triage. Centralists no longer need to search the internet to find the triage protocol of uncommon events, they can view it within the application.

The option to use video calls is a big advantage as well, it can be used as a substitute for a caregiver to go to a client physically. During the video call, a better triage can be completed and more frequently concluded that the event is not urgent enough to send a caregiver to the client. This will lead to a reduction in the number of unplanned visits and a response time for unplanned visits that do need to happen as a result. The distance between clients can easily be 45 minutes, so every visit that can be prevented will save a lot of time. The video call is also a good option for providing care in risky neighborhoods when it is not safe for a caregiver to go to the client physically.

On top of the stated operational advantages, the software will also help accomplish the strategic goals. The strategic goals of Thuiszorg West-Brabant are to work towards a digital transition in healthcare hybrid care to help clients stay at home longer and receive the care they need. This is possible by synchronizing medical devices with Syntilio and being able to video call for a quick triage and possible handling of an event. Increasing employee satisfaction is also one of the strategic goals, the employees are at their best when they do what they love (Thuiszorg West-Brabant, 2023). The service of Syntilio will help achieve these goals by creating a centralized platform that provides an easily accessible overview for the centralist. Another strategic pillar is to create safety for employees and clients, this is created by the option to video call so care is easily and faster accessible, and employees do not need to go to risky neighborhoods for care that can also be provided remotely.

Choosing Syntilio is also a strategic choice, it increases opportunities for the future. Other systems and services can easily be implemented with Syntilio, which means the system is future-proof. With a digitalizing world and more devices that generate data, Syntilio is the platform that can receive all this data and transform it into insights for the care organization. Because information is easily gathered, is there an opportunity to increase the care chain and department collaboration. With better communication between the parties, the organizations in the care path of the client can communicate better and provide higher quality care. So, working with Syntilio supports an organization’s strategic goals, helps it be future-proof, and increases collaboration within the care chain to provide high-quality care for the client.

2.4 Conclusion on the current situation

Chapter 2 created an overview of the current situation at care organizations, how their daily operations are structured and what steps they must take to do their daily operations. Next to that are the features of Syntilio, which stated and explained how this can be an advantage for the centralist and a care organization in general. Their two technologies, the CareHub and the complementary DataHub, are elaborated upon. Furthermore, these two sections combine operational and strategic advantages. The features of CareHub are applied to the current situation to indicate the advantages of using Syntilio's system. To understand the impact of Syntilio, a theoretical foundation is required. The next chapter reviews existing research on how value is measured and validated within the healthcare sector to establish the academic context for this study.

3. Literature review

3.1 Validate value in the healthcare sector

For this research, the impact is measured within a healthcare organization. A literature review was conducted to identify what is valued in the healthcare sector and how this is evaluated. In this review are different frameworks evaluated, these frameworks measure the value or principles that can guide an organization to become more valuable.

The ACEA + MCDA Hybrid is a framework that is used to make the trade-off between the cost-effectiveness and the social values of healthcare in the US. The framework is based on the Augmented Cost-Effectiveness Analysis (ACEA), which primarily consists of the measured costs of Quality-Adjusted life year (QALY), this is a method to measure the quantity and quality of life with other additional value elements. Next to this are other value elements, which consist of insurance value, equity, and value of hope. This framework is complemented by the Multi-Criteria Decision Analysis (MCDA), which prioritizes certain parts of this framework by giving weight to the criteria. In the rapport, the effectiveness of the combination of these frameworks is discussed, and it concluded that the frameworks work very similarly and well together if the assumption is made that health and income amplify each other. The framework is good for getting an overview of healthcare value and using this to make complex and high-stakes decisions (Zamora et al., 2021).

Instead of comparing care delivery to costs, the Health-Sustainability framework (H-S Framework) compares care delivery to sustainability considerations. This framework is primarily designed for healthcare facilities, such as hospitals and clinics, to measure performance and identify and improve lacking areas. The framework consists of core sustainable and health elements. The sustainable elements are economic responsibility (cost-effectiveness), environmental sustainability (minimizing environmental impact) and social responsibility (equitable access to healthcare).

The health elements primarily consist of the client matters indicator matrix, these are weighted client-centered indicators on which facility's scores. Client-centered indicators measure the overall client experience, including the quality of treatment, accessibility, and safety. With this framework can healthcare providers asses their performance in delivering quality care for economic, environmental and social sustainability. Using this assessment to measure how the clinic scores on these points and, if necessary, align their strategy and operations. (Moldovan & Moldovan, 2024).

The Multi-Criteria Decision Analysis (MCDA) can be easily adjusted to many different situations (Sharma & Sehrawat, 2020; Sharma et al., 2024). While conducting the literature study, two variations were used to validate the value in the healthcare sector. Starting with the client-centered MCDA, this framework is designed to measure the priorities of clients and caregivers. The framework is built on the principles of the Client-Driven Values in Healthcare Evaluation (PAVE) framework, which consists of client-driven value elements that reflect the priorities of clients. The elements of this framework are clinical impact (how well the treatment works), financial impact, social and emotional well-being, clients' functionality and their quality of life.

For this research, one-to-one client stakeholder discussions were considered to identify and weigh the client-informed value elements. The client-informed value elements that are considered important by the client stakeholders are the short and long-term treatment effects, treatment costs and access, life impact (impact on the ability to function in daily life) and social impact. It is concluded that the Client-Centered MCDA has a strong correlation to the PAVE framework, and it is a good way to reflect and measure the client's priorities (dosReis et al., 2020).

Another derivative of the MCDA is the value-based multi-criteria decision analysis, which is an adaptation of other value frameworks designed to measure value in specific cases of rare disease treatments. The criteria of the value-based MCDA are derived from the (International Society for Pharmacoeconomics and Outcomes Research) ISPOR Value Flower framework, this framework is an extension of the normal cost-effectiveness framework by including various other value elements. The key value elements are the Quality-adjusted life years, insurance value, value of hope, equity, science spillover and severity of the disease. All the “petals” of the flower represent value elements assigned a specific weight, which can be adjusted to the stakeholder preference. This framework functions very well in assessing a stakeholder value in very specific situations because it can easily be adjusted to stakeholders' preferences (Fischer et al., 2024).

The triple aim framework is a framework that is adopted by organizations all around the world to provide high-value care. The triple aim is centered around three interconnected goals. Improving the individual experience of care means improving the quality of care, accessibility and satisfaction of the patient. To improve population health, focus on preventive care and reduce the prevalence of preventable conditions. Finally, reducing the costs of healthcare, ensuring cost efficiency in healthcare without compromising in quality. This framework is expanded by also including the experience of providing care. The quadruple aim model considers the caregiver's health and experience to be able to give the client a good experience and reduce costs. The caregiver's well-being directly impacts the quality of care that is delivered and is therefore interconnected with the other goals of the triple aim. The framework is a guideline to redesign the healthcare system to improve the health of the population while simultaneously reducing costs (Sikka et al., 2015).Organizations use the framework to set goals and take measures to be able to track their performance across the dimensions. The framework is also adopted in the strategy and policy to shape the healthcare reforms and allow them to be responsive to evolving challenges.

To conclude, all the frameworks to assess value generally have the same approach. In most studies, some adaptations of the MCDA framework have been made. This is a framework that can easily be adjusted to the research perspective. That is possible because it consists of elements assigned to the stakeholders’ preferences and weighted on importance, so the framework is always adjusted to the situation in which it is used. It does not matter if the angle is costs, sustainability, client or value-centred; the MCDA framework is perfectly suitable for most situations in healthcare to assess and validate the value.

3.2 Framework to Measure Added Value

The previous literature found that a healthcare multi-criteria decision model is the best model to validate value in the care sector. However, in this situation, the impact of a platform used in the healthcare sector is measured, so there are more important aspects than healthcare value aspects. The platform is a new technology implemented in the healthcare sector, which is why other technology adoption frameworks are evaluated for suitability in this situation. The frameworks that are evaluated in this chapter are the Technology Acceptance Model (TAM), Diffusion of Innovations Theory (DOI), Unified Theory of Acceptance and Use of Technology (UTAUT) and Technology, Organization, Environment (TOE).

Starting with The Technology Acceptance Model (TAM), this model was introduced by Fred Davis in 1989 and has been a very influential model for technology acceptance (Charness & Boot, 2016). The model is derived from the Theory of Reasoned Action to explain the behaviors based on situation-specific combinations, it is a combination of two primary factors that explain user behavior across a broad range of end-user computing technologies. The first factor is perceived usefulness, this is defined as a user's subjective perception of whether a computer system enhances job performance when completing tasks. The other factor is the perceived ease of use, this refers to a user's subjective perception of the effort it takes to use a computer system (Rigopoulos & Askounis, 2007). To illustrate the concept of technology acceptance, take an older adult who plays digital games. When older adults view digital games as difficult or a waste of time, the likelihood of adopting this technology is very low. However, if the adult thinks the digital game is a mental stimulation and easy to learn, the likelihood of adopting this technology is high. The model will measure this on an individual level, how the individual's behavior is influenced by the new technology.

