A Feasibility Study Process for Humanitarian Engineering

Systematically increasing the Social Impact for a Swedish NGO

Master's thesis in Product Development

AMANDA JONASSON SARA PETERSSON

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Cover: A picture from an EWB-SWE project together with Mavuno, in Tanzania.

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Department of Industrial and Materials Science
Chalmers University of Technology

Abstract

The ongoing humanitarian and climate crisis arising around the world has increased the need for volunteers and Non-Governmental Organizations working to help the communities most in need. To meet the UN's 17 Sustainable Development Goals (SDGs) there is a need to ensure sustainable development in all areas of the world. Aiding the communities of the world most in need by laying a strong foundation for them to build a sustainable future is a necessary action to meet the SDGs. One of the organizations working to achieve this is Engineers Without Borders Sweden (EWB-SWE), an organization working to solve challenges related to inequality and global development. Their Humanitarian Engineering work aims to improve the living standard of low-income communities and ensure access to basic services.

This thesis is derived as part of EWB-SWE's goal to improve their internal work process in order to ensure choosing the projects where they can have the most positive social impact. This involves using their resources in the most efficient and effective way to develop long-term sustainable solutions. To achieve this a Feasibility Study will aid them in deciding which projects to take on. The aim of this master thesis is to deliver an improved process with methods and tools to benefit EWB-SWE's Feasibility Study. This will broaden the solution space and ensure the development of sustainable solutions.

The methodology for this thesis is divided into four phases. The first phase, **Problem Contextualization**, concerns collecting knowledge about Humanitarian Engineering and EWB-SWE through a literature study, an empirical study, and a qualitative study including interviews. The second phase, **Exploration**, concerns finding suitable Product Development methods and tools suitable for a FS. The methods and tools gathered in phase two and the knowledge from phase one are then combined into an initial concept in the third phase, **Concept Development**. Lastly, the fourth phase, **Finalization**, is where the final concept is developed in detail, evaluated through workshops, and, lastly, delivered to EWB-SWE as a process with a related report template.

The final Feasibility Study process is documented in a Feasibility Study Report with tailored methods and tools to fit the context of EWB-SWE and Humanitarian Engineering. It is divided into seven steps and it is structured to widen the solution space in order for the project team to develop the best solution for the community. For some methods and tools, a developed template to support the project teams is provided as well. To evaluate the sustainability of a potential solution a simplified Sustainability Fingerprint Tool is developed with specific criteria defined based on

the findings in the researched Humanitarian Engineering.

In conclusion, this master thesis has resulted in identifying important aspects to consider in Humanitarian Engineering, mapping of EWB-SWE's project process, and a developed Feasibility Study process with tailored Product Development methods and tools. As the process is developed for an organization mainly run by volunteers some steps had to be simplified, such as the Sustainability Fingerprint Tool. Also, the final Feasibility Study process promotes co-creation with the partner and enhances community engagement to create local ownership and a solution that will be maintained and sustained. The Feasibility Study has shown promising results but needs to be tested through case studies in order to validate if it fulfills its intended purpose.

Acknowledgements

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List of Acronyms

Below is the list of acronyms that have been used throughout this thesis listed in alphabetical order:

DR	Design Research
EWB-SWE	Engineers Without Borders Sweden
FS	Feasibility Study
SFT	Sustainability Fingerprint Tool
HE	Humanitarian Engineering
SDG	Sustainable Development Goal

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Introduction

This is a Master Thesis Project in Product Development at, the Department of Industrial and Materials Science, Chalmers University of Technology, and in collaboration with Engineers Without Boarders Sweden (EWB-SWE). The purpose of the project is to develop a process for the early design phase of a project with tailored methods and tools to the context of Humanitarian Engineering (HE) and EWB-SWE's prerequisites. The project focuses on the early stages of Product Development, which EWB-SWE refers to as the Feasibility Stage. A developed Feasibility Stage will aid them in understanding the context to define the solution space. Thus enabling them to, in collaboration with local partners and communities, find long-term sustainable solutions that can be adapted and maintained by the local communities.

1.1   Background

> "Ours can be the first generation to end poverty – and the last generation to address climate change before it is too late." By the UN Secretary-General Ban Ki-Moon, [1]

The ongoing humanitarian and climate crisis arising around the world has increased the need for volunteers and Non-Governmental Organizations working to help the communities most in need. Covid-19 by itself pushed 93 million more people into extreme poverty [2]. This erased more than four years of progress in poverty eradication and it needs to be rectified. To reduce the number of people in extreme poverty and raise the life quality and expectancy of people around the world, the way of living has to change and incorporate sustainable development. To meet the UN's 17 Sustainable Development Goals (SDGs) there is a need to ensure sustainable development in all areas of the world and so in HE. Aiding the countries most in need with sustainable development to ensure a low carbon footprint, socially acceptable solutions, and long-lasting solutions to lay a strong foundation for them to build a sustainable future is a necessary action to meet the SDGs. It is in everyone's interest to together work towards meeting the goals and ensuring that the developing countries are a part of it [2]. The Secretary-General of the United Nations, António Guterres, states that

> *"To recover from the COVID-19 pandemic and deliver global sustainability, we need an urgent rescue effort for the SDGs. We must deliver on our commitments to support the world's most vulnerable people, communities, and nations. Creating a global economy that works for all will require bold action."* [2, p.2]

Engineers Without Borders Sweden is a non-governmental, non-party-political, and non-religious organization working to solve challenges related to inequality and global development. They work to improve the living standard of low-income communities and ensure access to basic services. Furthermore, they only engage in safe and conflict-free areas. In their internal handbook they state that "The mission of the organization is: Through humanitarian engineering, we engage, inspire, and unite people to build a sustainable future. Our work is guided by our values: curiosity, equality, inclusivity, and sustainability." [3, p.7]. Their goal of working toward the UN Sustainable Development Goals is reflected in three dimensions;

- **What they do** consider contributing to Goal 4. Quality Education, 6. Clean Water and Sanitation, 7. Affordable and Clean Energy, 9. Industry Innovation and Infrastructure and 10. Reduced Inequalities

- **Why they do it** concerns how their activities answer to basic human needs for Goal 1. No Poverty, 2. Zero Hunger, 3. Good Health and Well-being, 5. Gender Equality, 8. Decent Work and Economic Growth, 11. Sustainable Cities and Communities, 13. Climate Action, and 15. Life on Land

- **How they do it** concerns Goal 17. Partnerships for the Goals.

The majority of the active members of EWB-SWE are volunteers who are engineers from the industry and academia. This provides the organization with a wide range of competencies and experts in different areas. Their annual report from 2022 shows that they had over 700 members, over 250 active volunteers, 19 local partners, and over 30 active international projects. As an example, they had contributed to that over 10 000 people benefited from secure water access. This led to an increase of 180 more school hours, meaning that more children could spend time in school [4]. This is an example of projects having a social impact.

EWB-SWE are currently on a journey to improve and restructure their international project's work process. This thesis has been derived as part of that journey and EWB-SWE's aim to ensure that they only choose the projects where they can have the most positive social impact and use their resources in the most efficient and effective way. This is part of their new strategy for quality, efficiency, and effectiveness for international work [5]. Quality is defined as "the features and characteristics of a service that bear on its ability to satisfy given needs", Efficiency as "our ability to accomplish quality results with the least amount of resources" and Effectiveness as "our ability to achieve great quality results" [5]. Social impact is the potential positive or negative effect or influence a particular action, project, or program has on the social well-being and development of a community. The aim of having a social impact is to improve the quality of life for individuals and communities and

to create positive change [6].

EWB-SWE's project process for International Projects is today divided into five stages, see Figure 1.1, Idea stage, Planning stage, Implementation stage, Conclusion stage, and Monitoring & Evaluation stage. As part of their journey to improve the work process, the Idea stage will be replaced with the new Feasibility Stage that is being developed. This stage will include the Feasibility Study which should enable a wider solution space, a measurement of social impact and to investigate the feasibility of project proposals before too much resources are put into a project. The Feasibility Study will be a documented framework for how to investigate, evaluate and then develop or terminate these project proposals. To widen the solution space and develop sustainable solutions suitable for the context in which they will be used it is important to assure the feasibility of the solution or project. This involves investigating the problem background, identifying the needs and wants of local communities that have initiated the project proposal, and exploring the context of the community such as social, cultural, and technological aspects.

Figure 1.1: EWB-SWE's existing project process concerns the five stages, Idea stage, Planning stage, Implementation stage, Conclusion stage, and Monitoring & Evaluation stage.

The term **Sustainability** is widely used all over the world and will occur multiple times in this report, therefore it is important to establish what it actually signifies. Sustainability was defined in the Brundtland report as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" [7, p.43]. The three dimensions of sustainability are social, economic, and environmental. However, the term sustainability is most often referred to as environmental sustainability, this means that many people ignore or are oblivious to both the economic and social perspectives of the term. The UN's SDGs aim to make all three pillars of sustainability equated with the term [8]. To develop sustainable solutions through HE Passino [9] emphasizes the importance of always putting the client in the driver's seat in almost all areas. To develop a sustainable solution that can be maintained by and bring value to the local community, there must be a close collaboration between the partner organization and its community and the help organization. The engineers in the help organization should take the role to "help the client help themselves with a technology" [9, p.416] by empowering the partner and community with the right capabilities to help themselves.

1.1.1 Feasibility Study

The purpose of conducting a Feasibility Study (FS) is to evaluate a project's potential for success by analyzing all critical aspects of the proposed project. What factors define success varies depending on the business or organization and can be factors such as community reaction, environmental impact, return on investment, benefit for society, etc. The definition of a FS differs in literature and between organizations and can be confused with a Pilot Study [10]. A distinction/definition based on a well-cited framework, that has been adopted by the UK National Institute for Health Research and the Health Research Board in Ireland to guide researchers applying for funding, is described by [11] as:

- A feasibility study asks whether something can be done, should we proceed with it, and if so, how?

- A pilot study asks the same question but has a specific design feature: in a pilot study a future study, or part of a future study, is conducted on a smaller scale.

Orsmond and Cohn [12] mention that an important distinction between Feasibility and Pilot Studies, especially for novel interventions, is that Feasibility Studies are iterative, formative, and adaptive. Feasibility Studies are performed before Pilot Studies that include more rigorous methodological components than the primary FS. Different types of Feasibility Studies can be done such as Financial, Technical, Marketing, and Organization Feasibility Studies [13]. The Antenna Foundation has developed a framework to conduct Feasibility Studies in the context of market-based safe water initiatives for governments but also Non-Governmental Organizations (NGO's) [14]. The purpose is that the FS will help them decide by indicating to what degree the implementation of household water treatment solutions or installing water kiosks will be feasible for a specific geographic area. The framework can support NGO's in deciding whether or not a solution is feasible for local programs or if a business idea will work or not for a certain area of technology or market.

1.2 Purpose

The purpose of the project is, based on EWB-SWE as an organization and their way of working, to develop EWB-SWE's Feasibility Study. This is to enable them to choose projects where they can have the most social impact, take on suitable projects for their organizational capacity and skills, and ensure that solutions are sustainable in the long term. Furthermore, the developed Feasibility study should provide volunteers with methods and tools tailored for Humanitarian Engineering work that will help them consider all aspects of what makes a solution sustainable and set up a basis to measure a project's social impact and evaluate what social impact a project could have.

1.3   Aim

The project aims to deliver a process of methods and tools to benefit EWB-SWE's Feasibility Study to develop sustainable solutions and determine appropriate projects. The main objectives of this master thesis are presented below and will be further broken down in the methodology chapter for each phase of the project.

- Provide an improved process to broaden the solution space by assessing partners, social constraints, and needs that would ensure a sustainable solution throughout its life cycle.

- Define criteria based on Humanitarian Engineering research and incorporate it with EWB-SWE's way of working to enable decision-making and ensure a positive social impact.

1.4   Scope & Limitations

The master thesis was carried out for 20 weeks in the spring of 2023, in Gothenburg. The thesis concerns how engineering methods and tools in product development can be tailored to a feasibility study for HE work. The project methodology is divided into four phases, where each phase contains specific objectives to be investigated. It includes the contextualization of the problem, exploration and screening of methods and tools, and development of a Feasibility Study process. The project concerns the early design phase of the product development process, i.e. the stages connected to project feasibility, needs and wants identification, idea generation, and conceptualization.

The developed Feasibility Study process including methods and tools is tailored to the context of HE and identified needs of EWB-SWE. To ensure this, the concept is developed together with engineers from the competence teams, project teams, and administration of EWB-SWE to include their thoughts and ideas. The Feasibility Study process is presented in with a report template including all relevant tasks. Furthermore, the process includes information about why it should be used and guidelines on how to perform the proposed activities. Some limitations of the project are that:

- All work is conducted in Sweden and mainly in a digital setting.

- A field trip is not possible to conduct due to limitations in time and budget.

- Humanitarian Engineering is a broad subject with many aspects to consider and thus all of them can not be further investigated due to limited time.

- Engineers Without Borders Sweden is a volunteer organization and the volunteer's time and resources are limited, thus the proposed Feasibility Study process is developed considering those factors. This means that there has to be a trade-off between quality and resource efficiency in the extent of the developed methods and tools.

- The authors of this report have limited experience working in the Humanitarian Engineering field and with EWB-SWE projects.

1.5 Frame of Reference - Design Research

As a frame of reference for this master thesis the area of Design Research (DR) is investigated. This serves as a basis for what is seen as important to consider when doing this kind of work. Various research has been done on DR and how to implement new methods and tools from academia in the industry. Therefore, DR is an important area to consider when developing methods and tools that are to be adapted and used by others. In the history of Product Development, there has been a barrier between the methods being produced by academia and the industry that utilizes them. According to Wallace [15] this could be due to some of the following aspects:

- Methods are too complex, abstract, and theoretical
- Too much effort is needed to implement them
- The immediate benefit is not perceived
- Methods do not fit the needs of designers and their working practices
- Little or no training and support are provided

It is important to consider these aspects when developing and introducing new methods and tools. Also, instances, where practitioners run into small problems that are time-consuming to solve when implementing the method, might result in them not using the method again [16]. Other aspects identified by Gerrike et al. [17] that might result in certain methods being abandoned are:

- When the immediate problem has been resolved through the application of parts of the method
- When the method does not deliver an obvious benefit
- When they run into difficulties in applying the method
- When the method becomes tedious, for example, building a complete model of an entire product or product family

The literature also states factors that need to be included for a method to be applied and sustained. For example, the expected benefits need to be clearly stated, the method needs to be explained with a clear and common vocabulary, and the methods used need to be applicable for that specific project or company [17], [16].

For this project the definitions of a method, a tool, a methodology, and a process are defined by Gerrike et al. [17, p.105] as:

- **Design Methodology:** In design, a clear and explicit articulated approach to producing designs for a class of systems, that specifies in more or less detail the

activities to be carried out, the relationship and sequencing of the activities, the methods to be used for particular activities, the information artifacts to be produced by the activities and used as inputs to other activities, and how the process is to be managed, as well as (tacitly or explicitly) the paradigm for thinking about the design problem and the priorities given to particular decisions or aspect of the design or ways of thinking about the design.

- **Design Process:** In design, (1) A formally specified sequence of activities to be carried out in developing a particular design, or a class of designs, which will often be an application or customization of a methodology to a particular problem. (2) The actual sequence of activities carried out in the development of a design, which may correspond more or less well to any formal specification process.

- **Design Method:** A specification of how a specified result is to be achieved. This may include specifications of how information is to be shown, what information is to be used as inputs to the method, what tools are to be used, what actions are to be performed and how, and how the task should be decomposed and how actions should be sequenced.

- **Tool:** An object, artifact, or software that is used to perform some action (for example produce new design information). Tools might be based on particular methods, guidelines, processes, or approaches or can be generic environments that can be used in conjunction with many methods.

2
Methodology

The methodology for this project has been developed specifically for this project by the authors. The methodology is divided into four phases, **Problem Contextualization Phase**, **Exploration Phase**, **Concept Development Phase**, and **Finalization Phase**. The first phase, **Problem Contextualization**, concerns collecting knowledge about the subject and the background to why the Feasibility Study (FS) is needed and then analyzing the findings. The next phase, **Exploration**, is concerned with finding suitable methods and tools that could be used in the FS. The methods and tools gathered in phase two and the knowledge from phase one are then combined into an initial concept in the third phase, **Concept Development**. Lastly, the fourth phase, **Finalization**, is where the final concept is developed in detail, evaluated, and delivered to EWB-SWE. For each phase, objectives have been formulated to work as milestones for what to accomplish. Once the objectives are met, the phase will be seen as complete and it is possible to continue to the next phase. An outline of the methodology can be seen in Figure 2.1.
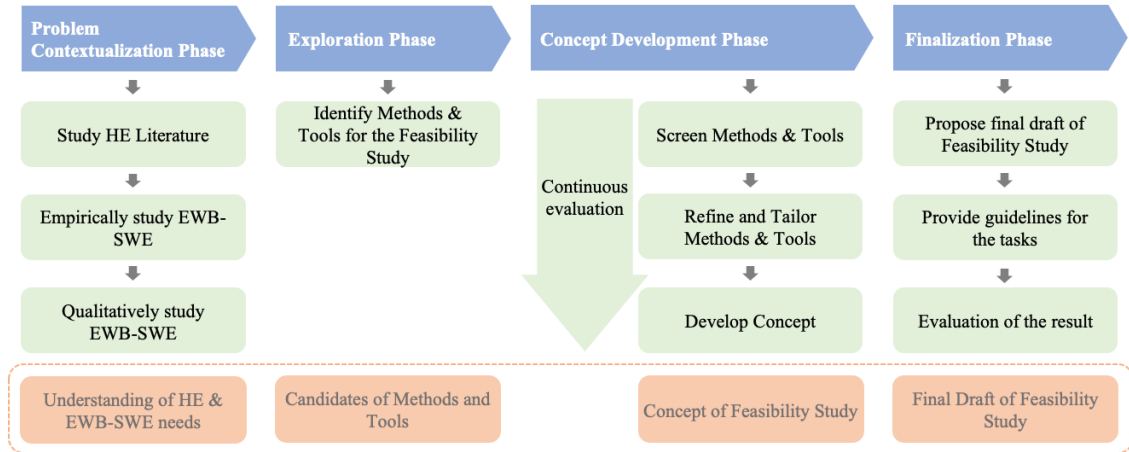
Figure 2.1: Illustration of the four phases of the methodology with activities for each phase and the deliverables at the bottom.

2.1 Problem Contextualization Phase

To understand what is important to consider when developing and proposing a method or tool the research area of Design Research (DR) was investigated. DR

is concerned with the research on how industry and professionals understand and make use of the methods and tools produced by academia. This served as a basis, for the project, on which research on Humanitarian Engineering and EWB-SWE was conducted, see Figure 2.2. The context of Humanitarian Engineering is different from the context of a traditional processing industry. Therefore, there is a need to understand this context and relate it to EWB-SWE's work process. The area of EWB-SWE involves research on their internal organizational needs, areas of improvement, and how different methods and tools could be adapted and used. The area of interest for this master's thesis is the parts of the subjects that, in the figure, are overlapping.
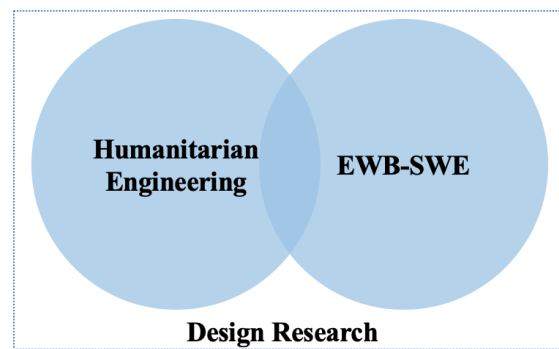
Figure 2.2: Illustration of the areas connected to the Problem Contextualization phase. Design Research serves as a basis for the research on Humanitarian Engineering and Engineers Without Borders Sweden. The area of interest is the overlapping area of Humanitarian Engineering and EWB-SWE.

The Problem Contextualization phase was completed when the following objectives had been met:

- Define the discipline of Humanitarian Engineering and how it relates to EWB-SWE.

- Provide an understanding of EWB-SWE's internal work process in the early project phase.

- Present the most common factors on how to conduct sustainable work in Humanitarian Engineering according to the research conducted.

- Present criteria for evaluation of the methods and tools as well as the final Feasibility Study.

- Present enough important factors of how methods and tools should be delivered for EWB-SWE to understand, apply, and sustain them.

The research conducted was a combination of a literature study and interviews. After the research was completed, an analysis of the collected information was made to serve as information for the next phase.

2.1.1 Literature Study

The literature study was conducted as a combination of a search using the snowball sampling method [18] and a systematic review with the use of keywords. The study covers literature connected to Design Research and Humanitarian Engineering. The snowball sampling method limits the literature search to those referenced in specific papers. Therefore, an additional search for literature was needed to meet the objectives. Therefore a systematic literature review, in Scopus, was also done for Humanitarian Engineering. This study was performed until the number of articles was satisfactory and a knowledge base was built. Searching for keywords resulted in thousands of articles and therefore the search scope had to be narrowed. This included a limitation of publicity year and more specific keywords. Some examples of the keywords used to get the initial search are listed below. Combinations of these keywords were also used to get different search results to enable a more diverse search;

- Ecological
- Sustainability
- Sustainable Community Development
- Humanitarian Engineering
- Social
- Cultural
- Economic
- Context

The relevant literature was also screened to be written in English, to be either an article, a book, or a conference paper. In some instances, a significant number of literature remained. To refine the selection further, specific keywords like "students", "civil engineering", "Undergraduate Students", and "First-year Engineering" were excluded during the screening process. This was, for example, to exclude social and cultural factors concerned with students working in the Humanitarian Engineering context since the area to be researched is the social and cultural aspects of the local community. The literature on Design Research was provided by the supervisor of this project. The articles that were provided are used within product development and some are written at the IMS department at Chalmers University of Technology.

2.1.2 Interviews

This part of the research concerned the understanding of the existing process, the new Feasibility Study, and the internal needs of EWB-SWE. This was done through conducting 12 interviews with people working for EWB-SWE such as engineers and humanitarian workers. More specifically, interviews with members of the different competence teams, project teams, the initial and partner assessment team, the evaluation and monitoring team, project coordinators, the International Project Sec-

retary, and the Head of International Projects were held to widen the understanding of the process and the member's needs. This was to find what was working with the current process and to identify areas with potential for improvement.

The interviews were one-on-one in-depth semi-structured and question-based to cover the necessary areas and enable a more open conversation. The exact formulation and order of questions varied between interviews and depending on the interviewee's experience. Figure 2.1 shows the functions targeted in the interviews and the areas of interest for each of them. The specific questions asked during the interviews are attached in Appendix A. An interview method called probing was used, this includes asking open questions to enable follow-up questions depending on the answers [19]. The interviews were held online and with people who have been involved in a project during recent years or that has experience with different types of projects in terms of the size of the project, country of implementation, and the success of the project. The interviews with the International Project Secretary and the Program Managers were conducted with a focus on EWB-SWE as an organization to get an understanding of how they see the process today and what they require for it to work smoothly. Also, to get a better understanding of how they work in the organization and what resources are available at what time in the process.

Table 2.1: Structure of the conducted interviews with the specific areas of interest for each function.

Competence Team	- Collaboration with the project teams - Knowledge storing and sharing
Initial Partnership Assessment	- Information gathered from the partner
Partnership Assessment	- Information gathered from the partner - Collaboration and knowledge sharing with other function
Monitoring & Evaluation Team	- What they need from the project teams in order to do their job
Project Team	- The team's way of working - Struggles with the current project process
Program Manager	- Collaboration with a partner organization - Structuring of different projects
International Project Secritary	- Organizational needs connected to EWB-SWE - Reflections on the old feasibility study template - How knowledge is shared within EWB-SWE
Head of International Projects	- Organizational needs connected to EWB-SWE - Reflections on the old feasibility study template

2.1.3 Data analysis and identification of areas of interest

The information collected during this phase was analyzed and summarized for further use. The information gathered during the interviews was written down separately for each interview and statements of interest were extracted and gathered in a new document. Later, the statements were analyzed with a thematic analysis in order to identify themes of needs and areas of possible improvements [20]. The literature research conducted on Humanitarian Engineering was summarized as a list of needs. The needs were also analyzed with thematic analysis to identify areas

of interest.

Based on the documents read and the information from the interviews, a visualization of the detailed process from the initial contact with a potential partner organization to the implementation of a project was created. This was done to get a better understanding of who is involved in the different steps as well as what type of data is collected and needed in the different steps of the project process. This also gave indications of what to improve in the process or what should be included in the new FS.

In this step, criteria were also defined to enable an evaluation of the methods and tools that are explored in the next phase of the thesis. Criteria to evaluate the final FS process were also stated. These criteria are based on the list of needs from the literature study and the results from the research conducted on EWB-SWE.

2.2 Exploration Phase

The aim of the exploration phase was to explore candidates of methods and tools based on the findings from the previous phase and if they align with EWB-SWE and their way of working with HE. For example, based on EWB-SWE's way of working, a prerequisite for the methods and tools is that they should be applicable to a remote and digital setting that engages and allow for creativity for all participants. The methods and tools that were considered for the FS process were also ones that are suitable to use in early product development processes. Thus this phase concerns exploring candidates of methods and tools that can be implemented in the Feasibility Study and that fall in the overlapping area of Figure 2.2.

The following objective was concerned with this phase:

- Provide a list of identified candidates for engineering design methods and tools that are suitable for the Feasibility Study.

The methods and tools explored were gathered from different sources. For example, product development (PD) methods and tools for the early phases of PD taught in the Mechanical Engineering bachelor and the Product Development Master at Chalmers. Knowledge about these was gathered from personal experiences, lectures, and *The Value Model* [21]. Another source of methods and tools candidates was specialists within the area of sustainable product development. Four researchers, two Ph.D. students, and two professors were interviewed to explore state-of-the-art methods and tools and to get input from specialists in the topics. Another source was the *Playbook* by Carleton [22] which provides methods and tools to aid in modeling, designing, and leading a team to new innovations. Other sources of candidates were the proposed principles and methods identified in the Humanitarian Engineering literature.

All methods and tools found during the exploration were written in a list and an initial screening was made to immediately delete the methods and tools that were

not applicable to the early phases of product development processes or that did not fall into any of the previously defined areas of interest in the research. The explored methods and tools that were initially seen as suitable candidates for the FS were summarized in a separate document where the answer to the questions listed below was given.

- What type of method or tool is it?
- Why should it be used?
- What type of project is it suitable for?
- Where in the process should it be used?
- How does it work?
- What resources are needed and what stakeholders need to be involved?

By combining the areas of interest identified from the Humanitarian Engineering research and the internal organizational needs of EWB-SWE categories of methods and tools were determined. These categories functioned as screening categories so that methods and tools that did not fit into any category were eliminated.

2.3   Concept Development Phase

The explored methods and tools were in this stage screened tailored, and compiled into a concept for the FS. This step involved continuously evaluating the methods and tools as well as the outline for the FS with key people of EWB-SWE, such as the International Project Secretary, the Head of International Projects, and people from competence teams. This was in order to ensure full applicability and the future use of the methods and tools in the organization.

In this phase the following objectives were concerned:

- Provide a list of screened methods and tools including a description of how these could be tailored to EWB-SWE and the Feasibility Study.
- Provide a concept for the Feasibility Study Report including developed methods and tools.

2.3.1   Screen Methods & Tools

The methods and tools were screened based on the previously defined evaluation criteria and the gained knowledge about the FS process and the methods and tools so far, the criteria can be seen in chapter 3.4.1. Thereafter, the screened methods and tools were evaluated in terms of their adaptability to the FS process and EWB-SWE's needs.

2.3.2 Tailor Methods & Tools

The screened candidates for methods and tools were in this step tailored to fit the Humanitarian Engineering context and EWB-SWE's way of working. This meant that each method and tool was adapted or adjusted to fulfill the needs of EWB-SWE's FS. For example, to mitigate the risk that a method or tool did not consider the Humanitarian Engineering context, new questions or areas to investigate were defined to ensure that the important areas are covered.

In this stage, a LEASA workshop was conducted during two sessions by the authors of this report to serve as the basis for the development of the Sustainability Fingerprint tool. The workshop was supported by a provided template and based on the knowledge gained during this thesis to ensure that the conducted research was incorporated into the tool and that it resulted in relevant and applicable criteria.

2.3.3 Development of Feasibility Study Concept

The main purpose of this step was to structure the outline of the FS process. This included dividing the tailored method and tools into sections and structuring the sections in a chronological order. To decide upon the content and structure of the FS process, the old FS Template was used as input, as well as the information gathered about feasibility studies in the research phase. This step also included defining who is responsible and who to involve in the different stages of the FS, this knowledge was captured in the visualization of EWB-SWE's work process created earlier.

2.3.4 Initial Evaluation

Simultaneously as the methods and tools were tailored and the outline of the FS was created, evaluations were conducted. The initial layout of the FS was evaluated on three different occasions. First, two separate meetings were held during the development to get continuous feedback, one with the Head of International Projects and one with the International Projects Secretary at EWB-SWE. These meetings were structured in a way that the FS draft at that time was presented and that they provided feedback on its structure and the included methods and tools.

A specific evaluation of the Sustainability Fingerprint Tool was conducted to get the Head of International Projects and key persons from the competence teams introduced to the tool as well as to get feedback on the content of it. A presentation of the initial concept was created and specific questions were defined for the evaluation workshop. The questions were written in the workshop tool Mural to be interactive and enable the participants to write their own thoughts on notes to each question. The questions that were asked during the workshop are presented in Table 2.2.

Table 2.2: Workshop questions on the Sustainability Fingerprint Tool criteria.

Material Aquisition	How can sourcing and producing of material be indicated?
	What is your knowledge today within EWB-SWE about material characteristics and sustainability?
	What is the lowest acceptable level for renewable and local materials?
	Other important material characteristics?
Solution Characteristics & Implementation	What are potential environmental risks in your area? And what could be indicators for those risks?
	What would the lowest acceptable level of renewable energy sources be?
	How should the number of created jobs be measured? For ex. number of jobs in relation to project size
	How should education and knowledge creation be measured?
	Additional important aspects or criteria?
Usage & Maintenance	What are potential environmental risks in your area? And what could be indicators for those risks?
	What would the lowest acceptable level of renewable energy sources be?
	How should the number of created jobs be measured? For ex. number of jobs in relation to project size
	How should education and knowledge creation be measured?
	Additional important aspects or criteria?
End-of-life Procedures	What does the waste management system usually look like in the communities?
	How could EWB- SWE influence a waste management system to become more sustainable as part of a project or solution?
	How could it be indicated if a solution emits green house gases during end-of-life procedures?
	How should the availability of materials and components be indicated? And what would an acceptable level of availability be?

2.4 Final result phase

This phase, and thereby the project, was considered finished when the following objectives were met:

- Propose a new template of a report for the Feasibility Study as a process with templates for the tailored methods and tools.

- Provide guidelines on how to use the tailored methods and tools in the Feasibility Study.

The developed concept for the FS was finalized and delivered in a report format with guidelines on how to use the included method and tools in the FS. Each method or tool was linked to a separate document with a template for the user to fill in. The instructions for the methods and tools as well as the description of the steps in the FS were based on the information collected during this thesis. More, specifically, the literature study of Design Research was considered in this step to ensure that EWB-SWE could use and sustain the proposed FS. When the FS was fully developed, an evaluation of the result was made based on the process evaluation criteria defined in the early steps of the project. These criteria were used to make an evaluation of the quality of the proposed FS and how well it contributes to achieving its purpose. The process evaluation criteria are a result of the research part of the thesis, hence they are presented in Table 3.2.

3

Problem Contextualization

This chapter includes a literature study on Humanitarian Engineering (HE) and related principles to achieve economic, environmental, and social sustainability. Thereafter, the background of Engineers Without Borders Sweden (EWB-SWE) and their related work process, organizational structure, and conducted projects are investigated through interviews and a literature study on the existing documentation from EWB-SWE. At the end criteria are stated, based on the research, to enable evaluation in the future steps of the project.