The next framework is the Diffusion of Innovation Theory (DOI), which was first published in 1962 by E.M Rogers. The theory has grown to a widely accepted valuable framework for social change that explains the stages of the adoption of new technological advancements. According to Rogers is the diffusion of innovation the process of how a by an individual new perceived object or idea is communicated throughout various channels of a social system. DOI consists of four main elements: Innovation, Communication channels, time and the social system. An innovation is an object or idea that is perceived as new by an individual or group. According to Rogers, there are 5 characteristics of an innovation that influence the adoption rate. The relative advantage is the extent to which an innovation is perceived as improving the current product or practice. Compatibility is the degree to which an innovation is perceived as consistent with the current values and needs. Complexity is the perceived level of difficulty in using and understanding the innovation. Trialability is the degree to which an innovation may be temporarily experimented with in part. Observability is how well the results of the innovation are visible or measurable.

The element of communication channels is how innovation is shared with the social system. Time is the element that discusses the adoption process and the stages of decision-making over the process. An individual starts the adoption process with knowledge and persuasion about the innovation before making the choice to put the innovation to use and experience the results of the innovation. The social system is the group or individual where innovation diffuses. The characteristics of the social system, like the attitude towards innovation is or how a system is structured has an influence on the level of adoption (Weiss-Randall, 2018).

The Unified Theory of Acceptance And Use of Technology (UTAUT) model was introduced in 2003 by Venkatesh, the model was created to measure the user acceptance of a new technology. New technology can improve productivity, but therefore, it should be accepted and used by the employees within an organization (Venkatesh et al., 2003). To establish the model, 8 adoption models are evaluated on their usage of information technology. The three direct determinants that influence the intention of use and two that influence the usage behavior are elaborated upon.

Performance expectancy is the first determinant that influences the intention of use, it is the extent of the individual's belief that the system will increase job performance while completing the task. The effort expectancy is the degree of ease of using the system or technology. Social influence is the last determinant that influences the intention of use, and it is the pressure an individual feels from a social influence to use the system. Next to the intention of use, there are also determinants that influence usage behavior. The first one is the intention, when an individual has the intention to use the technology, is it more likely to be used. The other determinant is facilitating conditions, which is the belief that the use of technology is supported by the organization or technical infrastructure.

Lastly, the TOE framework, as described in the book The Processes of Technological Innovation (Tornatzky & Fleischer, 1990). Describing the process of innovation starting from the development of innovation to the implementation of those innovations by companies. The framework has an organizational unit of analysis that explains the adoption of technology on three different elements (Baker, 2012; Sharma et al., 2023). The first element in the framework is the technological context, which includes all the technologies that are already present within the company and the specifications of those technologies. The next element is the organizational context, the company's characteristics, and the structures between departments and employees. The last one is the environmental context, the industry structure, and the market in which the company is present. So, the competitors or partners the company has, but also regulatory rules. The model has three categories, but the specific drivers of these categories need to be customized according to the application.

The technology acceptance model may not be the most suitable framework for the problem at hand, as it focuses solely on the perceived acceptance of the end user. Syntilio has next to the impact on an individual level, impact on an organizational and a financial level, which is not accounted for in this framework. Furthermore, the likelihood of the triage specialists adopting the system is high when the company chooses the platform, they have to use the platform to perform their job at hand.

The DOI framework may also not be the best framework for measuring the value of technological innovation. This framework discusses how innovation is adopted and spread through a social system. The research, however, focuses on the success of the innovation post-adoption, not how a startup's product diffuses over the market. So, the technological elements of the innovation are accounted for, but there is a limited organizational and environmental focus within the framework, and the economic focus is missing.

The UTAUT model includes the organizational and environmental determinants for the acceptance of the technology. The behavioral intention to adopt and use technology and the actual use behavior is measured. Within this setting could, the framework be used to measure if the employees of a care organization would adopt the platform of Syntilio and how this adoption can be favored. However, the UTAUT model is limited in measuring the platform's performance, a change in employees' productivity, and other factors that are influenced by the platform.

The TOE framework measures the innovation at an organizational level, just like the product of Syntilio is evaluated. Next to that, does it consider the technological aspects of the product itself, as well as the organizational and environmental aspects. Within this research will the implementation of the platform of Syntilio be measured to measure the impact should the effectiveness and improvement of this platform be taken into account. This framework is very suitable for measuring the impact, however, one dimension is missing. The aim of Syntilio is to provide digital solutions for efficient and personal remote care. To take the efficiency of providing care into account, the economic dimension should be added. When this dimension is included, economic drivers such as efficiency, care period, and costs can be taken into account. So, to adjust this framework to this specific situation, will there also be an economic factor added to the framework, creating a Technological, Organizational, Environmental, and Economic (TOEE) framework. To tailor the framework for the platform of Syntilio, drivers will be picked according to the factors that are influenced by Syntilio's platform. Based on the literature review and interviews the drivers per dimension picked that have an impact on the healthcare organizations where the platform is implemented.

Based on the literature review findings, the TOEE framework has been identified as the most suitable basis for assessing the impact of Syntilio. The following chapter will discuss the methodology used to establish the relationships between the identified drivers, providing a step-by-step explanation of how these relationships are analyzed and weighted.

4. Methodology development

Within this study, multiple drivers for the dimensions of the TOEE framework are identified, and a methodology should be used to identify and establish the relationships between the dimensions and the drivers. Understanding the relationships between the dimensions and drivers is critical to assigning weights and mapping the priorities. The priority ratios of these relationships greatly influence the perceived impact and, should be assigned by a systematic methodology. A systematic methodology is a prioritizing process structured and replicable while simultaneously avoiding a subjective and inconsistent evaluation.

To identify the relationships, the following methodologies were evaluated: Analytical hierarchy process (AHP), preference ranking organization method for enrichment evaluations (PROMETHEE) and technique for order of preference by similarity to ideal solutions (TOPSIS). AHP is a structured approach to translating decision problems into hierarchical components where weights are assigned through pairwise comparison. PROMETHEE considers the preference and outranking relationships by comparing the alternatives on a predefined preference. TOPSIS evaluates alternatives based on their distance to a positive ideal situation and their distance from a negative ideal situation.

For this research, AHP is chosen as the most suitable methodology for assigning weights to framework drivers because it allows for structured prioritization in situations where predefined preferences do not exist. Alternative methods such as PROMETHEE and TOPSIS require either predefined ranking preferences or an ideal solution against which alternatives are compared, making them less applicable in this case. PROMETHEE relies on outranking comparisons based on decision-maker preferences, which were not available at the start of this research. Similarly, TOPSIS ranks alternatives based on their distance from an ideal and negative ideal solution, but there is no absolute benchmark for impact measurement. Furthermore, AHP is widely used to create priorities for criteria in decision problems and assign weights through pairwise comparison (Saaty, 2008). Therefore, the theory used in this research will be AHP to assign weights to the drivers.

4.1 AHP theory

To be able to identify the found dimensions and drivers and weigh the relationships between them will, the Analytic Hierarchy Process (AHP) be used. AHP is a theory of measurement that allows pairwise comparisons of impact drivers based on expert judgment, translating qualitative assessments into a quantifiable priority ranking. When all the drivers are identified, they will be prioritized from the top down, so first, the dimensions of the TOEE framework and then the drivers within the dimensions. Pairwise comparison matrices will be used to determine the relative importance of each driver by assessing their priority rankings. For the comparison, a scale of numbers will be used to indicate how many times one (sub) category is more important than the other (Saaty, 2008). The ranking process will be executed according to the number scale of Thomas L. Saaty, the characteristics are presented in Table 2 (Saaty, 1977). Three experts will rank to ensure the expert opinion's validity. A consistency ratio (CR) was calculated to improve reliability, and an expert input with a CR above 0,10 was reviewed and redefined through an immediate discussion with the expert. This helps minimize inconsistencies and ensure that the final weightings reflect an objective assessment.

Intensity	*Definition*	*Explanation*
1	Equal importance	The two (sub)categories have equal importance to the objective.
3	Moderate importance over another	Experience and judgment slightly favor one (sub)category over another
5	Strong importance over another	Experience and judgment slightly favor one (sub)category over another
7	Very strong importance over another	An activity is strongly favored and its dominance is demonstrated in practice.
9	Absolute importance over another	The evidence favoring one activity over another is of the highest possible order of affirmation
2,4,6,8	Intermediate values	When compromise is needed.

Table 2: The Saaty number scale

For the hierarchy process of the TOEE framework is, a total of 5 square comparison matrixes necessary: one matrix that contains all the dimensions of the TOEE framework and four matrixes that contain the drivers per dimension. The diagonal of the matrix is always one since an element is equally important as itself, the upper triangle contains the relative importance values, and the lower triangle contains their reciprocals.

- Calculate the priority weights

When all experts evaluate all the elements based on their importance, the weights of the elements can be calculated.