3.1 Literature study on Humanitarian Engineering

Humanitarian Engineering, also referred to as "development engineering" or "engineering for change" is the application of engineering principles and techniques to meet the needs of communities in crisis or suffering from poverty and lack of resources [23]. It is an interdisciplinary field that combines engineering with multiple other principles such as economics, social sciences, entrepreneurship, and businesses together with/or for communities in need to create technological innovation [24]. This involves prioritizing the needs of the community and taking the cultural and societal factors into account when designing and implementing in the context of HE [23]. A normal assumption is that HE is limited to work in what is known as developing or low-income countries, which is not the case, HE can be practiced wherever a societal problem exists [24]. As mentioned in the introduction it is equally important to consider all three dimensions of sustainability, see Figure 3.4, as well as the contextual factors to achieve sustainable development. Therefore this chapter includes a literature study on how to locally sustain and maintain a solution and what the three sustainability dimensions mean in terms of HE.

3.1.1 How to locally sustain and maintain a solution

In HE projects it is important to ensure that the concerned community can adopt and maintain the implemented solution and that they can responsibly handle the product when it becomes obsolete [9]. Amadei et al. [25] give a possible solution to ensure this which involves educating and empowering communities primarily and
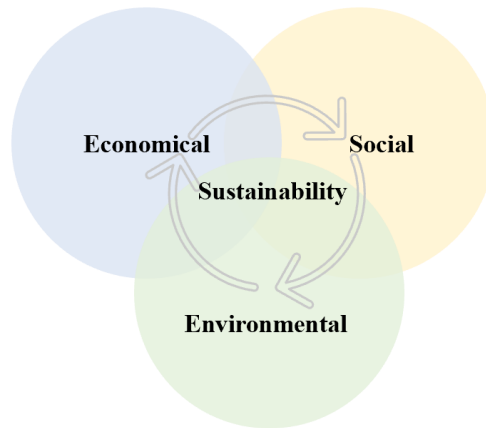
Figure 3.1: Illustration of sustainability in its three dimensions.

then letting technological solutions come secondly so that the communities are given the capability to adapt and sustain the technological solution. They explain that "This is done by partnering with the community to address its problems and needs and then devising long-lasting, successful solutions that are respectful of the community itself, its people, and its environment." [25, p.1090]. Lucena et al. [26, p.5] also emphasizes the importance that the "community needs to be central to development projects" for engineers in order to ensure that the implemented solution will be long-term sustainable and strengthen the independence of the community. Another way to develop solutions that can be kept long term is to focus on what the clients, in the following quote referred to as "beneficiaries", aspirations are. This means searching for what the client wants to achieve in the long term and not only what their current problems or needs are and creating a solution that the user will be engaged in and understand the purpose with. The difference between aspirations and needs is described by Gadgil and Madon as:

> It is useful to contrast aspirations with needs, the latter a common focus of both engineering and international development, in which the goal is to understand and address human needs through "needs assessments". While needs are often defined in relation to negative experiences – such as pain, hunger, illness, or poverty – aspirations are optimistic and forward-looking. Needs are also highly volatile, and intensely felt but tend to vanish upon being met; in contrast, aspirations sustain over the longer term. Thus, when projects connect to beneficiary aspirations, beneficiaries are more likely to engage productively and for the longer term. [27, p.86].

Passino [9] discuss how helping is to guide the people that need it to identify opportunities, and local resources and to exploit their own potential. This means involving the local communities to find out how they can help themselves. They are in the end the people who know their community the best and the people who will use the implemented solution. Therefore, involving them and finding their needs is a crucial activity for finding a long-term and sustainable solution. Furthermore, Passino also exemplifies when to not help a client. This involves when the client

expresses that they don't want to be involved in the process but rather expect the helper to do everything or when the client is already solving the problem on their own. The first example could result in a solution that is not correctly understood and/or maintained by the client, and therefore it might be unnecessary to waste resources if they are not being used in an optimal way. The second one could make the client lose the feeling of accomplishment by solving problems by themselves.

When it comes to implementing a technical solution for a client it might be beneficial to evaluate some trade-offs. For example, *Ruggedness vs cost* refers to clients not having the possibility of fixing or repairing a low-cost product that breaks easily. Therefore, this client might benefit from a more expensive product that lasts for longer and doesn't need the same maintenance. Another example is *Ease of use vs reliability* where some clients might want a product that is difficult to use (might need more maintenance or expertise) and that has a longer service time than a product that is very easy to use but doesn't last as long [9].

Some other aspects to consider when implementing a solution for a client are that it's important to investigate what technologies are present in their lives at the moment (if any) and how well they are being used and why they exist. This could bring insight into if a new proposed technology could work in that setting and if the community would use it. Also, to gather knowledge about what technologies are missing in the community, for example, if a community wants a computer room, but they do not have access to a steady internet connection or the needed electricity, then those technologies must also be solved for the ultimate goal to be fulfilled [9].

3.1.2 Social sustainability

In the humanitarian branch of engineering, there is a need to understand the differences between the top-down manner when it comes to introducing new technology and the bottom-up way of demanding new technology. There might be a need to have a more bottom-up demand for technology in settings where humanitarian engineers are implementing a solution or trying to help. The bottom-up way of demanding technology is rooted in assessing a community's needs, resources, capacity, and aspirations. There is a need to make sure that this way of thinking can be incorporated into the process and that the top-down approach is not used [9]. For example, not pushing a solution or technology onto a community that they might not need but rather developing a solution based on their aspirations and needs.

The extent to which a local partner is involved might vary between projects and how the intended solution is used. Jagtap and Larsson [28] bring up three main roles of the local communities; the consumer, the producer, and the co-creator. The consumer role means that a product is simply provided to the people in a community without much collaboration and communication. These types of products and projects tend to fail to meet the intended impact when the developer leaves the community or moves on to other projects. The producer role is when the people in communities are a part of producing a product, such as handicrafts, furniture, or household products, this is beneficial in terms of employment and reducing poverty

[28]. For the last role, the community and people are co-creators, this enables a better understanding of the social, cultural, and knowledge differences between the developing organization and the community. This way of developing helps the engineers to look beyond the technical and engineering parts of development and focuses more on context development. As [28] describes Context development it includes knowledge about their needs, preferences, life circumstances, and their aspirations for the future. Jagtap and Larsson also state that the co-create way of working enhances the acceptance and the ownership of the project, which in the end will ensure a better and more long-lasting solution.

A new way of working with engineering design is necessary to accommodate the ever-so-different contexts of the various communities. This is identified by Shekar and Drain [29] as well as the notion that products developed only in the western world and then put in the context of these communities many times result in failures. The failures are often due to a lack of understanding of the local users' needs and problems. The social, cultural, and economic aspects have been identified as areas that put tight boundaries on the available solution space and the ability to find appropriate solutions. Connected to this new way of thinking when developing products for resource-poor communities a few indicators have been identified by Whitehead et al. [30] to take into account:

- Affinity - Is it something users will be proud to own and take care of?
- Desirability - Is the product desirable for the user?
- Reparability - Can the product be maintained locally?
- Durability - Is the design robust enough to survive in the environment?
- Functionality - Are the product's functions adequate?
- Affordability - Is the product affordable for locals?
- Usability - Is it easy to understand and use correctly within different cultures?
- Sustainability - Is it environmentally sustainable and does it promote good behavior?

The Organization for Economic Cooperation and Development (OECD) has defined six evaluation criteria *Relevance, Effectiveness, Impact, Coherence, Efficiency,* and *Sustainability* that can support the evaluation of interventions [31]. An intervention in this case can be a policy, strategy, program, project, or activity. The purpose is that the criteria framework can be used to get a holistic view of the intervention and serve as a basis for evaluative judgment. It is supposed to encourage evaluators to "think more deeply about the nature of an intervention, its implementation process and its results." [31, p.10]. The OECD criteria were mainly developed for use in international development cooperation but can be applied in any sector. There are two recommended principles to follow when evaluating the criteria [31, p.23]:

1. **Principle One:** The criteria should be applied thoughtfully to support high-quality, useful evaluation.

2. **Principle Two:** Use of the criteria depends on the purpose of the evaluation.

Figure 3.2: Figure of the six evaluation criteria and their related questions by OECD [31].

The six criteria are defined with a related question as illustrated in Figure 3.2 and a short explanation:

- **Relevance**: Is the intervention doing the right things? The extent to which the intervention's objectives and design respond to beneficiaries' global, country, and partner/institution needs, policies, and priorities, and continue to do so if circumstances change [31, p.38].

- **Coherence**: How well does the intervention fit? The compatibility of the intervention with other interventions in a country, sector, or institution [31, p.45].

- **Effectiveness**: Is the intervention achieving its objectives? The extent to which the intervention achieved, or is expected to achieve, its objectives and its results, including any differential results across groups [31, p.52].

- **Efficiency**: How well are resources being used? The extent to which the intervention delivers, or is likely to deliver, results in an economic and timely way [31, p.58].

- **Impact**: What difference does the intervention make? The extent to which the intervention has generated or is expected to generate significant positive or negative, intended or unintended, higher-level effects [31, p.64].

- **Sustainability**: Will the benefits last? The extent to which the net benefits of the intervention continue or are likely to continue. Includes an examination of the financial, economic, social, environmental and institutional capacities of the systems needed to sustain net benefits over time [31, p.71].

In the book *Humanitarian Engineering: Advancing Technology for Sustainable Development* it is stated by Passino that the goal of HE is social justice [9]. Social

justice is defined by Leydens et al. as "engineering practices that strive toward an equitable distribution of opportunities and resources in order to enhance human capabilities while reducing imposed risks and harms among the citizens of a society." [32, p.3]. Social justice when it comes to Product Development is, therefore, to not only develop partial solutions that solve just one need but to design and implement solutions that are fully developed and can be incorporated into the community in a socially justice manner. For example, providing people with wheelchairs and also ensuring accessibility in the community for them. Vice versa also applies, to not only develop an accessible community with ramps and lifts but also to provide the people with the necessary means of transport.

As stated above, social aspects are important to consider but social constraints are not always easily identified [33]. This is due to different factors but it could be that the design teams and the local communities lack common social experiences and due to differences in culture. Wood et al. [33] identified certain aspects that could be seen as social constraints, these include:

- **Empathetic design:** Concerns developing a solution with the right person in mind. For example not testing a "solar cooker" by a tall male student in a lab environment in the US when a shorter woman in a remote village in Peru might use the cooker. It is important to ensure that the right people can use the product in the right context.

- **Tradition:** Considers the traditions in place in certain communities. Do not change something that will drastically change someone's life and might hinder them from doing things that they normally do.

- **Trust:** In many cases, people from developing countries and communities might express their thankfulness even though the product did not help them as they intended. This is because it might be customary to agree with outsiders trying to help. It might take years and years to get the bond needed for them to express their thoughts and have the relationship that is needed to develop a perfect solution.

- **Community engagement:** Having true community engagement can sometimes be hard, but nevertheless, it is a crucial factor to have for a project to be long-term successful. It is also important to know why a community is or is not engaged in a project. There have been instances where a local Non-Governmental Organization (NGO) has put economic incentives for a community to be involved but later on in the project revoked that incentive and that resulted in a disengaged community.

While using technology for sustainable development to make a positive impact it is important to be aware of the potential harm new technology can have on people and the environment in a community. There are many examples of sustainable development projects that have failed due to unknowns about the social norms, politics, or institutions surrounding the user as well as the conditions of the user environment. Often there is also a lack of information about the most disadvantaged households leading to their needs not being captured and thus solutions are designed

for the more fortunate households. One reason for this is that people living in extreme poverty might not be involved in the formal markets, thus their preferences are not included in consumer data [27].

3.1.3 Environmental sustainability

The Sustainable Development Goal (SDG) number 13 addresses the need to "Take urgent action to combat climate change and its impacts", fighting climate change is the most important key factor to meet the SDGs by 2030 [34]. The Secretary-General of the United Nations, António Guterres, states in *The Sustainable Development Goals Report 2022* by UN that "To recover from the COVID-19 pandemic and deliver global sustainability, we need an urgent rescue effort for the SDGs. We must deliver on our commitments to support the world's most vulnerable people, communities, and nations. Creating a global economy that works for all will require bold action." [2, p.2].

Global warming results in negative and challenging social and economic consequences, such as extreme temperatures, drought, and flooding affecting every region in the world in some way. This contributes to further poverty, hunger, and instability for people worldwide. Communities, where the adaptability to climate change is limited because of factors such as poverty, limited access to basic services, conflicts, or weak governance, put these people at risk of having to leave their homes. It is estimated that 3.3 to 3.6 billion people are living in contexts that are highly vulnerable to climate change. Global warming resulting in declining ecosystems and bio-diversity is risking human health. Human well-being is closely linked to ecosystems and thus all humans depend on ecosystems in many critical ways. For instance ecosystem services such as food, freshwater, and regulation processes for the global temperature [2].

This pinpoints the urgency of supporting the countries, communities, and people most in need through sustainable development. To achieve global sustainable development there needs to be a worldwide decreased Ecological Footprint and increased Human Development Index (HDI) [35]. These measures are defined as:

- The **Ecological Footprint** is the only metric that measures how much nature we have and how much nature we use. The Footprint helps countries improve sustainability and well-being, local leaders optimize public project investments and individuals understand their impact on the planet [35].

- The **HDI** is a summary composite measure of a country's average achievements in three basic aspects of human development: health, knowledge, and standard of living. It is a measure of a country's average achievements in three dimensions of human development: A long and healthy life, as measured by life expectancy at birth; knowledge, as measured by mean years of schooling and expected years of schooling; and a decent standard of living, as measured by gross national income (GNI) per capita in Purchasing Power Parity (PPP) terms in US$ [36].

The Global Footprint Network targets a measure of where we need to be in order to achieve the goal of sustainable development. The aim for the HDI is to be above the index of 0.7 for all countries and the Ecological Footprint is to be below the index of 1.6 for all countries [35]. However, only a few countries reached this target in 2018, as can be seen in the red frame of Figure 3.3.
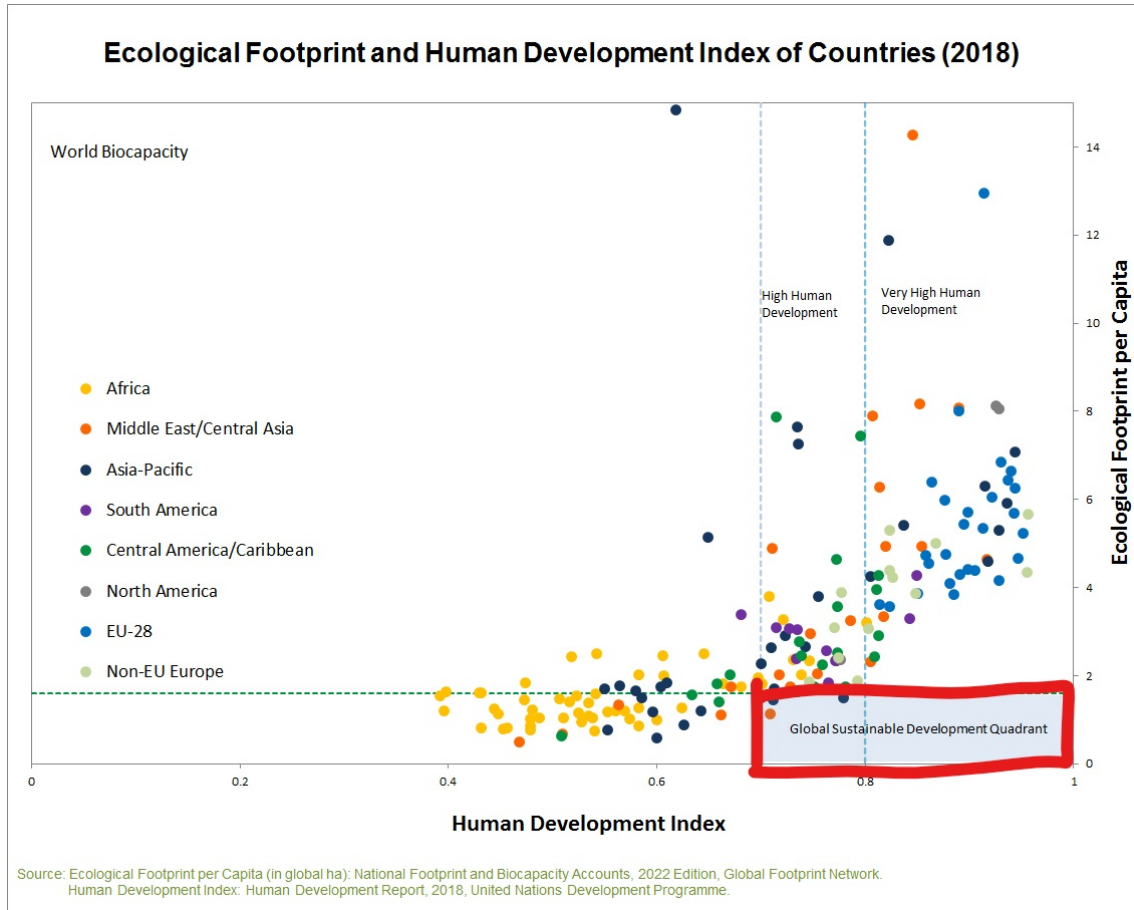
Figure 3.3: The Ecological Footprint and HDI of countries in 2018. The blue square, framed by red represents where the goal of sustainable development can be achieved.

If countries with a low HDI would develop in the same way as the rich countries with a high HDI it would lead to an environmental disaster. Thus, to prevent that from happening these countries need support to sustainably develop their countries [9]. The SDGs are supposed to lead the way for this and Passino [9, p.34] explain them as "set goals of ending poverty, improving development, and doing so in a sustainable way so that the environment is not ruined in the process.". This leads to the HE challenge of how to implement environmentally sustainable solutions that are also socially and economically sustainable. Most often there has to be a trade-off between these factors.

One of the major challenges communities around the world are facing is a lack of safe water and sanitation services. Every year 829 000 people die of diseases related to

the lack of not having these services and it affects human health, economic activities, and food and energy supplies. The growing water stress and declining water-related ecosystems are due to poor management and the over-extraction and contamination of freshwater and groundwater supplies, meaning that it is directly linked to human activities and environmental pollution.

To meet SDG 6 *Clean water and sanitation* for everyone there needs to be a fourfold increase from the current progress. Having access to clean water and sanitation facilities is closely linked with significant social impacts such as increased education and gender equality [2]. One of the reasons for this is that access to these facilities frees up time for women and girls who primarily are the ones responsible for water collection and household sanitation, resulting in them having more time to participate in other activities such as education. Having access to these basic necessities also results in improved health due to minimized spread of disease and economic benefits due to reduced health costs and increased productivity in the communities [37].

An example of a continent already facing severe climate change is Africa. Even though Africa has a rich natural resource base it is still the poorest region in the world [38]. Africa produces only 4 percent of the world's carbon emissions, making it the continent in the world with the lowest carbon footprint. Despite this, the continent is majorly affected by worsening climate change effects and has been noted as one of the world's most vulnerable regions to climate change. The climate change effects in combination with other sustainable development challenges the region is facing such as poverty, political uncertainty, environmental diseases, droughts, rapid forest degradation, etc. leave the region with a wide spread of challenges to face.

Based on a Nigerian case study, Mutanga et al. [38, p.137] concludes that "indigenous knowledge is a critical pillar to Africa's climate change adaptation" and that rural communities have intimate knowledge about their environment. UNESCO [39] describes that "Local and indigenous knowledge refers to the understandings, skills, and philosophies developed by societies with long histories of interaction with their natural surroundings. For rural and indigenous peoples, local knowledge informs decision-making about fundamental aspects of day-to-day life." However, the knowledge is not acknowledged or documented by, in this case, professionals working with agriculture or natural resource management [38]. The local or indigenous knowledge builds a baseline of knowledge to enable the development of solutions that are sustainable in their context [39].

3.1.4 Economic sustainability

Economic sustainability is to create long-term economic growth without having a negative impact on the social, environmental, or cultural aspects of a community. Amadei [40] argues that it is equally important to include economic mechanisms in a solution as it is to include education, capacity training, and empowerment to ensure the long-term success of a solution. This also includes assessing the community's needs and existing capital to know what the community needs in order to have

the capacity to help themselves and get value from the solution. The UN's SDG 8 "Decent work and economic growth" concerns promoting inclusive and sustainable economic growth, employment, and decent work for all [2].

The COVID-19 pandemic had major negative effects on the work towards decent work for all and it especially affected the labour market of women, youth, and persons with disabilities, who are also the last ones to recover from this. In addition to the COVID-19 pandemic the Ukrainian war, pressures on inflation, disruptions in supply chains, and more are also negatively affecting economic growth and people's access to education and work. One target to achieve Goal 8 is to increase economic productivity through technological upgrading and innovation and diversification i.e. to create new products or enter new markets. Having access to technology can help stimulate entrepreneurship and enhance innovation which in turn increases economic growth.[41].

One important factor to enhance economic development is access to electricity [27]. Gadgil and Madon [27] state that "The extent of the challenge facing developing countries must not be understated. In order to guarantee growth and development, it is necessary that they find paths to scale up energy generation in a way that is sustainable for the planet and financially viable." The SDG 7 (Access to affordable, reliable, sustainable, and modern energy for all by 2030), is not projected to be met [42]. Data from the International Energy Agency said that 770 million people in the world lived without access to electricity in 2020 and it is predicted that 660 million people will still lack access to electricity by 2030. It is also stated that enabling electricity for all is necessary to achieve net-zero emissions by 2050. Without access to electricity, people will continue to rely on fossil resources for transportation, cooking, heating, lighting, etc.

The global energy crisis needs to be tackled with sustainable energy sources. Gadgil and Madon [27] say that the only way to achieve this is by utilizing technological innovation. Some constraints towards utilizing electricity are badly functioning utilities and electricity theft which inhibits work performance and activities that can be carried out in households and businesses. Access to light and power has been proven to extend the time available for conducting productive tasks such as studying.

3.1.5 Key aspects of the HE literature

The studied literature emphasizes the importance of understanding the context of the humanitarian project, thus adapting the project to social and cultural aspects, the technology level of the community, and the local's needs and aspirations. Understanding the context and then using that knowledge as a baseline when developing a solution is an essential factor to succeed with projects. To illustrate these findings a figure with the important aspects to consider is presented below, see Figure 3.4. Also, a list of the needs identified during the research can be seen in Table 3.1.
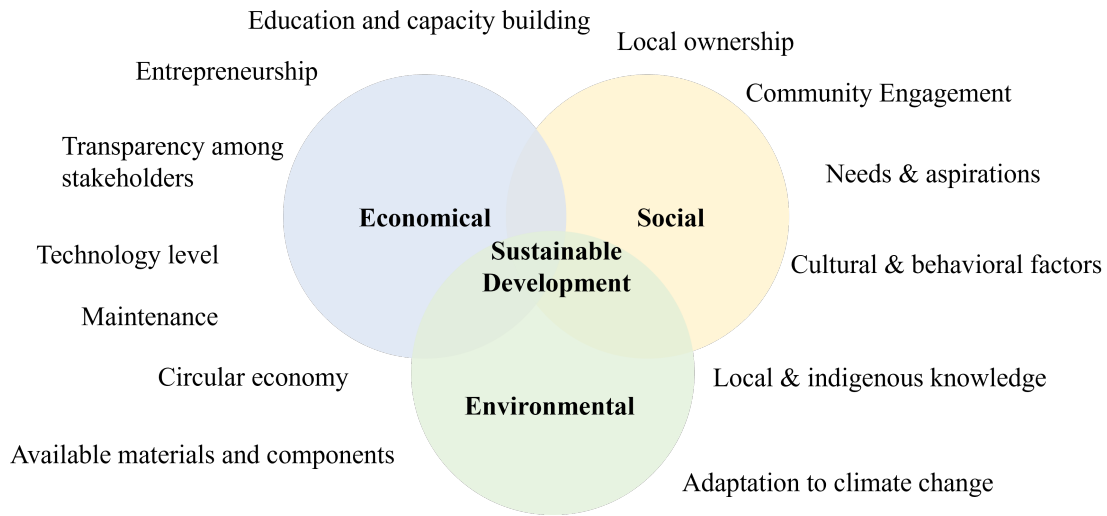
Figure 3.4: A summary of the aspects identified in the literature study on Humanitarian Engineering.

Table 3.1: A list of needs identified from the literature study on Humanitarian Engineering.

1	Adoption and maintenance of sustainable solutions.
2	Waste management and end-of-life solutions.
3	Education and empowerment of communities.
4	Community involvement central to development efforts.
5	Addressing long-term aspirations of the community.
6	Identification and utilization of local resources.
7	Identification and utilization of local opportunities.
8	Understanding and addressing community needs.
9	Enhancing the capability of community members to fix products.
10	Access to knowledge and understanding of technology.
11	Integration of technology into community life.
12	Assessment of community needs, aspirations, resources, and capacity.
13	Collaboration with partners as co-creators.
14	Developing solutions that generate revenue.
15	Understanding and accommodating different social, cultural, and economic contexts.
16	Ensuring social justice in solutions.
17	Identifying and addressing social barriers and constraints.
18	Amplifying the needs and voices of minority groups.
19	Implementing environmentally friendly solutions.
20	Considering environmental changes and adaptation.
21	Leveraging local knowledge about the environment.
22	Identifying economic mechanisms within solutions.
23	Ensuring affordability of the solution.
24	Identifying and mitigating risks associated with economic mechanisms.

3.2 Empirical Study on Engineers Without Borders Sweden

Engineers Without Borders Sweden's (EWB-SWE) work is split into five main operations, this report will focus on the area called International Projects. This area is concerned with achieving sustainable and long-term positive impacts for local communities in low-income areas around the world. The international projects are always carried out in collaboration with local grass-root organizations, here after called the partner organization or the partner, and the aim is to empower communities to have the capability to meet their humanitarian basic needs. EWB-SWE's work is focused on sharing knowledge and supporting local partners with engineering and technology expertise in their focus areas energy, waste management, water, sanitation, food supplies and processing, construction, and digitization [3]. The year of 2022 EWB-SWE was involved in projects in South America; Suriname, Asia; Nepal and Bangladesh, and in Africa; Ghana, Rwanda, Kenya, Uganda, Tanzania, Mozambique, Zimbabwe, and South Africa [4].

The procedure for International Projects is described in EWB-SWE's *Handbook for International Projects* [3]. EWB-SWE's Organizational Structure for International Projects is illustrated in Figure 3.5 and relevant roles are explained below:

- The Board operates at the organization's national level and consists of one representative from each operations area.

- The General Secretary also operates at the national level and is together with the Board responsible for the daily operation and continuous development of the organization.

- The Head of International Projects is responsible for communicating what happens in the International Project operations to the board and secretary general and managing and developing the International Project process.

- The International Projects Committee (Decision committee, in Figure 3.5) is responsible for reviewing and giving feedback on projects, this includes deciding whether a project can enter the next stage in the process or not.

- The International Project Secretary is part of project selection and supports the Project Teams.

- The Project Teams carry out the projects while the Project Manager is responsible for planning, communicating with stakeholders, and ensuring that the project is carried out according to plan.

- The Competence groups have the task to participate in the Decision Committee meetings and support Project Teams with their experience and expertise in specific areas as well as gather and store knowledge from previous projects.

- Part of the Competence Groups is the Monitoring and Evaluation team which is quite new and has the task to follow up on and evaluate implemented projects.

- The Partner Coordinators are responsible for communication and planning of collaboration with the Partner Organizations.

- The Project Coordinator is the link between the Decision Committee and the Project Teams. It ensures that the Projects are carried out according to the *Handbook for International Projects.*

- Partnership Assessment and Initial Assessment are responsible for gathering information, assessing and scoring potential partners.
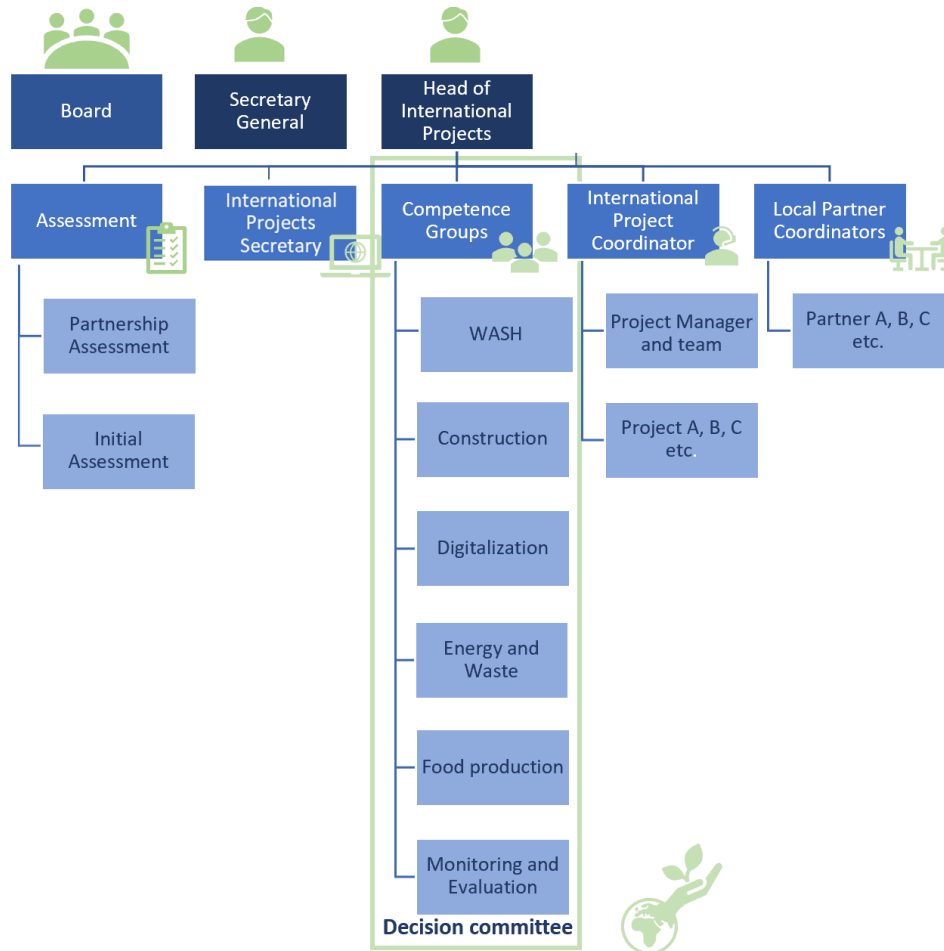
Figure 3.5: Illustration of EWB-SWE's Organizational Structure of groups and roles involved in the International Projects

3.2.1   EWB-SWE's five stage Project Process

Each International Project must follow the five stages of the Project Process, illustrated in Figure 1.1. For each stage, the International Projects Committee must accept or decline the project before it can move on to the next stage. These decision meetings occur on a monthly basis and to enable a baseline of data to take decisions on, all information is documented in the Project Charter which describes the five stages. The Project Charter acts as a documentation and work-in-process document where each stage is described and includes guiding activities.

In the **Idea stage**, the project team presents the problem that initiated the project. Ideas can come from different sources, such as possible partner organizations or already existing ones. The ideas must be grounded in needs identified by the partner organization. It is stated that "At the Idea Stage, information about the location of implementation, partner organization, community needs, sustainable development context, and EWB-SWE's potential role needs to be clarified." [3, p.19]. The next stage, the **Planning stage**, involves planning the project and more specifically the implementation stage. This involves setting reasonable goals and indicators that are measurable and the advice from EWB-SWE is to "keep it as simple as possible".

In the **Implementation Stage**, the project plan is followed and the Project Charter must be continuously updated with the conducted work while a monitoring plan must also be used to keep track of the progress. It is also important to gather knowledge from the local community to enable evaluation of the implemented solution's effect on the community. During this stage, field trips can occur if approved, with the purpose of being part of implementing the solution. The next stage, the **Conclusion Stage**, occurs when the solution has been implemented. In this stage, the completed project charter must be approved by the Board and the International Projects Committee. The project team must make a plan for how to monitor and follow up on the implemented solution. Lastly, the project enters the **Monitoring and Evaluation Stage** where the International Projects Administration is responsible for following the suggested monitoring and evaluation plan, however, the process for this stage has not been fully implemented in the process yet.