1) Aggregate the pairwise comparison matrices.
   The judgements of the multiple experts need to be merged into a single matrix, this is done according to the aggregation of individual judgment (AIJ) approach (Forman & Peniwati, 1998):
   a) For each pairwise comparison, calculate the geometric mean of their judgements.

$$a_{mn}^{aggregated} = \left(\prod_{i=1}^{k} a_{mn}^{i} \right)^{1/k}$$

   Where a_{mn}^{i} is the judgement of the i-th expert comparing factor m with factor n and k, the number of experts.

   b) Ensure that the reciprocal property, the product of a number and its reciprocal, is always one: $a_{mn} = \frac{1}{a_{nm}}$.
   c) Combine the experts' opinions in a single aggregated comparison matrix.

2) Normalize the aggregated pairwise comparison matrix according to the following steps:
   a) Compute the sum of each column in the matrix.
   b) Divide each element in the matrix by the sum of its column.
   c) Calculate the relative weights by taking the average of the values in each row.

3) Validate the matrix to ensure consistent judgments using the following steps:
   a) Compute the λ_{max}, by multiplying the original matrix with the weight vector and dividing it by the weight vector's elements for each matrix.

   b) Calculate the consistency index (CI):

$$CI = \frac{\lambda_{max} - x}{x - 1}$$

      Where λ_{max} is the largest eigenvalue of the pairwise comparison matrix, x is the dimension of the matrix.

   c) Compute consistency ratio (CR):

$$CR = \frac{CI}{RI}$$

Where RI stands for the random consistency index matrix of size x.

if CR ≤ 0.10, the level of consistency is acceptable, and the AHP is valid. When CR ≥ 0.10, the level of consistency is unacceptable, and the pairwise comparisons should be revised.

With the established methodology, the next step is to develop the framework for measuring the impact of Syntilio. The following chapter integrates findings from the literature review, expert interviews, and AHP ranking results to construct the impact assessment framework.

5. TOEE framework design

Now that the most suitable framework is identified, the framework can be tailored to the specific situation. Within the dimensions are the drivers that directly influence the impact of Syntilio in that dimension. In this chapter, the drivers will be identified and their priority assessed.

Some drivers of the framework are identified by interviews with stakeholders at Syntilio and a client where their platform is implemented. Next, a literature review was conducted to identify what drivers are valuable for the healthcare sector. In that literature review, the Lean Six Sigma healthcare model was found, and some principles of that model are also relevant to this framework. Take lean healthcare principles to minimize waste in every process and task, consistently striving to eliminate all the operations that do not add value for the clients. In combination with Six Sigma in healthcare, it is also aimed to create improvements by reducing medical errors and removing defects from processes. The methodologies combined focus on eliminating waste and decreasing defects, striving to optimize operations and increase client value. Drivers of the Lean Six Sigma model that can be applied to the case of Syntilio are the reduced waiting times, for example, clients waiting for a caregiver to arrive. Eradicate defects to improve the quality of care by making more informed decisions and thus making a more accurate triage of the centralist. Next, they save time by reducing motion, by the increase in the use of remote care will decrease the (unnecessary) movement of caregivers. Furthermore, maximize resources by minimizing healthcare overproduction, when waste events are processed by the centralist is overproduction of the handling of events. To remove waste from over-processing, the centralist fills out the same information on administration forms, which can also be filled in automatically (NEJM Catalyst, 2018). These principles increase the value in the healthcare sector, so when Syntilio contributes to lean care for healthcare organizations, this will create an impact. Consequently, will relevant principles of the lean healthcare model be included as a driver in the TOEE framework.

5.1 Technological dimension

The perspective of the healthcare sector towards technology has changed in recent years. Once viewed as a threat to how care is provided, now seen as a supplement to health and relief for caregivers. The rapport of Gupta Strategist (2022), highlights how existing technologies can help keep healthcare accessible. By implementing technology into the operations, Telehealthcare can be provided to monitor patients and provide remote care. Within the healthcare sector is an administrative burden experienced, this can be reduced by (partially) automating the administrative process. This results in more time for the patient, and thus, more patients a caregiver can help, resulting in higher scalability of the healthcare organization. When monitoring technologies are implemented in the healthcare sector, there is a constant and automatic stream of events. These events enable data-driven insights within the work process (Fokker, 2024). A delay or lack of client information hurts the client's treatment and lowers the quality of care. Therefore, it is important that data is always and quickly available, which can be ensured by a good data architecture. Communication between systems and speed in the communication process is crucial for a smooth data exchange (Ferreira et al., 2015). Furthermore, the workflow design within the healthcare process creates an automated transition of information or tasks (Dwivedi et al., 2001). By implementing this technology into care operations, the caregivers are relieved of unnecessary burdens and can focus on providing quality care. The Technological drivers and their definition are elaborated in Table 3.

Technological factors

Driver	*Definition*	*Source*
Interoperability	The ability of two or more systems to exchange information and understand the information that is exchanged.	(Ieee, 1990)
Centralization of the user interface	Providing an aggregated overview of data from different places in a single central tool.	(Vitale et al., 2020)
Process automation	The transformation of a certain manual task of a business process into a task that ICT can perform or assist to increase process effectiveness.	(Martinho et al., 2015)
Workflow design	Workflow and process infrastructure provide the means to support the seamless and timely transfer of, access to, and manipulation of pertinent information.	(Bolcer & Taylor, 1998)
Data-driven insights	Decisions are based on quantifiable measures that track and assess the performance of critical business activities.	(Rejikumar et al., 2020)
Telehealthcare	The delivery of healthcare services and information through ICT.	(Goodridge & Marciniuk, 2016)
Scalability	A scalable infrastructure whose infinite resources are available on demand.	(Ardagna et al., 2012)

Table 3: Technological drivers

5.2 Organizational dimension

The company strategy is everything an organization does to achieve the set objectives. The way the resources are located and the actions that are taken by the company to achieve the company's long-term goals and objectives (Richter & Littmann, 2013). On an organizational level, employee engagement is one of the first factors that tell how an organization performs. With high employee engagement, employees have a high commitment to the organization and are willing to put more effort into the company and stay longer. There are some factors that influence employee engagement, and one of them is the level of satisfaction an employee has. Only a satisfied employee can become an engaged employee (Sundaray, 2011). A company's onboarding process also influences employee satisfaction and stress levels, and a good onboarding process will benefit organizations in the long run. When new employees experience a good onboarding process and are more engaged in their work, they are more likely to stay and put more effort into the company (Cable et al., 2013). Another factor that has an effect on organizational performance is cross-department collaboration. Next to the direct impact of cross-department collaboration on performance, is there also an indirect effect on the knowledge creation and resource allocation (Wipulanusat et al., 2021). A healthcare-specific challenge is the staff shortage, so it is extra important to assign the available staff in the best possible way to meet the needs of the patients. Within a care organization, this is done by task shifting, which is the process of matching the caregiver's skill to the level request of the client. Because lower-skilled caregivers require less pay, is it a way to reduce costs and increase efficiency (van Schalkwyk et al., 2020). All organizational factors and their definition are elaborated in Table 4.

Organizational factors:

Driver	*Definition*	*Source*
Strategic goals	The determination of basic long-term goals and objectives of an enterprise, the adoption of courses of action and the allocation of resources for carrying out these goals.	(Richter & Littmann, 2013)
Caregiver satisfaction	The extent to which caregivers can find joy and meaning in their work.	(Sikka et al., 2015 [ed.])
Department collaboration	Increased levels of interaction within organizational relationships.	(Martin et al., 2016)
Employee onboarding	All development processes that are used to advance new employees to desired levels of performance.	(Holton, 1996)
Task shifting	The process of matching skills to changing needs and opportunities.	(van Schalkwyk et al., 2020)

Table 4: Organizational drivers

5.3 Environmental dimension

The environmental category within the TOEE framework is the environment where the organization is operating, including the industry, competitors, suppliers and partners (Cruz-Jesus et al., 2019). The service of Syntilio is made for healthcare organizations, these are primarily foundations and, therefore, have a non-profit motive. Simultaneously, there is no real competition between care organizations because of a shortage in healthcare capacity. It is common for a patient to require care from multiple organizations within their period of care. The quality of this care is measured by the continuity of the provided care, which strongly correlates with the correlation between the actors in the care chain. To ensure a well-functioning care chain collaboration, the information about the patient should be sufficient and shared on time. Better planning and coordination is associated with higher patient satisfaction and less extended care necessary (Paulsen et al., 2013). Syntilio also creates opportunities to extend the environment a care organization is working in. Because of their technological specs, it is possible to link medical devices to their platform for monitoring purposes. This enables care organizations to explore new partnerships in the future. Next to that, the implementation of Syntilio's platform leads to reduced events that need to be handled physically. This results in a reduction in the number of waste events and simultaneously waste kilometres travelled, contributing to the company's sustainability and the company's green image. The environmental factors and their definitions are elaborated in Table 5.