The Idea Stage, as it is today, does not promote the engineers to widen their solution space or consider the actual root causes of why the solution is requested. Therefore, the Idea stage is about to be restructured and improved to what EWB-SWE refers to as the Feasibility Study. This stage is illustrated in Figure 3.6 and can be compared to the current process which was illustrated in Figure 1.1.
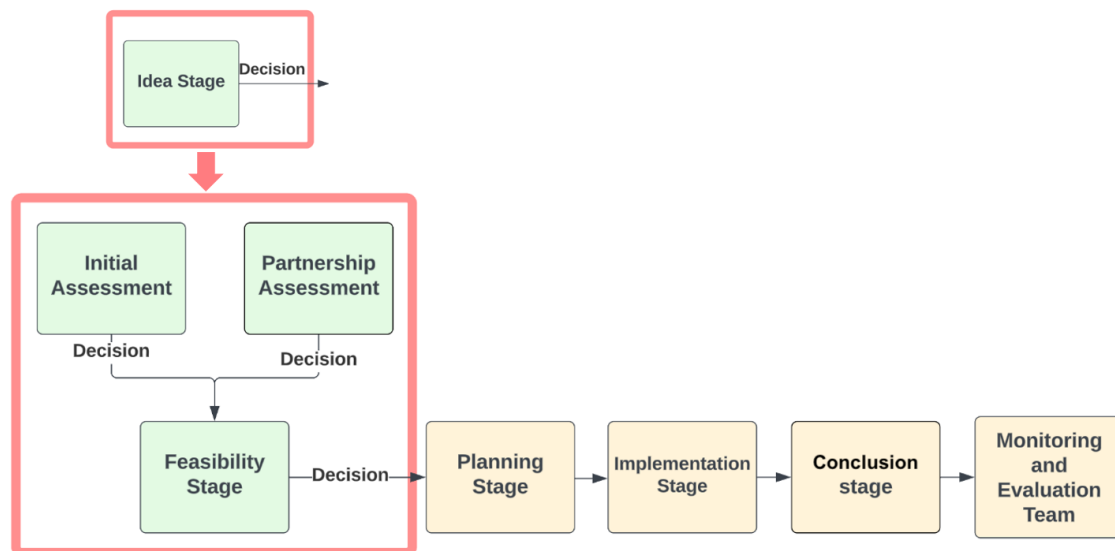
Figure 3.6: Illustration of the Feasibility Study included in the Project Process.

3.2.2 New Process Proposal

The current project process involving the Project Charter is applied to all projects no matter the project size or scope. The process takes the Project Team through all the steps including the implementation step even though all projects do not result in a solution that will be implemented. This makes the processing time-consuming and doesn't allow for smaller more investigative projects. Therefore, implementing a Feasibility Study would aid in enabling these other types of projects. However, this requires a new way of working and a restructuring of the Project Charter, adding steps and dividing the process into guiding documents and decision documents to enable projects to not go through all stages in the process. An initial Feasibility Study Template has therefore been developed by EWB-SWE and its current structure is illustrated in Figure 3.7. However, this will be updated and improved through this thesis work.

Feasibility Study Process
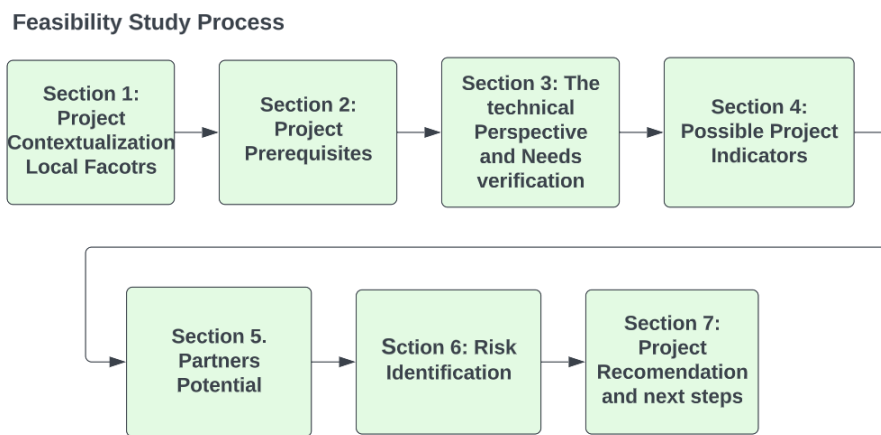
Figure 3.7: Illustration of the process proposed in the Feasibility Study Template consisting of seven proposed sections.

The aim of it is to guide the project team through the Feasibility Study and to ensure that the right information is gathered and that the process is documented. When the study is completed, the information gathered or created about the partner and the project should be documented with enough information for the Decision Committee to be able to make a decision on whether to conduct the project or not. For example, this information should include the size of the project, what resources would be needed, a few alternatives of suitable technical solutions, and the described goal of the project in terms of social impacts. This would enable EWB-SWE to ensure that they take on projects where they can use their resources in the most efficient way and have the most impact.

The current project process doesn't promote alternative solutions to be investigated thus limiting creative thinking. The reason for this is that in today's process, if a partner organization comes up with an idea for a solution to be implemented and the project proposal is approved, the proposed solution is not questioned. Therefore, EWB-SWE has decided to restructure the International Project Process to enable a

thorough Feasibility Study to accommodate a wider solution space. Passino [9] states in his book *Humanitarian Engineering* that if a helping organization implements solutions without having enough background information the people and community receiving the help might see the helper as incompetent. This in turn could result in a bad relationship and a solution that is not maintained or sustained in an optimal way. Also, it can be explained with Toyota's Lean Product Development System Model principle to "Front-Load" activities i.e. maximizing the design space, which means opening up for more possible designs, while thoroughly exploring alternative solutions [43]. Morgan and Liker [43] describe how front-loading can be achieved through working with cross-functional teams, thus involving engineering, design, and manufacturing in the early stages and working with a "set-based" approach, meaning that different solutions are explored at the same time. In terms of EWB-SWE the Feasibility Study is a way of Front-loading activities to ensure they do not take on projects that they might not be able to follow through on due to uncertainties. Thus it is important that they can investigate the project, and its context and explore alternative solutions from the start instead of finding out halfway into a project that the solution cannot be implemented due to some unknown aspect resulting in a waste of resources. Working cross-functional in the Feasibility Study would promote knowledge sharing such as when the competence teams provide the project teams with knowledge and experiences from earlier projects to ensure that no one has to "reinvent the wheel" or remake mistakes.

3.3 Qualitative Study on Engineers Without Borders Sweden

The analysis of the 12 conducted interviews resulted in different areas that are important to understand and consider when working with HE. This chapter is divided into two main parts, the first concerns the work process of EWB-SWE as an organization based on the interviewee's personal description of their work procedure and experience. The second presents the identified needs that are connected to the project process, cooperation with partner organizations, and aspects to consider when developing a solution for a community. The presented information is based on the thematic analysis of the transcribed interviews, see Appendix C.

3.3.1 EWB-SWE as an organization

The information gathered during the interviews shows that EWB-SWE as an organization has a wide range of both internal and external challenges to phase. It is evident that the current project process, the Project Charter, is a process that needs to be restructured to accommodate and facilitate the many different projects that EWB-SWE undertakes.

From the conducted interviews, information about the newly developed Initial Assessment stage was gathered, and how this phase differs from the Partnership Assessment. The chronological order and what informational output in terms of documents

are available after each stage is illustrated in Figure 3.8.
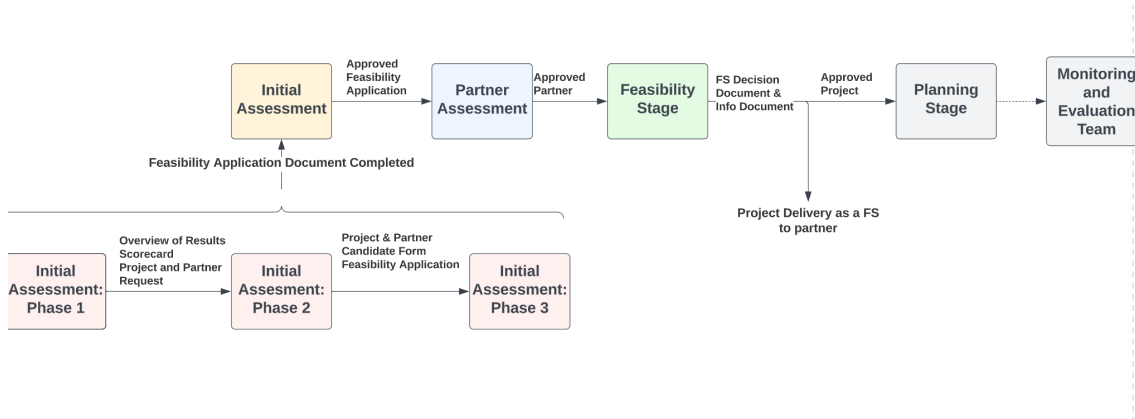
Figure 3.8: Overview of the Initial Assessment, Partnership Assessment, and Feasibility Stage along with a short description of each stage output.

The Initial Assessment is divided into three stages:

- Phase 1: This phase is initiated when an email with a partner request is received. All requests are saved in a Project Bank and are answered with a *Project and Partner Request questionnaire* for the partner to answer. This concerns what the potential partner's goal with the partnership is, the social challenge they want to solve, their perceived technical solution, if and how they measure project impact, and information of previous relevant experience. The results from the questionnaire are then saved in a folder and filled into a *Scorecard* where each project and partner request is ranked on different factors such as organizational capacity, scalability potential, and project potential in terms of social impact and project type. Further on, all partner scores are filled in the *Overview Results.* Based on the overall score, a decision is then taken if the partner is approved to enter the second phase or not.

- Phase 2: The second phase requires the partner to fill in a more thorough document, the *Project and Partner Candidate Form*, once answered it's saved into the partner folder and a *Feasibility Application* is created with an assigned Project Coordinator.

- Phase 3: The third phase, concerns the assigned project coordinator, that has the task to summarize the partner information in the *Feasibility Application* that the Decision Committee will use to make a go or no-go decision. If a partner is approved the Partnership Assessment can start. Some partners/projects are approved but rejected due to EWB-SWE's limited capacity, these are then saved for future review. The rejected partners are sent a rejection email.

Once a partner has been approved in both the Initial Assessment and then the following Partnership Assessment the project can enter the Feasibility Stage. The whole procedure is illustrated in figure 3.9 with a flow diagram.
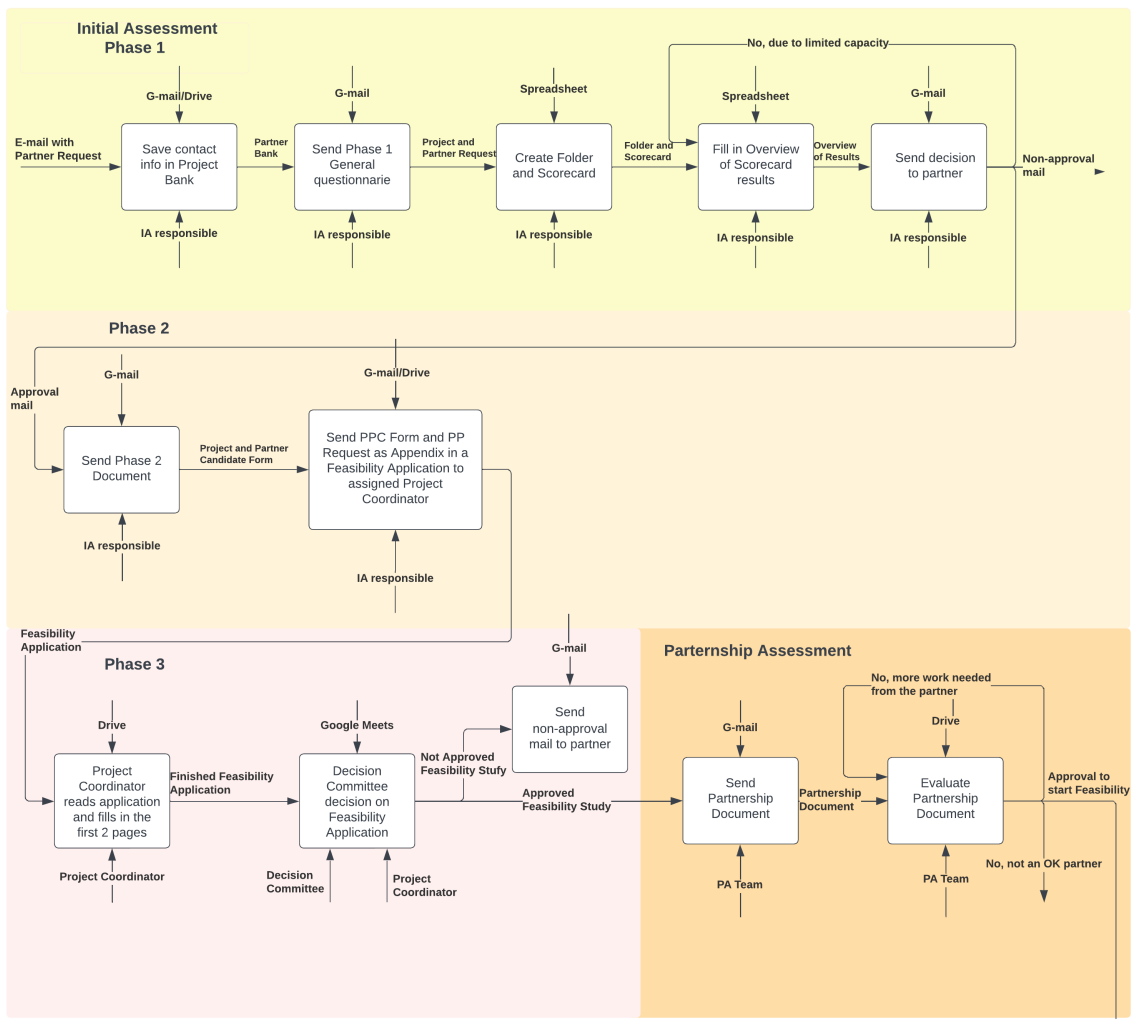
Figure 3.9: Flow diagram of the Initial Assessment and the Partnership Assessment, each activity is visualized in a square with related inputs and outputs along with an arrow from above stating what tools or documents are used and an arrow from below stating who is responsible

Since EWB-SWE is a voluntary organization and the project teams often consist of students there is a limited amount of time a volunteer can spare resulting in them often only being part of one project. Projects might run for multiple years, and thus the same volunteers are not always part of a project from start to finish. This results in the challenge of maintaining knowledge in the organization and motivating people to follow through on projects. From the interviews, it was identified that one reason why projects are so time-consuming is due to the comprehensive Project Charter and its related activities.

Another observation from the interviews was that there is a lack of understanding, between members of EWB-SWE, about what the different groups and functions do and who they are. For example, the competence teams' work includes helping project teams with technical questions and knowledge about certain solutions. The competence teams are also responsible for maintaining and storing knowledge con-

cerned with their area of expertise. However, it was identified that some project teams are not aware of the available support or do not make use of it.

Also, it was evident that there is a lack of standardization in the conducted work. Many activities, for example, Initial Assessment and Partner Assessment are both reliant on a specific person and their experience. If for some reason those persons were to leave or not be available for some time, the work would be hindered or possibly stopped. This is a clear risk that could be avoided by implementing a standardized and understandable way of working. However, there have been activities and attempts to solve and mitigate these risks, but as it stands they are still a factor to consider.

Due to the above-stated factors and risks as well as the perceived internal communication system, there is a risk of knowledge and information getting lost. Experiences from previous projects and used technologies might not be utilized in the most optimal way in future projects. EWB-SWE gathers usable information and knowledge in all their projects, through improved knowledge management their work process could be streamlined and their resources could be used in a more efficient way while ensuring that they do not have to "re-invent" the wheel.