Environmental factors:

Driver	*Definition*	*Source*
Care chain collaboration	A partnership in power where mutually dependent individuals share decision-making, information and plans within the care chain.	(Lemetti et al., 2017[ED])
Sustainability	A long-term commitment to balancing social, environmental, and economic concerns rather than short-term profits and chaotic practices.	(Dadhich & Hiran, 2022)
Client satisfaction	The result of some comparison process in which expectations are compared with what is actually received by the client.	(Ahmed & Kangari, 1995)
Partnership opportunities	The potential to form partnerships with external parties to integrate new technologies and systems seamlessly.	Author's own

Table 5: Environmental drivers

5.4 Economic dimension

Even though Syntilio's product is generally implemented in foundations that have a non-profit motive, it is still important that they are financially healthy and at least break even. Furthermore, when they are profitable, they can use this money for new investments or to make the care cheaper. Syntilio's features will probably lead in an increase in the caregiver efficiency, because some tasks are automated or is a better workflow design. This will result in faster handling time for the caregiver and simultaneously more time for the patient's quality care (Gupta Strategist 2022). A higher caregiver efficiency will go hand in hand with an increase in the number of clients a caregiver can provide care for. This results in the potential growth of the care organization and the increase in its client volume. The method to assess the efficiency with which healthcare technologies use limited resources to produce health outputs is called the cost-effectiveness analysis (Weinstein, 1990). This economic evaluation method can also be used to calculate the added value of Syntilio's software. The Economic factors and their description are elaborated in Table 6.

Economic factors

Driver	*Definition*	*Source*
Profit	The income accruing to the owner of a business or productive "enterprise," through the operations of that business or enterprise.	(Knight, 1942)
Productivity of caregiver	Improved employee performance by simplifying access to critical information and streamlining workflows.	(Kiani, 2023)
Care period	The period of time a client receives care in a care segment	Author's own
Client volume	Number of clients that receive care from the care organization	Author's own

Table 6: Economical drivers

5.5 Weighting the framework

When all the drivers of the TOEE framework are identified, the framework can be weighted on priority. For this process, three experts have prioritized the drivers according to Thomas L. Saaty's number scale. To be called an expert, individuals need to be exceptionally knowledgeable about the valued elements within a healthcare organization that provides unplanned extramural care and knows all the ins and outs of Syntilio's CareHub.

Therefore, the three experts will be elaborated upon, starting with the CEO of Syntilio. He is exceptionally knowledgeable, with almost a decade of experience in healthcare technologies, and is the CEO of multiple companies within this sector. Two years ago, he started Syntilio and built the platform that is used for this case study, he has conducted sales interviews with multiple healthcare organizations and knows what they value and where Syntilio is adding value to the organizations. The second expert is the program manager of health logistics at TWB, with a master's in management and policy in healthcare and more than a decade of experience in manager positions in healthcare organizations. Right now, she is responsible for the strategy and execution of the health logistics program and is involved in the process of transferring to Syntilio. She knows what is valued within the healthcare organization, why TWB chooses Syntilio and in what areas they appreciate the most impact. The third expert is Syntilio's business developer and hybrid care coordinator. He has almost a decade of experience in healthcare technology companies and has been working early on at Syntilio. He has many health provider relations and is exceptionally knowledgeable about the CareHub.

To conclude, the experts are exceptionally knowledgeable about the healthcare sector, they all have almost a decade of experience in healthcare organizations. With their input to weigh the framework drivers, the weights assigned will be a good representation of the practical situation. The priority is calculated using the AHP theory that is discussed in Section 4.1, the results of these calculations are shown in Table 7. See Appendix B for the exact weights per driver and the AHP process for the experts.

Drivers	Expert 1	Expert 2	Expert 3	Geometric Mean	Rank
Interoperability	0,004448834	0,006976517	0,049576639	0,011544824	17
Centralization	0,016180922	0,003767495	0,051377833	0,014631109	16
Process automation	0,009297487	0,013066034	0,037166574	0,016528012	15
Workflow design	0,012310828	0,016828039	0,022719011	0,016758561	14
Data-driven insights	0,018330884	0,023289922	0,139429391	0,039045285	9
Telehealthcare	0,002987114	0,006403305	0,062669587	0,010622766	19
Scalability	0,004037998	0,004863613	0,050178965	0,009951356	20
Strategic goals	0,092140861	0,032654898	0,107265212	0,068594058	3
Caregiver satisfaction	0,047604157	0,261628534	0,107680305	0,110277968	1
Department collaboration	0,008205479	0,071190677	0,054548009	0,031703118	11
Onboarding employee	0,012030124	0,064807101	0,025139085	0,026961707	12
Task shifting	0,03347638	0,078005281	0,065691029	0,05556349	5
Care chain collaboration	0,053016902	0,080319109	0,036279102	0,053657436	6
Sustainability	0,015379733	0,009463205	0,009069836	0,010969719	18
Client satisfaction	0,144112497	0,042213234	0,043882539	0,064389344	4
Partnership opportunities	0,022593869	0,019171604	0,030876524	0,023736999	13
Profit	0,279700986	0,020081498	0,006454383	0,033096465	10
Productivity Caregiver	0,14891139	0,138195332	0,015901501	0,06891067	2
Care period	0,029392806	0,074289523	0,04163334	0,04496452	7
Client volume	0,045839818	0,032784912	0,042460882	0,039960904	8

Table 7: AHP weighted drivers

With the normalized AHP ranking results from the experts, weights are assigned to the TOEE framework. The following chapter will assign KPIs to the drivers, enabling the framework to assess the impact of Syntilio. Furthermore, the framework will be applied to a care organization to evaluate its impact, and the results will be analyzed.

6. Application of the framework

Now that the drivers of the TOEE framework are identified and their priority is weighted, the framework can be used to determine the added value of Syntilio. Which drivers are influenced by the technology is known, but to determine the impact, the drivers should be quantified. This quantification is done by connecting a performance indicator to the driver. The score of this performance indicator before the CareHub is implemented is compared to the score of the performance indicator when the CareHub is implemented. The quantification of the driver is the percentual improvement of the situation after compared to before the implementation of Syntilio. The percentual improvement will count as the weight of priority of the corresponding driver in the model.

6.1 Framework implementation

The timing of the impact measurements has a big influence on the perceived impact. The baseline measurement should take place before the implementation of Syntilio starts, resulting in a valid value with which the impact can be compared. When a technological innovation is implemented, there are different implementation phases. Starting with the initial adoption period, the level of adoption within the organization can be assessed during this period. There are also early challenges and barriers to the implementation, but this phase is not the best time to measure the impact. The lengths of the phases can differ based on the intensity level at which the technology is used. After six months, the technology is expected to be consistently applied in daily operations and has become part of the workflow. This stabilization phase also accurately reflects the performance and provides crucial insights about the technology performance. After twelve months, the long-term impact can be evaluated and determined if the changes maintained after an extended period of time (Doelmatigheidsonderzoek, 2015). Based on the phases of implementation, between six and twelve months after the implementation is a moment that provides crucial insights and a good representation of the impact. After this period, organizations have had sufficient adoption time, reliable data collection and the opportunity for mid-implementation corrections.

The key to a good and representative model is to choose the correct performance indicators. According to (Carlucci, 2010) are there certain criteria for selecting performance indicators. The first one is relevance, a relevant performance indicator provides information that influences a decision. In the case of this framework, the performance indicator should represent the influence of the driver it represents. Secondly, reliability, a reliable performance indicator is free from error and bias and represents what it claims to represent. Thirdly, comparability and consistency are a key criterion. Comparability represents the quality of the information that is related to the performance indicator so the data can be compared and similarities or differences can be identified. Therefore, the information should be consistent, so a similar period with unchanging characteristics. Finally, understandability and representational quality, meaning that indicators need to be interpretable and easy to understand for users. Considering the criteria for good performance indicators, these indicators are picked to represent the drivers in the TOEE framework.

To all the framework drivers, a KPI is assigned to provide a comprehensive assessment. The data of these KPIs is gathered using two different techniques. Part of the KPIs are derived from objective, quantifiable data that is collected through Syntilio, TWB or other measurable sources. They provide concrete insights into the impact of Syntilio based on efficiency levels and performance trends. The other part of the KPIs is quantified by a questionnaire full of statements that are answered by a 5-point Likert scale. A Likert scale translates subjective opinions and perceptions into numerical values that can be systematically analyzed. This quantitative data will be used to compare the answers to the same statements before and after the implementation of Syntilio. Furthermore, a statistical analysis can be performed to provide aggregated insights. Some drivers will have multiple KPIs, which will be considered equally for the driver. First, the measured data KPIs will be elaborated on, and then the KPIs will be quantified via a questionnaire. The drivers with measurable KPIs are presented in Table 8.

Driver	KPI	Explanation
Interoperability	#Average number of applications used to handle cases.	Fewer applications used to handle a case are a result of increasing interoperability.
Process automation	#Reduction in manual tasks.	Process automation is visible in reducing the number of manual tasks needed to perform and simultaneously the time it takes to perform tasks.
Remote care	#Percentage of events handled remotely by the Centralist.	An increase in the usage of remote care indicates the impact of remote care.
Scalability	#Maximum concurrent event throughput.	The biggest weakness of the system used in healthcare organizations is to receive many events at the same time.
Task shifting	#Percentage of cases in which task shifting happened successfully.	If Syntilio helps by task shifting, this will be displayed in more successfully matched cases.
Sustainability	#Average distance travelled per handling of an unplanned event.	When Syntilio reduces the physical visits by caregivers, the distance travelled will be reduced.
Client satisfaction	#Relevant segments of client satisfaction score (PREM). -Punctuality, employee consistency and level of monitoring.	The impact on client satisfaction will be presented by changing relevant client satisfaction scores.
Partnership opportunities	#Number of services and systems integrated with the platform.	If Syntilio contributes to partnership opportunities, this will be displayed in the number of partnerships.
Profit (cost to serve per client)	#Average service costs per client.	The result of a care organization will increase with a deduction in the average costs per client.
Caregiver productivity	#Average time by centralist to handle the event.	A lower average handling time results in the ability to serve more clients and thus increase productivity.

Care period	#Average period a client receives care per care segment.	Impact on the care period will be visible in the average time a client receives care per care segment.
Client (care) capacity	#Number of clients/centralist; #Number of clients/caregiver	A possible increase in client capacity is displayed in the number of clients/employee.

Table 8: Drivers with KPIs measured by data

The following drivers are quantified by a questionnaire that contains statements about the drivers that are evaluated on a 5-point Likert scale. The scale with the questionnaire answers and the respective score is presented in Table 9:

Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1	2	3	4	5

Table 9: Five-point Likert scale.

The Drivers that are quantified via a questionnaire are elaborated in Table 10, which contains the statements and for which role the statement is relevant.

Driver	Statement	Centralist	Caregiver	Manager	Board of directors
Centralisation (User interface) SUS-Score (Bangor et al., 2009)	1. "I think I would like to use this user interface frequently."	X			
	2. "I found the user interface unnecessarily complex."	X			
	3. "I found the user interface easy to navigate and use."	X			
	4. "I think I would need the support of a technical person to use this user interface effectively."	X			
	5. "I found that the various elements in the user interface were well integrated."	X			
	6. "I thought there was too much inconsistency in the design of the user interface."	X			
	7. "I think most people would learn to use this user interface very quickly."	X			
	8. "I found the user interface very awkward to use."	X			
	9. "I felt very confident using the user interface."				
	10. "I had to learn a lot before I could get started with this user interface."	X			

Workflow design	11. "The workflow aligns well with my daily needs."	X			
	12. "The workflow is intuitive and easy to follow."	X			
	13. "I can perform my tasks efficiently."	X			
	14. "It is easy to understand where I am within the workflow."	X			
	15. "I have a good overview of all my tasks and receive sufficient feedback on progress."	X			
	16. "Throughout the entire workflow, I have all the necessary information at my disposal."	X			
	17. "I feel supported throughout the entire work process by the workflow."	X			
	18. "The workflow includes sufficient automated processes to minimize manual actions."	X		X	
	19. "The current systems and processes support a uniform way of working within the department."	X	X	X	
Data-driven insights	20. "All relevant and up-to-date data is available for the triage process."	X			
	21. "The data-driven insights help me make better-informed decisions."	X			
Strategic goals	22. "Syntilio contributes to achieving strategic goals."	X	X	X	X
	23. "With Syntilio, strategic goals can be better monitored."			X	X
Caregiver satisfaction	24. "Syntilio contributes positively to employee satisfaction."	X	X	X	X
	25. "With Syntilio, I experience less workload in my daily tasks."	X			
	26. "Syntilio contributes to a reduction of the administrative burdens"	X			
	27. "With Syntilio, I am better supported in planning my daily tasks."	X			
Department collaboration	28. "Syntilio supports communication between different departments within the organization."	X	X	X	
	29. "With Syntilio, a smoother transfer of tasks between departments is possible."	X	X	X	
	30. "I have experienced better collaboration with colleagues and other teams since we started using Syntilio."	X	X		
Onboarding employee	31. "With Syntilio, a new employee is fully onboard more quickly.	X		X	

Task shifting	32. “With Syntilio, the skill level of the care task and the employee is matched more frequently on average.”	X	X	X		
Care chain collaboration	33. "With Syntilio, better chain collaboration with other organizations along the client's care path is possible."	X		X	X	
	34. "Syntilio improves communication and information exchange between different healthcare organizations."	X		X		
	35. "With Syntilio, relevant client information from another organization is easily accessible."	X		X		
	36. "Syntilio facilitates a seamless transfer of care between organizations along the client’s care path."					
Client satisfaction	37. “Working with Syntilio contributes to higher client satisfaction..”	X	X			
Partnership opportunities	38. “With Syntilio, it is easier to integrate other technologies and third-party systems.”	X		X	X	

Table 10: Drivers quantified with questionnaire statements.

6.2 Results of the application

To identify the impact of Syntilio by measuring the previously stated KPIs the framework is applied to a care organization where Syntilio is partially integrated. This care organization is Thuiszorg West-Brabant (TWB), right now, there are two Medido (medicine dispensers) clusters living on the CareHub of Syntilio. To apply the framework, the questionnaire was answered by three employees of TWB: A senior centralist, a centralist, and a program manager. The Centralists are handling the Medido cases on the CareHub of Syntilio and the other incoming cases on ONS (the old platform). The program manager is the same expert who did the weighting process, she is very knowledgeable about the strategic choices of TWB and what contributes to this vision. The senior centralist is an employee who works for more than 15 years at TWB and has a senior position for more than 6 years. She is very knowledgeable about everything that happens at the healthcare organization and where the impact is made with Syntilio. Finally, the centralist has been employed for more than 6 years at TWB and uses Syntilio daily. Therefore, she knows what features and elements of Syntilio make an impact and has valid input to evaluate the statements.

Within the questionnaire is distinguished between the function of the employee that completed the questionnaire would get relevant questions for their function. The statements are evaluated twice, first a baseline and follow-up measurements with Syntilio. In this case, a baseline measurement and a follow-up measurement take place for the first three drivers: the user interface, Workflow Design and Data-driven insights evaluated for ONS (the old system) and then evaluated for Syntilio (the new system). The score of the evaluation of Syntilio is then compared to the score of ONS, and a percentual difference is calculated, which is shown in Table 10. With the evaluation of the user-interface statements, the SUS-Score is calculated. This is done by subtracting one from the odd-numbered questions, subtracting the value of the even-numbered questions from 5 and multiplying the sum of these questions to 2.5. Because there was a time limitation to complete the questionnaire, the structure of the other statements is slightly different. Syntilio is still in the adoption period of its implementation, the first clusters are live and running on the CareHub for two months. Next, the other clusters are still running on ONS and will have to be transferred to CareHub soon. Resulting in a change of structure, instead of evaluating the statement on their score with the ONS platform to Syntilio is the statement reframed. The statement in favor of the impact of Syntilio is evaluated once, and this score is compared to the base score of the platform. The base score is an average score of three (neutral) for each statement, meaning no impact is measured when the score remains three. The comparison of the evaluation score to the base score is a comparison value, which will be greater than one in case of a positive impact (confirmation of the statement) and smaller than one in case of a negative impact (denial of the statement). All the results are shown in Table 11, the complete questionnaire results are shown in Appendix C.

Driver	*Baseline score*	*Follow-up score*	*Improvement factor*
User Interface	110	112,5	1,023
Workflow design	57	75	1,316
Data-driven insights	9	11	1,222
Strategic goals	18	21	1,167
Caregiver satisfaction	27	32	1,185
Department collaboration	24	21	0,875
Onboarding employees	9	10	1,111
Task shifting	9	9	1,000
Care chain collaboration	36	30	0,833
Client satisfaction	6	6	1,000
Partnership opportunities	9	12	1,333

Table 11: Evaluated questionnaire results

The application of the framework for the drivers for which their impact is measured by KPIs is measured at TWB as well. Two measurements are completed: a baseline measurement before Syntilio is implemented and a follow-up score. The two values are compared, and an improvement factor is calculated based on these values. As stated before, Syntilio is still in the adoption period with their implementation, resulting in a limitation in the measurement of the follow-up score. The KPIs that measure performance, like the average number of applications or the average handling time, are measurable. However, insights about performance and long-term impact, such as profit and client satisfaction, can be accurately measured when all the care organization operations are live on CareHub for at least three months. At the moment of measurement, only part of the Medido cases live on the platform, so it is not possible to get an accurate follow-up score for these values. Next to that, measurable results of drivers like remote care and scalability can only be measured when urgent cases that require follow-up are also handled by Syntilio. So, given the time restrictions, some KPIs cannot be measured accurately. In these cases, there is the improvement factor one: there is no (positive or negative) impact of Syntilio. The scores of the measured KPIs and the respective improvement factors are stated in Table 12.

Driver	*Baseline score*	*Follow-up score*	*Improvement factor*
Interoperability	4	3	1,333
Process automation	8,5	5,5	1,545
Remote care	-	-	N/A
Scalability	-	-	N/A
Task shifting	54,50%	55,73%	1,023
Sustainability	16,97%	15,90%	1,067
Client satisfaction	7,6 ; 7,3 ; 8,7	-	N/A
Partnership opportunities	0	1	1
Profit (cost to serve per client)	-	-	N/A
Caregiver productivity	03:46	02:04	1,823
Care period	-	-	N/A
Client (care) capacity	6,86	-	N/A

Table 12: Measured KPI results

To calculate the impact of Syntilio, a new normalized geometric mean is calculated where the drivers that are not applicable are excluded. The improvement factor is multiplied by the new normalized geometric mean to calculate the impact. The impact per driver and the ranking are displayed in Table 13.