3.3.2 Identified organizational needs and areas of improvement

Based on the results of the thematic analysis it was possible to distinguish common needs for EWB-SWE internally as an organization but also needs from external parties such as partner organizations and local communities related to EWB-SWE's work.

Internal Organizational Needs
There is an internal need for a standardized process with clear guidelines on how to perform activities, which involves defining:

- When and how relevant persons should be contacted. The contact information should be easy to access and communication needs to be smooth.

- A structure for knowledge transfer between project teams, the monitoring and evaluation team, competence groups, and initial and partnership assessment to prevent knowledge loss. This is important since EWB-SWE has a high staff turnover.

- A method for how to write qualitative long-and short-term project goals, that are somehow standardized to enable continuous follow-up during a project.

Other internal organizational needs that were identified are related to the volunteer's own achievements and motivations. See Figure 3.10 for quotes stated during the interviews. There needs to be a plan for:

- How the follow-up results of a project will reach the volunteers that have been

involved. It is important for them to know if the implemented projects had a positive impact on the community. In this way, they might also spread the word about EWB-SWE and the good they do to attract more volunteers and sponsors.

- How to streamline projects so that volunteers do not feel that the projects are too time-consuming or heavy and that they have the possibility to finish their projects. This also relates to EWB-SWE's need to work with resource efficiency, to only do projects where they have the required capacity and knowledge, as well as use the budget for projects where they can have the most impact.

- How to ensure that the projects are in line with EWB-SWE's values and applicable SDG's.
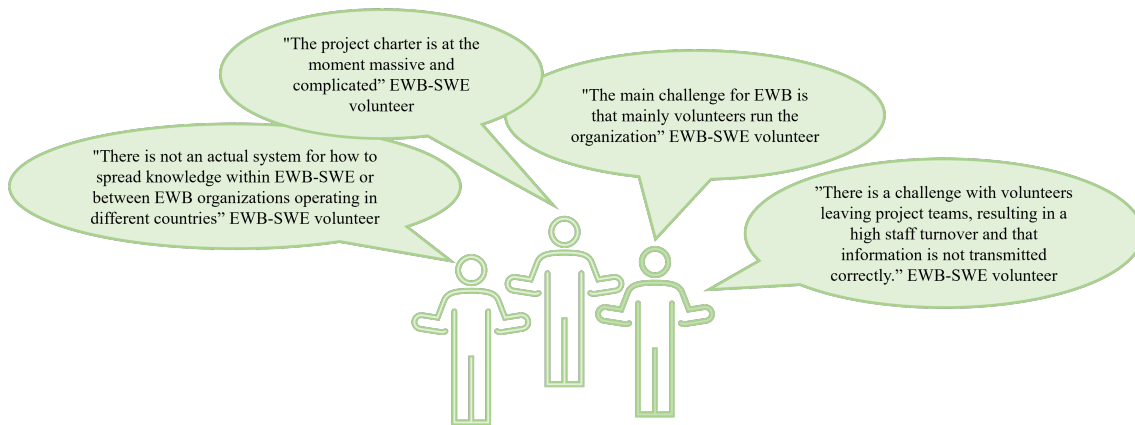
Figure 3.10: Quotes by EWB-SWE volunteers stated during the interviews regarding internal organizational needs

Assessment of Social Impact

EWB-SWE wants to measure social impact in all projects, which will enable documentation of a project's success rate and help them evaluate what projects have the most positive impact. See Figure 3.11 for quotes stated during the interviews. To achieve this there is a need to:

- Identify indicators or criteria that can be used to capture the context of where the project is to be conducted.

- Define who is responsible, both internally and externally for activities related to the evaluation and monitoring of projects.

Identified Factors for Successful Partner Cooperation

Figure 3.12 are examples of quotes stated during the interviews. When working with a partner organization it is important to ensure:

- Continuous communication with partners to create mutual trust, transparency, and cooperation between both parties.
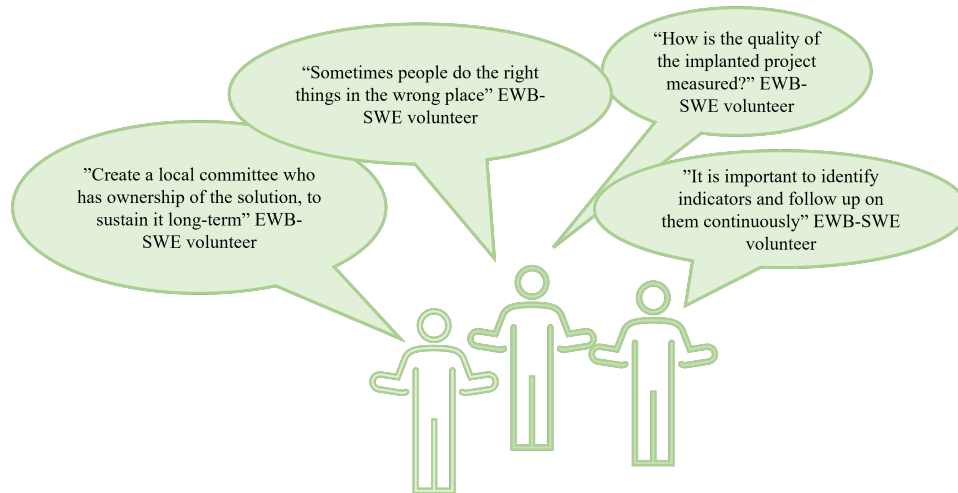
Figure 3.11: Quotes by EWB-SWE volunteers stated during the interviews regarding social impact.

- Local ownership of the solution, so that the solution can be adapted and sustained by the community.

- Community engagement, which requires the partner to be engaged with and established in the community. This is necessary for the project to be accepted by the community and to capture and understand their actual/latent needs.

- An understanding of the context where the partner is located since this affects what type of solution the partner and local community will be open to and what drives them. An example was given by an EWB-SWE worker when a project had to be moved due to conflicts in the area and the new receiving community could not adapt to the solution in the same way since they were living in a different country with different social aspects, thus the project did not have the same social impact as it could have had.
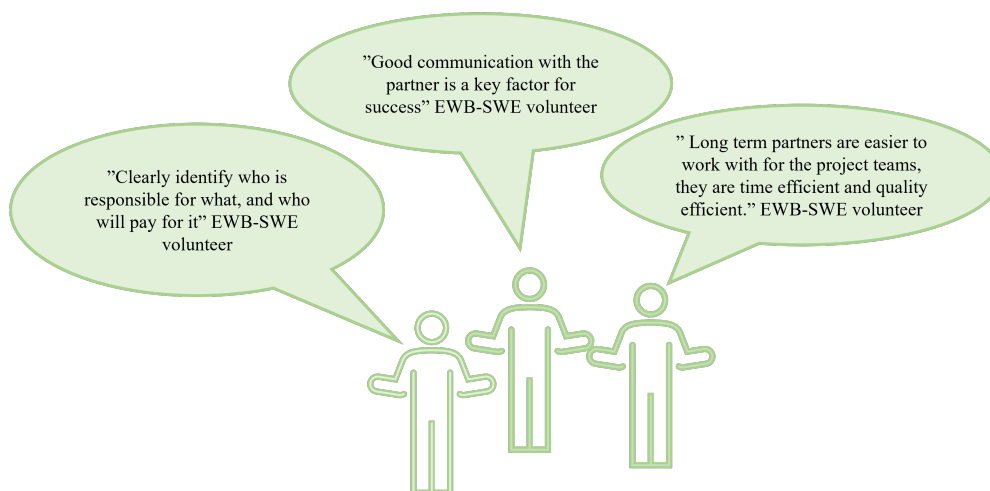
Figure 3.12: Quotes by EWB-SWE volunteers stated during the interviews regarding factors for successful partnerships

Development, Implementation, and Adaptation of Technical Solution:
Figure 3.13 shows examples of quotes stated during the interviews. Some barriers that might lead to the solution being incorrectly implemented, used, or maintained were identified and defined as factors to consider in the solution:

- Most often a trade-off between price and sustainability is required, especially if the partner does not see the need to work with environmental sustainability. One worker of EWB-SWE explained it as "The way of life" referring to that it is not always that easy to change a person's attitude towards technology or what factors that matter. What matters to a person is rooted in their upbringing, culture, education, and way of living. Thus an environmentally sustainable solution might not be what another person prioritizes, and then there needs to be a trade-off in the solution between what indicators are the most important focus and which needs to be down-prioritized.

- The solution or idea should come from the local partner and be grounded in the local community's needs. Based on the requested solution the most suitable solution can be sought out through cooperation, but it can not be pushed onto the community. This relates to the need of identifying the community's and partner's long-term goals.

- In order for a solution to be successful the community must have the right capabilities to maintain and use the technology. Thus there is a need for EWB-SWE to either empower the community with the required knowledge and tools or to develop the solution after their current capabilities.

- The resources used in the project implementation should preferably be local resources such as entrepreneurs and the use of local materials. A project should always strive to increase local work opportunities and local engagement, not the opposite.
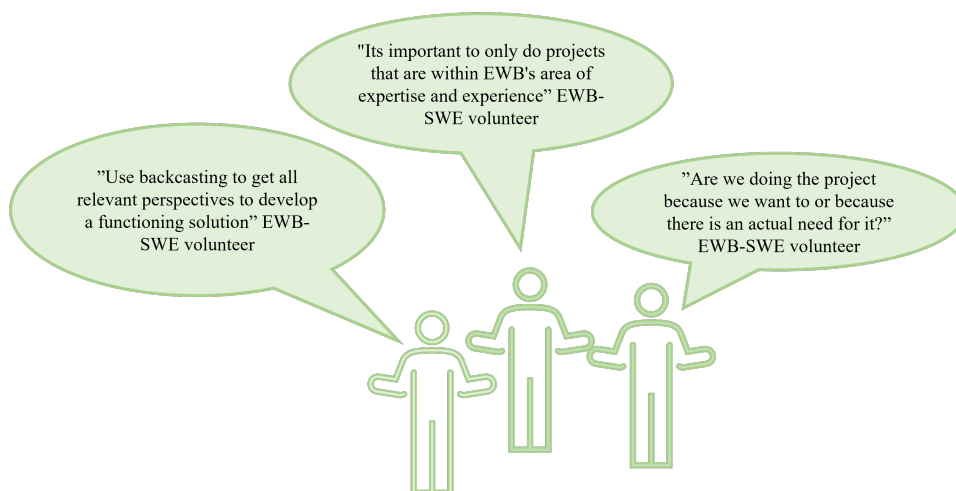
Figure 3.13: Quotes by EWB-SWE volunteers stated during the interviews regarding development of the solution

3.4 Project criteria for evaluation

The following sub-chapter presents two lists of identified criteria, one for the methods and tools to be evaluated against, and one for the complete Feasibility Study. The criteria are based on the findings in the Design Research, chapter 1.5, the findings in the Literature Study on Humanitarian Engineering, chapter 3.1, and the Empirical Study on Engineers Without Borders Sweden, chapter 3.2.

3.4.1 Criteria for Methods and Tools

The following list presents the defined criteria that the methods and tools are evaluated against;

1. How much time or resources (extensive) it needs.

2. How understandable it is to use.

3. How it promotes collaboration and cooperation with stakeholders.

4. How possible it is to perform at its intended stage in the Feasibility Study.

5. How possible it is to adapt and align with EWB-SWE's work procedure.

6. How it contributes to its related need.

3.4.2 Criteria for FS process

Besides the criteria for the method and tools, criteria are defined in order to evaluate the whole Feasibility Study process, these are presented in Table 3.2.

Table 3.2: Criteria to evaluate the final Feasibility Study, based on the research conducted in the project.

Criteria	Explanation of Criteria
Community Capabilities	How well it contributes to improved community capabilities that will ensure that the solution can be maintained and sustained.
Incorporation into work process	How well it can be smoothly incorporated into the international project work process.
Decision basis	How well it includes the information required to decide if a project should be approved or declined.
Solution exploration	How well it promotes the exploration of different solutions.
Motivation of the volunteers	How well it motivates the volunteers to use it.
Knowledge sharing (internally)	How well it promotes knowledge sharing internally.
Knowledge sharing (externally)	How well it promotes knowledge sharing with and from external stakeholders, such as the partner.
Ease of communication	How well it ensures clear and continuous internal and external communication.
Contextual understanding	How well it contributes to contextual understanding.
Sustainability evaluation	How well it ensures that the solution sustainability can be evaluated.
Partner collaboration	How well it involves the partner in the project.
Social impact evaluation	How well it promotes and evaluates the social impact of a project.
Ensure local needs	How well true local needs have been identified and verified
Community Engagement	How well the community is involved in the project and its potential to be

4

Exploration Methods & Tools

This chapter presents the areas of interest for methods and tools suitable for the early phases of Product Development projects. The exploration is limited to methods and tools that could be aligned with Humanitarian Engineering (HE), EWB-SWE's way of working, and Design Research, chapter 3 and chapter 1.5.

4.1 Areas of interest

Based on the list of needs in Table 3.1 and the identified organizational needs from chapter 3.3.2, a thematic analysis, see Appendix B, was made to find areas of interest when developing a Feasibility Study for the HE context. In Appendix B, the numbers correspond to the numbers in the needs list from Table 3.1. The area of Context Analysis and Needs Identification is somewhat connected, but moving forward it is separated in order to find tools to ensure the accommodation of both. The analysis resulted in the following five areas;

- Needs Identification
- Context Analysis
- Explore Solutions
- Sustainability Aspects
- Project Management

The first four areas are from the thematic analysis of the HE needs and the last one is from the internal organizational needs of EWB-SWE.

4.2 Methods & Tools

The five areas of interest are presented further in this sub-chapter and the explored methods and tools are, for each area, briefly described. The description for each method and tool answers what it's intended to do and why it is used.

4.2.1 Methods & Tools for Needs Identification

The methods and tools identified for this type of analysis are presented in Table 4.1 and **??**. The methods connected to needs identification are identified to get a better understanding of the problem, the user, and the areas of importance when developing a solution as well as to gather information about the user and other related technologies.

Table 4.1: Methods and tools for Needs Identification with explanations of what they do and why they are useful.

The Kano Model [21, p.506]	**What?** A tool that helps classify needs into different areas: unspoken basic, spoken performance, and unspoken excitement needs. The unspoken basic needs are needs that the user expects the solution to accommodate without them expressing them if they are not met would have a negative impact on the perception of the solution. The spoken performance needs are needs that will enhance the solution if they are met and the unspoken excitement needs are "delighters" that if they are met would enhance the solution in unexpected ways. **Why?** It helps to understand what is expected of a solution and what could enhance the solution.
List of Customer Needs [44]	**What?** A structured list of categories of needs to gather data on. The list can be divided into two parts service needs and product needs. **Why?** It helps to summarize and categorize the identified needs in the project.
Voice of the Customer [21, p.454]	**What?** An iterative process that starts with a step called exploring where in-depth interviews are conducted to get an understanding of the customer's way of thinking as well as spoken and unspoken needs. After that, a step called quantifying where the needs are prioritized and the market is investigated. The next step is called verifying and it aims to, in a structured way, verify the product concept. The next step, testing, is a structured way to test the prototype and lastly, the validation step is to get feedback from the pilot launch on the pilot market. **Why?** To have a structured way of working when collecting needs and investigating the market.
Future User [22]	**What?** It is concerned with creating a profile of a potential user and comparing similar groups over time. **Why?** It is a tool to help identify the user needs of a market segment in the future. It helps to identify differences in values, attitudes, and behaviors between customer generations as well as to visualize and get a clear view of the future needs and expectations of a solution
Observations [20, s.144]	**What?** Observations can be divided into two dimensions direct or indirect, where direct observation is when something is directly observed, for example, a production process or a project meeting. The indirect approach is done by some form of measuring instrument and is often used when the observation can't be carried out by the observer's senses. Observations are also divided into structured and unstructured observations, where the structured approach is when the researcher follows a schedule or protocol to get specific records and insights. The unstructured approach is documented by taking notes during the observation. **Why?** It is a method where researchers observe a certain object or scenario in order to evaluate a certain objective or research question.
Interviews [20, p.152], [45]	**What?** Interviews are used to get insight into a person's perception and experience of a certain topic. The researcher must in this case be a good listener and active to capture the interviewee's stories, views, attitudes, and opinions on the studied subject. An interview can be more or less structured, whereas an unstructured interview is open and involves a few areas to be discussed freely. A semi-structured interview includes more specific questions to get some structure in the interview but some elaboration from the interviewee and follow-up questions are required. A structured interview is said to resemble an oral questionnaire where the respondent answers fixed questions with fixed alternatives. When conducting an interview the five Whys approach can be used to get to the root cause of the problem or question. The five whys work by first stating the problem and then answering the question "Why?" five times or until the question no longer yields any more useful information. **Why?** To get one-on-one input on a specific topic.
Focus Groups [20, p.157]	**What?** It is a type of qualitative research that gathers a small group of people to be investigated. The research includes observations of the group's answers to specific questions, the discussion around them, and the group dynamics. A focus group requires the researcher to be somewhat involved to guide the conversation, but not too involved as to hinder the discussion. **Why?** To get insight from a group into a specific topic or scenario.
Gender Analysis [46]	**What?** It allows the development of interventions to address gender inequalities and to ensure that the different needs of women and men are met. This is done by, for example, acknowledging differences between and among women and men, ensuring that the different needs of women and men are clearly identified and addressed at all stages, and recognizing that policies, programs, and projects can have different effects on women and men. **Why?** It helps to identify the differences between women and men in terms of their relative position in society and the distribution of resources, opportunities, constraints, and power in a given context.
Benchmarking [47]	**What?** It is the activity of continuously and systematically measuring and evaluating the performance of your own or a competitor's product, preferably the best competitor's product. Benchmarking can be used as both qualitative and quantitative measurements and evaluations. **Why?** It helps to make informed business and engineering decisions.

4.2.2 Methods & Tools for Context Analysis

The methods and tools identified for this type of analysis are presented in Table 4.2. These are to enable an investigation of the context that the solution will be a part of. It will also help to ensure that the surrounding factors of the solution are considered in the project.

Table 4.2: Methods and tools for Context Analysis with explanations of what they do and why they are useful.

SWOT Analysis [48]	**What?** It is a tool that represents the areas of Strengths, Weaknesses, Opportunities, and Threats of or to a company or organization. The analysis is divided into two parts an internal analysis (Strengths and Weaknesses) and an external analysis (Threats and Opportunities). The overall objective of a SWOT analysis is to determine how to enhance strengths, overcome weaknesses, control threats, and take advantage of opportunities **Why?** The tool is intended to help companies to assess their and their product's situation in a market.
PEST(EL) Analysis [48]	**What?** The PEST analysis includes Political, Economical, Social, and Technological factors and the PESTEL also includes Environmental and Legal factors. This analysis provides information to outline the macro-environment of the intended solution and its related market **Why?** The objective is to identify the threats and opportunities that are affecting a company in the national context.
Context Map [22]	**What?** It is helpful in finding groups of important aspects to consider in a specific context. Furthermore, the tool can be used as a visualization tool to communicate the identified important aspects and could be used as an ice-breaker for a new team to start their innovation discussion. **Why?** It is used to visualize themes that emerge when investigating a certain problem or project.
Janus Cones [22]	**What?** It is a method to look backward and forward in time to identify previous events concerned with, for example, a specific technology, the context, or a community and to identify how these might affect potential future events. **Why?** To create a contextual understanding of a situation.

4.2.3 Methods & Tools to Explore Solutions

The methods and tools identified as important for the development of a technical solution in the conceptual stage are presented in Table 4.3.

Table 4.3: Methods and tools for the exploration of solutions, with an explanation of what they are and why they should be used.

Frugal Innovation [49]	**What?** A way to develop products or solutions with scarce resources, often with locally sourced materials and with a minimal cost. These types of inventions are often built by local community members and their needs often come out of necessity. **Why?** To turn constraints into advantages, make simple innovations into invaluable inventions, and reuse what already exists in the area. Organizations can help connect solvers or innovators from different communities with each other to spread their local inventions
Failure Identification Techniques [50]	**What?** A technique to identify failures in a product development process, at what stage it happens, why it happens, and how they could be prevented. From a failure analysis, it should be clear what actions to take based on the identified failures. **Why?** The purpose is to determine the most fundamental reason why something failed.
Quality Function Deployment (QFD) [51]	**What?** A structured approach to define customer needs or requirements and translate them into specific plans to produce products to meet those needs. To define the stated and unstated requirements or customer needs the "voice of the customer" can be used. The defined needs or requirements are then presented in a product planning matrix referred to as House of Quality to translate the needs or the "what's" into requirements or "how's". **Why?** To aid in translating customer needs into defined targets. The aim is to increase customer satisfaction.
Morphological Matrix [52]	**What?** A method to generate different concepts by listing sub-functions and then brainstorming and generating sub-solutions for each sub-functions. The sub-solutions can then be combined in different ways into potential concepts. **Why?** It supports coming up with new possible solutions that otherwise might not have been explored.
Functional Model [21]	**What?** A structuring of functions(the activities it carries out) and functional elements(the objects of the activities) of a product. The identified functional elements and functions can be visualized in a model with arrows connecting the functional elements to one another in sequential order. **Why?** To get a better understanding of how a product functions.

4.2.4 Methods & Tools for Project Management

The following methods and tools are explored because of their possibility to support the management of a project and the project process and they are presented in Table 4.4.

Table 4.4: Explored methods and tools for project management, with an explanation of what they are and why they should be used.

Theory of Change [53]	**What?** A methodology or criteria used to promote social change, that NPOs use for planning, participation, adaptive management, and evaluation. It explains the process of change by identifying short-term, intermediate, and long-term outcomes and then connecting them to activities and objectives that will achieve the stated outcomes. **Why?** It can help users make more informed decisions about the strategy.
Mission Statement [21], [54]	**What?** A few sentences defining the objectives, purpose, and goals a business or project will pursue. It is straight to the point and explains the "what" and the "how" of a project and it can be complemented with a vision statement that explains the "why' i.e. the purpose or final goal of the project. **Why?** A mission statement can motivate team members since it connects purpose to action and it allows them to work more freely and make their own decisions, as they can assure that the decision is aligned with the mission statement. However, it is important to note that a mission statement is not the same as a goal statement since the latter also involves stating what objectives and what actions need to be achieved to fulfill the needs, meanwhile, the mission statement only focuses on what strategies are needed to achieve the vision
Value Creation Analysis [55]	**What?** The process of turning labor and resources into something that meets the needs of others. It concerns the question of how to create value for customers or stakeholders while creating a sustainable business case. For Non-profit organizations value is created in different ways for different stakeholders which may be donors or investors, local partners, and communities which all have different needs. **Why?** Non-profit organizations create value by having a positive impact socially, environmentally, and economically.
Decision Tree Diagram [56]	**What?** A graphical tool to visualize different decision alternatives, understanding sequential decisions and decision outcome dependencies. A decision tree can act as a complementary tool for project planning. The tree consists of nodes indicating a decision point, and branches indicating a decision alternative or outcome of the decision point. **Why?** It helps to explore all options and potential decision outcomes of a decision in one model, which eases decision-making.
Project Stakeholder Identification [57]	**What?** Identification of stakeholders at the beginning of projects enables all stakeholders to be involved in or be aware of what happens in a project. They can come with valuable information that can help to mitigate risks and drive projects forward. **Why?** When a project has been completed it is the stakeholders who deem a project successful or not depending on their satisfaction. Thus, being able to identify and manage project stakeholders is a key aspect of a project's success.
Requirement Specification [21]	**What?** A document with defined target values for each function of the solution. The specification also includes what performance metric and unit, if applicable, is related to measuring each target value. The targets can be formulated as requirements and wishes and they should be based on identified customer and market needs. **Why?** To ensure that the solution fulfills the needs of all stakeholders and follows regulations and standards for a certain product.
Risk Analysis [21]	**What?** An analysis to predict what uncertainties there are with a project and then minimize the occurrence or impacts of them by mitigation. Three types of risks to consider are technical, financial, and social risks. **Why?** The purpose is to improve the chances of succeeding in a project without encountering unexpected problems that might cause delays and exceed budgets. It is a way to streamline the project process.
Pugh Matrix [52]	**What?** A criteria-based decision matrix that uses criteria scoring to determine which of several potential alternatives should be selected. The result of a Pugh Matrix is knowing what solution best meets the listed criteria or requirements. **Why?** It enables easy comparison between the criteria of a solution to aid in prioritizing different solutions.
Kesselring Matrix [52]	**What?** A decision matrix used for determining the weight of each identified criterion, by weighing each criterion with every other criterion to decide which of the two has the most weight. In the end, all criteria are scored and the weighting factors are used for prioritizing the importance of different criteria. **Why?** This can be helpful when there is a need for prioritizing requirements or compromising between them and it is unclear which one to prioritize

4.2.5   Methods & Tools for Sustainability Aspects

To incorporate sustainability in the early design process or concept stage the broad design approach of Design for Sustainability with some included methods was explored as well as the state-of-the-art Sustainability Fingerprint Tool. These are presented in Table 4.5.

Table 4.5: Explored methods and tools to incorporate sustainability, with an explanation of what they are and why they should be used.

Design For Sustainability [58, p.24-26]	**What?** A holistic design approach that connects people, planet, and profit with social, environmental, and economic aspects. It is a wide approach with the aim to consider the overall impacts of design. DFS can involve the redesign of existing products, radical sustainable product innovation, and new product development. DFS results in improved environmental performance, social impacts, profit margins, and increased product quality. In the DFS approach, DFX methods can be included if they promote sustainable development such as Design for Disassembly which is suitable for designing a product with the aim to enable recycling, reparation, easy maintenance, etc. Other examples are Design for Recycling, Design for Longevity, etc. **Why?** It helps to incorporate sustainability in a solution already in the design phase.
Sustainability Fingerprint Tool [59]	**What?** A tool that enables a measurement approach to the sustainability of a product or technology early in the design process. The sustainability of the product is scored based on specific Leading Sustainability Criteria (LSC) defined for the product type and the whole lifecycle and to cover the social, ecological, and economic aspects of a product. The Sustainability Fingerprint Tool results in a spiderweb diagram that visualizes the product's sustainability profile. **Why?** To determine the sustainability profile of a solution. It can be used to compare between, down-select, or find areas where sustainability improvements can be made.

5

Concept Development

In the following chapter, the presented methods and tools are first screened and then tailored to Engineers Without Borders Sweden's (EWB-SWE's) needs, the scope of a Feasibility Study (FS), and the context of Humanitarian Engineering (HE). Thereafter, the tailored methods and tools are structured into an initial concept for the FS which is evaluated on three occasions with key persons from EWB-SWE. This chapter explains how the methods and tools could be tailored and used to fit EWB-SWE.

5.1 Screen Methods & Tools

The methods and tools listed in chapter 4 are screened, for each area of interest, against the criteria defined in chapter 3.4.1. The reason why some of the methods and tools were screened out at this stage is described in this sub-chapter. A few methods and tools for each area are screened out. However, at least one method or tool should remain for each area in order to develop a full FS. In the area of **Context Analysis**, no methods or tools were eliminated, since they all fulfilled the criteria, and it is one of the more important aspects to consider during the FS.

5.1.1 Eliminated methods and tools

In the area **Needs Identification**, the method **Future User** was screened out due to that it was seen as taking too much time in relation to what the output of it would be as well as because it was concerned with only finding future needs, while other methods and tools covered this aspect as well as the current needs. **Benchmarking** was also screened out in this step due to that it was not seen as possible to perform in the intended stage of the FS process. The **Voice of the Customer** method was eliminated due to its ability to be performed during the FS. Since the FS is not a process that includes creating prototypes and conducting testing on the pilot market.

Furthermore, in the area of **Solution Exploration**, **Frugal Innovation** was screened out due to its inability to be adapted to EWB-SWE's work process, it is more of a process to be used by the locals of the community. The tool **Quality Functional Deployment** was screened out due to that it was seen as more time and resource-

consuming than, for example, a requirement specification, and since they both have the objective to state requirements the QFD was eliminated. The **Failure Identification Techniques** was screened out due to that it was not seen as possible to perform in its intended stage of the FS. It would require a specified solution or product that is not available already in the FS process.

In the area **Project Management**, the **Value Creation Analysis** was screened out due to that it was not seen as possible to perform in the FS process. It is more connected to business development and is not applicable to all projects at the FS stage. For example, it requires the developer to define the whole value chain and what each activity in that would cost which would be difficult in the FS stage. **Theory of Change** was eliminated for the same reason, it was not seen as an efficient method to use during this stage. Also, it is a method that requires time and is complex to understand at this stage of the FS, the time required versus the gains from it is not seen as worth it. The **Pugh matrix** was screened out based on that it was not seen as relevant to perform this type of analysis in the FS. Since a Pugh matrix is used to evaluate several alternatives for a solution it is not applicable for the evaluation of the smaller amount of concepts to be created in the FS process. The tool called **Kesselring Matrix** was mainly eliminated due to the time and resources needed to create criteria to evaluate against as well as to understand the tool.

Lastly, in the area **Sustainability Aspects**, **Design for Sustainability** was eliminated due to its broadness, and its in-applicability for the FS. Since it is a design approach that requires experience and knowledge in that way of working which are resources that can not be guaranteed in all EWB-SWE projects. The remaining methods and tools, for each area, are presented in Table 5.1.

Table 5.1: Methods and Tools left for further development after the screening.

Needs Identification	Context Analysis	Solution Exploration	Project Management	Sustainability Apsects
Interviews, Observations & Focus Groups	SWOT Analysis	Morphological Matrix	Mission Statement	LEASA + Sustainability FIngerprint Tool
List of Customer Needs	PESTEL Analysis	Functional Model	Project Stakeholder Analysis	
Gender Analysis	Janus Cones		Decision Tree Diagram	
KANO Model	Context Map		Risk Analysis	
			Requirement Specification	

5.2 Tailor Methods & Tools

The remaining methods and tools are at this stage tailored to the context of EWB-SWE, the FS, and HE to ensure that they complement each other. The purpose of this chapter is to define how each method and tool can be used in the FS and why it should be used and thus tailoring them to the process. However, it does not concern at what order in the FS process each method or tool is to be done, this is defined in the next chapter.

5.2.1 Needs Identification

The identification of needs also concerns the identification of aspirations. The methods and tools also have the purpose to aid in categorizing and documenting the different needs connected to the solution or problem.

5.2.1.1 Interviews/Focus Groups & Observations

Conducting interviews is a structured way to gather data and experiences that you need at a certain point and it can be used both on-sight and remotely. This is therefore a suitable tool to use both for the project team to find needs from the community when working remotely or as a part of a potential field trip. Focus groups have the same purpose and can be beneficial to use to study the emotions and behavior of the participants when discussing a certain topic. However, including multiple participants at the same time also adds barriers to how it can be carried out remotely. Focus groups require a well-functioning internet connection and the facilitator needs to be alert to ensure that everyone gets their actual point across and can express their minds. As identified in previous chapters aspirations of the communities and people are beneficial to investigate and this could be done by including questions that probe for these types of answers during the interviews or focus groups.

Observations are beneficial to use for a project team to not only find needs but to also understand the context, culture, and true behavior of the intended user or the area in which it is to be implemented. It can aid in finding latent needs and defining the problem. Some aspects to take into account when conducting an observation are; the relationship between the participants, the impact that the observer might have on the behavior of the participants, and the execution of the observation (when, how, where, etc.) [20].

5.2.1.2 Gender Analysis

Gender Analysis is done to analyze and investigate the gender differences in a community and is important to include in this type of development project. However, in this thesis, it was decided that this tool is to be developed by other members of EWB-SWE who are more experienced and familiar with the subject.

5.2.1.3 List of Customer Needs

The different areas of needs presented earlier can serve as a checklist or input to what is important to investigate in a project. The areas can help when planning for an interview, observation, or focus group. The list could also be an efficient way to visualize the needs and present them to other stakeholders or people within EWB-SWE. It is also a structured way to summarize and document the findings of needs and aspirations related to the problem.