Driver	*New normalized geometric mean*	*Improvement factor*	*Impact*	*Rank*
Interoperability	0,018824956	1,333	0,025	13
Centralization	0,023857443	1,023	0,024	14
Process automation	0,026950528	1,545	0,042	11
Workflow design	0,027326461	1,316	0,036	12
Data-driven insights	0,063667126	1,222	0.078	6
Telehealthcare	-	N/A	N/A	16
Scalability	-	N/A	N/A	16
Strategic goals	0,111849269	1,667	0,13	3
Caregiver satisfaction	0,179818929	1,185	0,213	1
Department collaboration	0,051695011	0,875	0,045	10
Onboarding employee	0,043963679	1,111	0,049	9
Task shifting	0,090601663	1,023	0,092	5
Care chain collaboration	0,087493657	0,833	0,073	7
Sustainability	0,017887191	1,067	0,019	15
Client satisfaction	0,104993074	1,000	0.105	4
Partnership opportunities	0,03870548	1,333	0,052	8
Profit	-	N/A	N/A	16
Productivity Caregiver	0,112365534	1,823	0,133	2
Care period	-	N/A	N/A	16
Client volume	-	N/A	N/A	16

Table 13: Impact per driver

6.3 Analysis and Interpretation of the Results

This subsection highlights and analyses the drivers with the most significant impact or notable findings. The drivers with the most significant impact are Caregiver satisfaction, Caregiver productivity and Strategic goals, the most notable finding is the driver Sustainability, which has the lowest impact. Furthermore, in this section, the whole framework will be analyzed, and the total impact of Syntilio will be calculated.

What is surprising is that the three highest-ranked drivers of impact are the same as the three highest-weighted drivers. This can be the result of aligning features of the framework and priority of the framework, or it can be the case that the difference in improvement factor is too low to cause a shift in the impact ranking. The Syntilio platform was initially built to make remote care more efficient for the centralist and available to the client. Consequently, caregiver satisfaction and caregiver productivity ranked first and second is not strange, the platform was initially created for them.

Starting with the driver with the highest impact, caregiver satisfaction. This driver is the highest-ranked driver with a geometric mean of 0,180 / 0,816, so it has a priority of 22,1% of all the drivers combined. The driver did not have the greatest improvement factor, the factor is ranked 6 compared to the other drivers. This driver is the driver with the most impact and is supported by the literature, employees with high satisfaction are more engaged within the company. When an employee is more engaged, he or she has a higher commitment to the organization and puts more effort into work (Sundaray, 2011). Moreover, caregiver satisfaction also has a positive effect on patient outcomes. The higher employee engagement results in higher commitment to the patient as well, it leads to personalized and higher quality care delivery (Bodenheimer & Sinsky, 2014). With Syntilio, operations go faster and have a better overview, so this will increase employee satisfaction with all the advantages.

The caregiver productivity is the driver with the second-highest impact, with a geometric mean of 0,112. So, it is little more than half of the importance of caregiver satisfaction, but it did have nearly the same improvement as caregiver satisfaction. As stated before, the platform is essentially built so that the centralist can be more efficient and provide better care. Consequently, that this driver is in the top three rankings is as expected, also in the literature, this is supported. Value is assigned by either increasing the output or reducing the costs to deliver the output. As stated in the Lean Six Sigma healthcare model, the principle of the lean healthcare model is to reduce all the waste in every process that does not add value.

As measured, Syntilio reduces the average time to handle an event, reducing waste within the care organization's process ("What Is Lean Healthcare?," 2018). Furthermore, as stated (Davenport & Short, 1990), workflow optimization and automation significantly enhance caregiver efficiency. These technological improvements reduce work for the caregiver, resulting in more time for the patient. Syntilio optimizes the workflow and automates certain parts of the workflow, so the high-impact findings reinforce the technology and its impact on productivity. As stated in the previous paragraph, does caregiver satisfaction lead to a higher commitment to the company and, therefore, higher caregiver productivity (or quality of productivity). Consequently, it should be expected that caregiver productivity is more important than caregiver satisfaction because satisfaction is a means to increase caregiver productivity.

It is contradicting that the workflow design and the centralization scored very low. As stated in the literature, a smart workflow design means higher productivity. Simultaneously, for centralization, all information available in one place is a means of high employee satisfaction. Even though the result is more important than the means, it is expected that because of the advantage Syntilio has over these drivers, their score would be higher.

The driver with the third highest impact is the strategic goals, with also a geometric mean of 0,112. So, it is ranked with almost the same priority as caregiver productivity, only it has a slightly smaller improvement factor. That the strategy of a company is important is very clear, it is everything an organization does to achieve the set objectives (Richter & Littmann, 2013). Because TWB has set strategic goals to improve caregiver satisfaction and provide more remote care, Syntilio makes a contribution to achieving these goals. Organizations with clearly defined strategic goals tend to adopt technology more effectively when aligned with their goals. However, it is not expected that the strategic goals score this high, the strategy is a means in order to accomplish the set goals and, in this case, provide high-value care for clients. It is expected that, for example, the remote care driver would score much higher since this is one of the strategy goals of the care organization and is directed in favor of the client.

The most notable driver is sustainability, this driver scored the lowest impact. This driver already scored in the bottom tier on the priority ranking and had an improvement factor of 6,7%. Sustainability is a long-term commitment to balance the social, economic and environmental concerns rather than short-term profits. A big driver of sustainable improvement are regulatory pressures and societal expectations (Eccles et al., 2014). The low priority of this driver is probably the result of the lack of sustainable regulatory pressure, next to that, the shortage of care organizations. Clients are happy that someone can provide their care and do not question the sustainability score of the care they receive. Furthermore, Syntilio is built to increase efficiency at the care organization and provide more remote care, but it does not have a primary sustainability objective.

To Calculate the final impact of Syntilio, the N/A drivers were excluded from the analysis to ensure an accurate impact score. Because the normalization of the AHP scores does not sum to one, the remaining AHP scores are normalized again. These new normalized AHP scores are multiplied with their respective improvement factors to calculate the individual impact contributions. These individual impact scores are summed and indicate the impact of Syntilio, when the total sum is below one, Syntilio has a negative impact, and if the score is above one, Syntilio has a positive impact. After recalculating the score is, the total improvement factor 1,115, which indicates that the overall impact of Syntilio is an improvement of 11,5%. This number demonstrates the measurable progress of the weighted Key Performance Indicators, which reinforces the effectiveness of the implementation of Syntilio.

6.4 Discussion

This research aimed to develop a structured and generalizable approach to measure the impact of Syntilio on care organizations. By a tailored TOEE framework with quantitative drivers in an improvement factor calculated. The findings of this process indicate that Syntilio has an overall positive impact of 11,5%, especially caregiver satisfaction and productivity, which has the most impact. However, there are areas for improvement and limitations that are important to discuss. This section will evaluate the results to the existing literature, followed by theoretical implications and study limitations.

Through data-gathering methods, qualitative interviews, observations, and literature reviews, 20 drivers have been identified. AHP theory is used to identify the relationships between the drivers, and by expert opinions, the drivers are ranked on their priority. Caregiver satisfaction and caregiver productivity have scored an overall priority. The priorities of the AHP results are not identical for all experts. While one expert is more economically focused, and ranks the profit, productivity and client satisfaction as drivers with the highest priority. In this case, the technological drivers score the lowest since the standpoint is that they are the means to accomplish other results. There is one expert with an opposite opinion, and here are data-driven insights, caregiver satisfaction, and strategic goals that are highly prioritized. However, in this case, the profit score is very low since healthcare organizations do not have a profit perspective. While some drivers are ranked similarly, there are still some inconsistencies that could even out when the number of experts who prioritize the drivers by AHP increases. Furthermore, the experts work at two companies, limiting the generalizability. Different care organizations have varying processes and operations, which could influence Syntilio's impact. The objective of this research is to build a generalizable model to measure impact, but the result of the study is the extent of the generalizability questioned.

The study results indicate that **caregiver satisfaction** is the most critical driver, which aligns with previous research suggesting that higher employee engagement results in better commitment and effort at work, resulting in an enhancement of the quality and efficiency in healthcare delivery (Bodenheimer & Sinsky, 2014; Sundaray, 2011). Additionally, the high impact of **Caregiver productivity** is consistent with the lean healthcare principles, which state that reducing inefficiencies maximizes care delivery value (NEJM Catalyst, 2018). Similarly, task shifting, where responsibilities are redistributed among healthcare workers according to their competencies. The impact of this driver is high, supporting (van Schalkwyk et al., 2020), who found that reallocating tasks improves system efficiency. Since the shortage of staff is one of the current challenges within the healthcare sector, it was already a driver that was evaluated with high AHP priorities. An unexpected but top three high-impact driver is **Strategy**, this aligns with (Richter & Littmann, 2013). They state that everything an organization does to achieve the set objectives is strategy, which shows that Syntilio is a means to accomplish strategic goals and indicates the influence of strategic plans on the operations.

There are findings of the study that are outline in the literature, sustainability measured the lowest impact. This is inconsistent with (Eccles et al., 2014), which states that sustainability is gaining importance due to regulatory pressures and societal expectations. This may indicate that care organizations perceive sustainability as secondary and that Syntilio does not contribute to sustainability within a care organization. Furthermore, the relatively low ranking of client satisfaction contradicts models, such as the client-centered Triple Aim Framework (Sikka et al., 2015), which states that technology implementation should be evaluated by its impact on patient outcomes. This suggests that care organizations prioritize internal operations before focusing on client metrics. However, this can be biased because the experts knew the research objective was to assess the impact of a digital platform used in internal operations, and Syntilio affected client satisfaction minimally. The impact score of workflow design and process automation is lower than expected and contradicts previous studies. They indicate that automation is a major driver of efficiency in healthcare organizations, in the rapport of (Davenport & Short, 1990) states that automation significantly improves workflow efficiency by reducing manual tasks. A possible explanation for this difference in score could be that process automation and workflow design are ranked as a means to achieve caregiver productivity.

The second part of this study is about quantifying the identified drivers so the impact of Syntilio can be calculated. Within this section are limitations, which should be taken into account to reflect on the findings of this study critically. The low number of questionnaire respondents significantly affects the reliability of the findings. With the sample size of three respondents, the reliability of the conclusions about the overall impact of Syntilio was questioned. Similarly, the number of measurements of the KPI productivity is too limited to draw reliable conclusions. There is a lack of structured pre-implementation data, making it difficult to compare pre-and post-implementation performance. Syntilio is only partially integrated, so some pre-implementation data could still be gathered, but most pre-implementation data rely on expert assessment or neutral scores. At the moment of measurement, the centralist did not receive more cases that could be measured. This constraint affects the ability to make strong claims about the improvement in efficiency and a reduction in time, which also weakens the claim of the total impact of Syntilio

This research was conducted shortly after Syntilio was implemented, meaning that it is too early to identify and measure the long-term impact. Certain drivers, such as client satisfaction, care period or the number of clients, require more time to realize an adjustment. There are drivers that could be measured, but the claim that the improvement is solely Syntilio is weak. For example, sustainability, remote care and task-shifting are improved, but because Syntilio is only partially implemented for a short period of time, it is disputable that this improvement is the result of Syntilio.

6.5 Practical implications

For this research, the goal was to develop a structured approach to quantify the added value of Syntilio. A literature review identified a framework as the most suitable and used as the structure for the model. A significant aspect of this research was engaging with multiple companies' stakeholders to ensure that both the technical features and the company priorities were considered for the framework. When all the priorities were aligned and used to weigh all the elements, improvement factors could be measured per driver and used to quantify the added value relative to the importance of the aspect.

The practical implications of this research are directly relevant to all the care organizations that implement Syntilio or a similar platform. All care organizations that provide unplanned extramural care can use this framework to calculate the impact of their software platform and compare it to the score of other platforms. Because this framework is built by evaluating all the relevant drivers where the platform can make an impact, AHP weights the drivers based on importance and then measures the actual improvement per driver. Can the model also be used to identify areas that care organizations prioritize and use this framework as a structure for evaluating other healthcare technologies. Furthermore, the application of the framework identifies drivers where a low impact is scored or where the score is lacking. Hence, they identify these drivers and can change their operations or adopt strategies to optimize these areas.

Because of the limited implementation of Syntilio, the analysis of the rapport shifted from a holistic vision to a standalone vision. Given that there is one company where Syntilio is partially implemented, the scope narrowed specifically to that care organization. So, there is no input from experts of other care organizations, resulting in the framework's applicability for just this type of organization. Furthermore, the platform was only partially integrated for two months, resulting in limited data availability. The measurements of the KPIs are only the immediate impact measured of the implementation because it is not yet possible to measure it for the long-term effects.

Next to the practical implications of care organization, there are also implications for Syntilio. They can use this framework to measure their impact on an organization and compare the score of their impact from one organization to the other. Based on these scores, they can identify areas to increase their impact. As well as the areas that organizations value the most, which they can use to identify the order of research and development of their product.

6.6 Validity and Reliability

The framework's validity is ensured through expert validation using interviews and the AHP process. To ensure reliable results, multiple experts from different functions of different companies assessed and prioritized the drivers and dimensions of the model. The experts have (almost) over a decade of experience in the healthcare sector and have held responsible positions within care organizations. They work with healthcare technology daily, which gives them a deep understanding of Syntilio's functionalities, advantages and limitations. Their inputs increase the framework's validation, as their experience and position make them a reliable source. However, it is important to note that this study focuses on only one care organization, making the results less generalizable. Therefore, the validity of a generalizable study is limited. Future research should include experts from multiple care organizations to improve the generalizability of the framework.

During the AHP process, experts assigned weights to the identified drivers based on their priorities. The overall alignment of the priorities with the literature supports the validity of the findings. However, the individual priority scores of the experts are not aligned, all experts have given the highest priority to another dimension, which is a limit factor of the validity. The final priority per driver the experts gave is partially aligned, the difference in scores is probably explainable by the fact that they work in different companies at different positions with associated responsibilities. To increase the validity of this study, more experts at multiple care organizations or other positions within the care organizations should execute the AHP process.

Multiple experts were consulted to reduce individual bias and improve the reliability of this research. The 5-point Likert scale questionnaire that's partially used to quantify the drivers for this study is also evaluated by three experts. These experts work with Syntilio daily and represent the care organization well. However, certain limitations in the available data affect the reliability of the quantification of the impact per driver. The KPIs measured through fixed counts, such as the number of applications or process automation, provide reliable data. These are easy to identify and the performance will not differ when Syntilio is implemented for a longer period of time. On the other hand, KPIs based on averages, percentages or time differences are less reliable during the limited sample size and the short implementation period. Some KPIs could only be measured physically at the care organization because of the limited time for this study, and the sample size of these measurements is small. Therefore, these numbers do not represent a longer period, and the reliability of the conclusions drawn from these measurements is affected. To increase this study's reliability, the questionnaire responders' sample size and the KPI measurements should be increased and measured after at least 6 months of full implementation. The score of the long-term KPIs will stabilize over time, so they should be measured with a higher sample size after the stabilization period for a representative measurement.

7. Conclusion and Recommendations

7.1 Conclusion

The objective of this research is to quantify the impact of Syntilio on extramural unplanned care organizations, by applying a structured weighted framework. The TOEE framework is identified as the most suitable framework because it contains all the dimensions on which Syntilio has an impact. It combines the technological features of the technology, the organizational aspects of the organization, the environment where it is implemented and the economic impact. Relevant drivers are assigned to the different dimensions based on stakeholder interviews impacted by Syntilio. Using the Analytical Hierarchy Process (AHP), the dimensions and drivers are weighted on priority. To every driver, a KPI assigned or questionnaire statement is evaluated on a 5-point Likert scale. For each driver, a baseline and a follow-up score are measured. These scores are the improvement factor calculated and combined with the AHP score, which is the impact of the driver.

The framework provides valuable insights for Syntilio as to what areas of their product perceive the most impact. It measures how well their product is implemented and where they can improve it. Next, can they apply the framework to care organizations to measure their impact and compare it to other organizations. The findings reveal that caregiver satisfaction and productivity were the drivers that had the most impact. This suggests that Syntilio has a positive effect on workforce engagement and efficiency. Additionally, strategic goals alignment has a high impact score, suggesting that Syntilio contributes to achieving the strategic goals of a care organization.

This research successfully quantified the impact of Syntilio on an extramural unplanned care organization. The result of this measurement is 1,115, which means that they have impacted the overall performance positively by 11,5%. This is measured on an early-stage implementation, so the score can differ when the product is fully implemented and the performance is stabilized. The study provides a foundation for further refinement of the framework and broader application in the healthcare sector.

7.2 Recommendations

Following the conclusion, it is recommended that Syntilio apply this framework to measure the impact they make on care organizations. The applied framework has measured an impact on the care organization where Syntilio is partially implemented. Still, some recommendations exist to increase the accuracy of the measured impact and areas where they can improve their impact.

Starting with the quantification of all the drivers, currently, not all the care organization's operations are live at Syntilio. Consequently, not all KPIs could be measured because it was not applicable yet or because the partially integrated platform is not affecting that KPI yet. Therefore, it is recommended that the framework is measured again when all the care organization operations are live at Syntilio. Furthermore, it is recommended that the framework measurement be conducted after the whole platform has been implemented for at least six months. This is the period of time that is necessary to get used to the platform and resolve the early barriers. So when the follow-up value is measured after six months, the performance will stabilize and help identify the sustained improvements.

These findings provide clear strategic recommendations for Syntilio's future implementation efforts. Given that caregiver satisfaction was ranked as the most important driver, Syntilio should focus on improving user engagement initiatives, such as onboarding, training, and ongoing support This would ensure that caregivers fully utilize the platform's features and experience tangible benefits. While the user interface measured minimal improvements, this is recommended to improve for the upcoming R&D project. Additionally, the lower prioritization of workflow automation suggests that care organizations may not fully recognize the value of automation features. Syntilio may need to reassess how these features are communicated and demonstrated to clients. For example, providing case studies to show how measurable time savings from automation could impact their operations.

Finally, a recommendation is to implement a continuous measurement feature at the care organization before deploying CareHub, which provides real-time insights into the KPI performance. The data had to come from many different places and people to measure the KPIs for the framework. With this feature live before deployment, it allows a clearer pre- and post-implementation comparison. When a constant feature measures the performance and can be viewed on a dashboard, the impact can be monitored frequently, and proactive adjustments can be made to ensure sustained improvements.

7.3 Further research

To further redefine and enhance the validity of the framework and the generalization for which it can be applied, the following future research should be explored. The current framework is built upon the input of one care organization and Syntilio. Therefore, the framework perfectly suits the setting of that care organization. To improve the generalizability of the framework, interviews across multiple types of extramural unplanned care organizations should be conducted. This will help to identify whether additional drivers are relevant and impacted by Syntilio. So, a more comprehensive understanding of the framework's applicability is ensured, and its effectiveness in diverse settings is increased.

Next to identifying possible additional drivers, research on the framework's validity can be further improved. Increasing the number of experts who weigh the framework using the Analytic Hierarchy Process (AHP) will also increase the framework's accuracy. In this case, the credibility of the framework assessment will grow. and will it give a more accurate measurement of the actual impact.

Lastly, a recommendation for further research is to identify how the framework can be applied across the healthcare sector. The current state of the framework is created to be applied to extramural care organizations, but Syntilio can also be implemented in intramural care organizations or hospitals. This leaves the opportunity to investigate whether the framework can be applied to other types of care organizations and what possible adaptions should be made to do this successfully.

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9. Appendices

A. AHP survey

To rank the drivers of the TOEE framework, the Analytic Hierarchy Process (AHP) is used, this is a tool that helps to analyze multiple criteria. The decision-making process breaks the problem down into prioritizing the driver compared to the other driver within the dimensions and the dimensions compared to each other. Experts with a lot of knowledge of Syntilio do this process. The decision-making is done by a ranking process in a table that contains the dimensions or the drivers per dimension. Figure 4 is an example of the AHP prioritization of the dimensions of the TOEE framework.

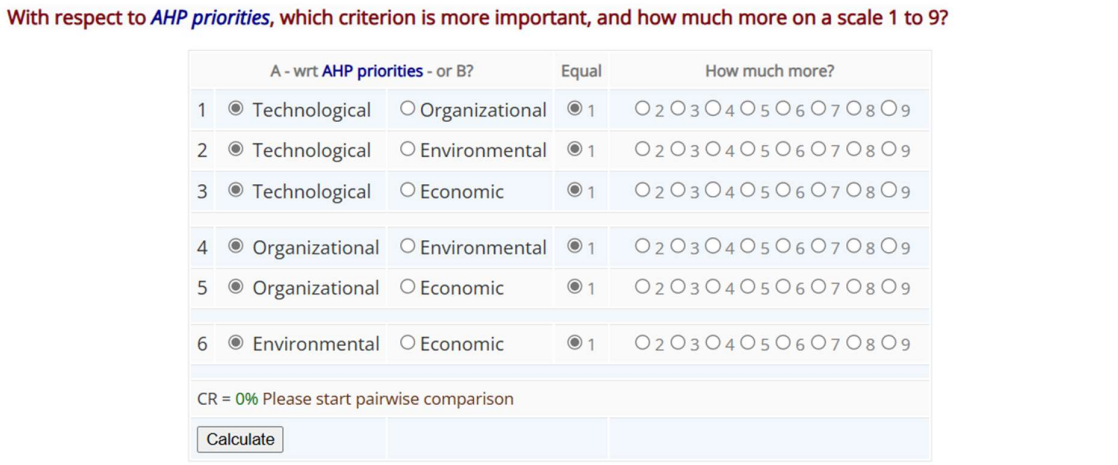

Figure 4: AHP Priority Calculator

B. AHP Scores

Tables 14,15, and 16 below show the AHP priorities of the TOEE framework and its drivers per expert.

Expert 1 TWB

Categories	Weights categories	Subcategories	Weights subcategories	Final weights
Technological	0,067594	Interoperability	0,065817	0,004448834
		Centralization	0,239384	0,016180922
		Process automation	0,137549	0,009297487
		Workflow design?	0,182129	0,012310828
		Data-driven insights	0,271191	0,018330884
		Telehealthcare	0,044192	0,002987114
		Scalability	0,059739	0,004037998
Organizational	0,193457	Strategic goals	0,476286	0,092140861
		Caregiver satisfaction	0,246071	0,047604157
		Department collaboration	0,042415	0,008205479
		New employee training	0,062185	0,012030124
		Task shifting	0,173043	0,03347638
Environmental	0,235103	Care chain collaboration	0,225505	0,053016902
		Sustainability	0,065417	0,015379733
		Client satisfaction	0,612976	0,144112497
		Partnership opportunities	0,096102	0,022593869
Economic	0,503845	Profit	0,555133	0,279700986
		Productivity Caregiver	0,29555	0,14891139
		Care period	0,058337	0,029392806
		Client volume	0,09098	0,045839818

Table 14: AHP scores of expert 1 at TWB

Expert 2 Syntilio

Categories	Weights categories	Subcategories	Weights subcategories	Final weights
Technological	0,075195	Interoperability	0,092779	0,006976517
		Centralization	0,050103	0,003767495
		Process automation	0,173762	0,013066034
		Workflow design?	0,223792	0,016828039
		Data-driven insights	0,309727	0,023289922
		Telehealthcare	0,085156	0,006403305
		Scalability	0,06468	0,004863613
Organizational	0,508287	Strategic goals	0,064245	0,032654898
		Caregiver satisfaction	0,514726	0,261628534
		Department collaboration	0,14006	0,071190677
		New employee training	0,127501	0,064807101
		Task shifting	0,153467	0,078005281
Environmental	0,151167	Care chain collaboration	0,531327	0,080319109
		Sustainability	0,062601	0,009463205
		Client satisfaction	0,279249	0,042213234
		Partnership opportunities	0,126824	0,019171604
Economic	0,265351	Profit	0,075679	0,020081498
		Productivity Caregiver	0,520802	0,138195332
		Care period	0,279967	0,074289523
		Client volume	0,123553	0,032784912

Table 15: AHP scores expert 2 at Syntilio

***Expert** 3 Syntilio*

Categories	Weights categories	Subcategories	Weights subcategories	Final weights
Technological	0,413118	Interoperability	0,120006	0,049576639
		Centralization	0,124366	0,051377833
		Process automation	0,089966	0,037166574
		Workflow design?	0,054994	0,022719011
		Data-driven insights	0,337505	0,139429391
		Telehealthcare	0,151699	0,062669587
		Scalability	0,121464	0,050178965
Organizational	0,360324	Strategic goals	0,297691	0,107265212
		Caregiver satisfaction	0,298843	0,107680305
		Department collaboration	0,151386	0,054548009
		New employee training	0,069768	0,025139085
		Task shifting	0,182311	0,065691029
Environmental	0,120108	Care chain collaboration	0,302054	0,036279102
		Sustainability	0,075514	0,009069836
		Client satisfaction	0,365359	0,043882539
		Partnership opportunities	0,257073	0,030876524
Economic	0,10645	Profit	0,060633	0,006454383
		Productivity Caregiver	0,14938	0,015901501
		Care period	0,391107	0,04163334
		Client volume	0,398881	0,042460882

Table 16: AHP scores expert 3 at Syntilio

C. Driver measurement scores

In the table below are the 5-point Likert evaluation scores of the questionnaire per expert displayed. The (New) scores of the experts and the scores of expert three are the follow-up scores, and the (Old) scores of the experts are the baseline scores. As indicated in Table 9, certain statements are only suitable for certain roles within the care organization. Experts one and two are centralists, so most statements are relevant to them. Expert three, however, is a program manager, resulting in an evaluation score of only the relevant statements for that role. All the evaluation scores that are a result of the questionnaire are displayed in Table 17, from these scores are the improvement factors of the respective drivers calculated.

Statement	*(New) score expert 1*	*(New) score expert 2*	*Score expert 3*	*(Old) score expert 1*	*(Old) score expert 2*
1	4	4		4	2
2	3	3		4	4
3	4	4		5	2
4	4	4		1	2
5	4	3		4	2
6	2	3		3	4
7	2	4		3	3
8	2	3		2	4
9	4	3		5	2
10	3	4		1	3
11	4	4		4	2
12	4	4		4	2
13	4	4		2	2
14	4	4		4	3
15	4	3		4	2
16	4	2		3	2
17	4	3		4	2
18	3	2	5	3	2
19	4	4	5	4	2
20	2	2		4	2
21	3	4		1	2
22	4	2	4		
23	4	3	4		
24	4	3	4		
25	4	2			
26	4	4			
27	3	4			
28	3	2	4		
29	3	2	3		
30	2	2			
31	3	3	4		
32	4	3	2		
33	2	3	4		
34	2	2	4		
35	2	2	2		
36	2	2	3		
37	3	3			
38	4	4	4		

Table 17: Expert individual questionnaire evaluation