5.2.1.4 The Kano Model

The Kano Model can be tailored to fit the work of EWB-SWE in the way that it promotes thinking about the needs in different ways. It might not be necessary to fully define needs in all the categories of the Kano Model but to give an understanding and put the project team in the mindset of thinking about what they might have missed. The Kano Model could be used to promote analyzing the collected needs and to contribute to the understanding of the needs, wishes, and to some extent the context of the problem. It can be hard to, from a distance, understand what a user of a specific solution in a remote village expects from a solution and what functions need to be included for them to think of the solution as a success. Something that might be taken for granted by the project team might not be the same for the user or the community and vice versa.

5.2.2 Context Analysis

The methods and tools connected to the context analysis are to enable the team to get an understanding of the context, i.e. social, cultural, and environmental factors, that the solution might be a part of. The analysis helps to identify areas and information that is not readily available or information that the partner has not explicitly expressed yet by email, meetings, or the initial assessment.

5.2.2.1 SWOT Analysis

A SWOT analysis has the potential to be an efficient tool for an HE project. It can be used in various ways by different stakeholders and people to get different insights depending on the purpose. It also has the potential to be tailored and guided to include the relevant areas in a HE project, for example, defining specific questions to investigate and answer and thus ensure that all important aspects are covered. The method can also be used co-creatively by both involving the project team at EWB-SWE and the partner or by letting the partner conduct the SWOT analysis and the project team evaluate the results of it. Involving the partner in the analysis enables for easier identification of factors that might not be evident for the project team or someone not currently at the location of possible implementation. This is because the SWOT analysis focuses on internal aspects such as the strengths and weaknesses of the partner organization and thus the partner would be needed to answer some of these questions. It can also be an efficient tool to use if the project team can travel to the partner organization and the community. An illustration of the outline of a SWOT analysis can be seen in Figure 5.1.

Identifying the strengths of a partner could help to define what of the partner's strengths to utilize in the project, and thus what parts could be handed over to the partner to develop or investigate by themselves. The weaknesses of a partner are also something that could be beneficial for EWB-SWE to understand to help and support in those areas. The external analysis of threats is important to discover what might hinder a project and what needs to be done to minimize the risks concerned with the threats. Likewise, the opportunities to discover how these can be taken
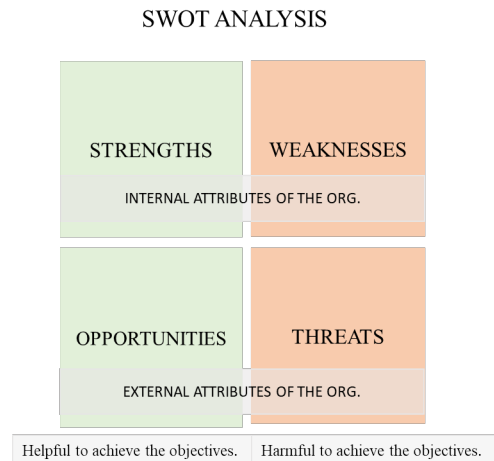
SWOT ANALYSIS

Figure 5.1: An illustration of a common SWOT analysis layout.

advantage of in the most optimal way. In the end, the analysis should contribute to a better understanding of the partner and its surrounding factors that are important to have in mind during the project. However, a risk of doing a SWOT could be that it is not done correctly or that aspects or opportunities are missed or overlooked. There could also be a risk when the partner organization is doing the SWOT that they have a different mindset and conducts the analysis in their way and not in line with what the project team had intended. Also, they could choose to focus more on their strengths and not put focus on defining their weaknesses to not make a bad impression. Thus these are factors that have to be considered when evaluating a SWOT.

5.2.2.2 PESTEL Analysis

The PESTEL analysis has similar benefits as the SWOT when it comes to tailoring it with specific questions to fit the context. Also, the fact that it can be used in a co-creative way or at least with inputs from the partner organization. To compare the SWOT to the PESTEL, they are intended to be used for different areas. The SWOT is more concerned with a specific company or competitor and internal factors while a PESTEL is more concerned with the surrounding market and external factors [60].

Evaluating the Political and Legal aspects of the project and community can give good insights into what is required of a specific solution and what regulations are present in the area of implementation. The Economic aspect is important when developing a solution, since it can be influenced by the local market, inflation, and the employment rate is a factor to consider when developing and implementing a potential solution it is therefore beneficial to have this in mind. The Social aspect is a key factor to understand, see chapter 3.1, and is, therefore, a part that should be included in the PESTEL analysis. The PESTEL analysis structure and some areas to consider can be seen in Figure 5.2.

Analyzing the social surroundings of a problem or solution can give important insights into what is necessary to include and consider in the development project
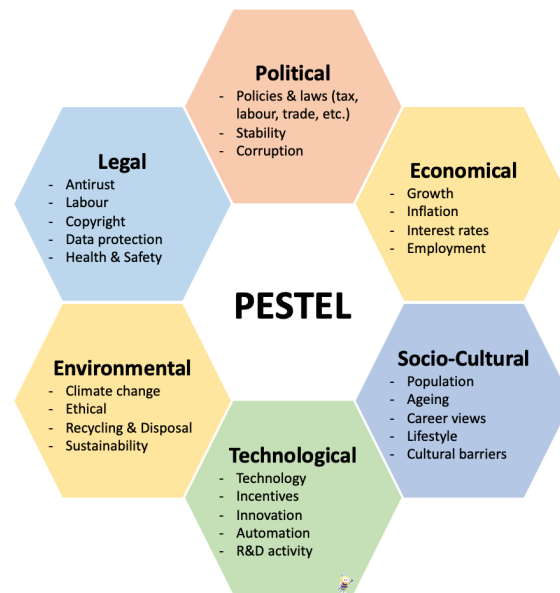
Figure 5.2: The aspects included in a PESTEL analysis.

and if the solution is feasible in the end. The Technology aspect of the PESTEL is connected to technology awareness and could be a ground on which a solution is based. In the case of the project being approved for implementation, it is important to make sure that the technology is something that people can understand and use as it was intended. Therefore, a technology investigation could be made to determine the appropriateness and readiness of certain technologies. The next part of the PESTEL is the Environmental aspect which concerns the physical environment in terms of weather, climate change, and pollution, but also the sustainability of a solution, how and if it can be recycled, and for example what needs to be considered when developing a product to be recyclable.

5.2.2.3 Janus Cones

A Janus Cones analysis is based on previous knowledge of the subject in question. It is a tool that requires multiple participants and is suitable to use in a workshop format, see Figure 5.3. It is done by first drawing a cone facing the left and representing the past. Thereafter the participants discuss what has happened or changed in the community up to this point in time. They should identify major moments in time and place them inside the cone. Time stamps are also added to the diagram and vertical lines are drawn to represent these. Also, to tailor the cone to the application of HE and to what has been identified as important, the cone to the right is important where aspirations and future plans of the locals in the community, and optimal situations are visualized. This helps the project team in understanding the development of a community today and what might be needed for a solution to be sustainable in the long run.
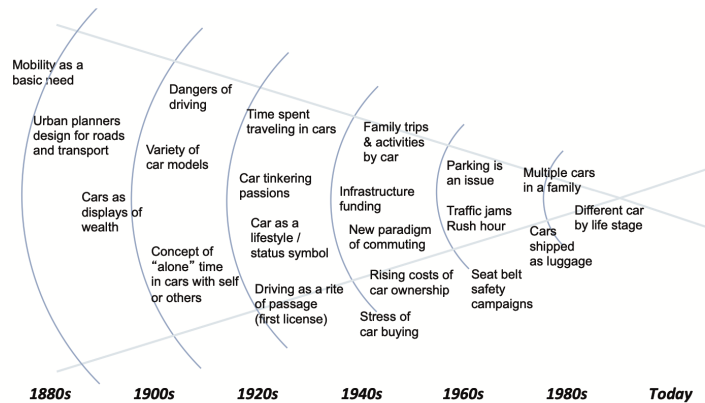
Figure 5.3: An example of a Janus Cones of a team wanting to understand the American beliefs in driving and how these beliefs had changed in recent years. Source: [22, p.82]

5.2.2.4 Context Map

A context map's purpose is to visualize the most critical aspects of a topic. It can be used by EWB-SWE to present and compactly visualize the identified contextual factors identified in the FS. The tool can later be used by new people in the team or project to get an introduction to what is important. Also, the creation of the context map can give the project team insights into the different team member's perceptions of the project and what factors are important. An example is visualized in Figure 5.4. The context map can also be created from different perspectives, for example, the supplier, the user, the community, or EWB-SWE.
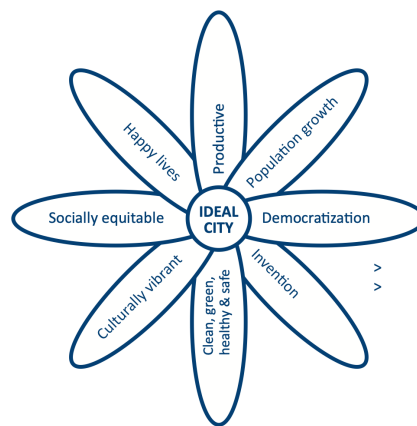
Figure 5.4: An example of a Context Map where a future ideal city is described with eight aspects. Source: [22, p.62]

5.2.3 Solution Exploration

In this part, the methods and tools that can aid in the exploration and development of solutions are presented further with an explanation of how and why they can be

used.

5.2.3.1 Functional Model

One purpose of the FS is to promote a wider solution space and the process will require a method or tool to enable that. When breaking down a solution into functions it is possible to see the solution from a different point of view and more as a set of sub-functions rather than a full solution. However, for the FS, when all functions of a solution might not be fully defined creating a functional model might be difficult. Therefore an idea could be to make a functional breakdown of the problem and simply list the problems, sub-problems, functions, and sub-functions in a table.

5.2.3.2 Morphological Matrix

Using a morphological matrix is beneficial to generate a width of concepts by generating sub-solutions for each sub-function and then combining these in multiple ways into concepts. The concepts that are considered feasible can then be further developed and evaluated. Most often each sub-solution is described with a quick drawing which makes it easy to communicate ideas in a group. A morphological matrix can be used in a group as well as by one person, which makes it suitable for EWB-SWE where project teams can span from one volunteer to a dozen who are often distanced geographically, making efficient communication and visualization of ideas extra important.

5.2.3.3 Risk Analysis

A risk analysis is beneficial to include in the FS in order to ensure that potentially harmful risks of the project are mitigated. Therefore, a guided risk analysis should be created to fit the FS and EWB-SWE's way of working. However, this is not further investigated in this project partly due to time limitations, but also due to that there is an existing risk analysis used in the old project charter that is seen as good enough to be included in the developed FS as well.

5.2.4 Project Management

The tools for project management are related to how the FS could be managed, and to aid in identifying the scope and responsibilities of the project.

5.2.4.1 Mission Statement

Writing a mission statement for the FS will aid EWB-SWE in defining the scope of the study and describing how the team will work to achieve aspired results. However, if the mission statement is too narrow or too broad it could also confuse the team and lead them in a different or wrong direction. The mission statement could be in the form of a template to answer the following questions in about 2 sentences:

- What is the project?

- Who are we doing this for?

- What are the objectives?

- What does it take to reach the objectives?

5.2.4.2 Requirement Specification

Writing a requirement specification is an efficient way to structure requirements found and established during the project. Doing this will help to state what constraints there are on the solution that is to be developed. Including this in the FS will aid in communicating with people within and outside the project about the requirements, constraints, and in a sense the customer needs of the solution.

5.2.4.3 Decision Tree Diagram

A decision tree diagram will help the project team plan the FS and visualize the different decision alternatives and decision outcome dependencies. In relation to the FS, it will specifically aid in determining the scope of the FS by helping the team members to decide on what needs to be done or not. As an example, a FS will look different depending on if the project concerns a new partner or a new development area thus a tree will aid in visualizing what the alternatives are. A drawback of this is that it can be time-consuming to adapt the decision tree to different purposes.

5.2.4.4 Project Stakeholder Analysis

Conducting a stakeholder analysis early in the FS helps EWB-SWE to establish and explore collaboration with different stakeholders and ensure that all stakeholders are more or less involved from the beginning of the project. Also, it helps them to establish what resources will be required, how often communication will be needed, and what all parties' expectations are. A stakeholder analysis starts by identifying:

- who is involved in the project, directly or indirectly

- who the project stakeholders are

- who the suppliers are

- who is authorized to accept or reject the project

- who might be affected by the outcome of the project

These questions can be discussed with project team members, experts, or already-identified stakeholders to get a clear picture. Furthermore, to effectively manage project stakeholders it is important to:

- involve stakeholders throughout the project and create a plan for their involvement

- ensure that all stakeholders agree on the project deliverables, and what their roles and responsibilities are

- define a framework for handling change requests

- communicate effectively and frequently

- see things from the stakeholder's perspective and context.

However, the importance of doing this will also depend on the particular stakeholder's involvement and interest in the project [57].

5.2.5 Sustainability Aspects

The tool that is screened to be part of the sustainability aspects in the FS, is the Sustainability Fingerprint Tool (SFT). However, this requires that Leading Sustainability Criteria (LSC) are defined and [61] suggests that the LEASA workshop is used to do this. During the meetings with the PhD student and the researcher within sustainable development, they suggested the same.

5.2.5.1 LEASA

The **LEASA** workshop has its roots in the Sustainable Design Space approach (SDS) with the LSC included, and the Sustainable Product Development workshop for early design phases [62], [59], [63]. The method is based on back-casting and the workshop is divided into two steps, LEASA step 1 and LEASA step 2, and it covers all life cycle phases of a product or solution and all dimensions of sustainability [64].

The LEASA step 1 is divided into three stages; the "To be", the "As is", and the "Strategies and Guidelines". The "To be" scenario is where a completely sustainable product would be and what characteristics that would imply. To define the "To be" scenario some guiding questions are stated in the workshop template. However, these are changed to fit the context of the specific product or project being evaluated. There is therefore a possibility to tailor the questions to fit EWB-SWE and the HE context. One example of these questions is "What material characteristics are needed for a sustainable solution?". Also, during this stage, an overall question is used to aid in the brainstorming; "What characteristics does your solution need to have to fit into a sustainable society?".

The next step is to define the "As is" scenario, i.e. where they are today. This is also guided by some specific questions tailored to the specific project and related to the previously answered guiding questions. An example of these questions is "What are current strengths and/or weaknesses when choosing materials in the current process?". The overall question for this stage is "What are the current preconditions to designing and delivering these characteristics?". In this stage, the answers are divided into the three dimensions of sustainability; ecological, economic, and social. After that, "Strategies and Guidelines" for how to get from the "As is" to the "To be" are written down, these are also stated for each of the three sustainability dimensions.

LEASA step 2 is where the Leading Sustainability Criteria (LSC) are defined based on the previously described strategies and guidelines. The names of the LSC are defined and appropriate indicators to measure the criteria are generated with a

specific target or ideal scenario also stated. Furthermore, it is noted what life cycle stage the criteria are concerned with and what dimensions of sustainability are relevant for that specific criteria. It is therefore possible to ensure that all life cycle stages are represented and that all dimensions of sustainability are covered. However, for EWB-SWE and this project, the social dimension is the one that has the most focus and this should reflect in the criteria.

Since the workshop is divided into these steps and stages and some preparations and finishing work needs to be done the workshop requires a rather long time. It is therefore not possible for EWB-SWE to use this workshop in every project to define specific criteria for each product. Therefore, the workshop is conducted as part of this thesis to define general LSCs that are applicable to the majority of the EWB-SWE projects. The results are a basis for the development of the SFT.

5.2.5.2 The Sustainability Fingerprint tool

The generated LSC defined in the described LEASA workshop serves as the basis to the SFT. The next step is therefore to define the different levels of the Sustainability Compliance Index (SCI). The SCI is defined as steps from 0-9 with specified levels at "1", "3", "6", and "9" [59, p.258], see Figure 5.5. These specified levels are defined based on the indicators and the ideal scenario that has been defined in the LEASA step 2.

Sustainability Compliance Index (SCI) scale	
SCI 9	The strategic sustainability criterion is fulfilled. Reached excellent level.
SCI 6	Have implemented a strategy with concrete actions for how to move step-wise towards more sustainable solutions. Moving strategically towards the excellent level (SCI9).
SCI 3	Compliance with socio-ecological related regulations. A low but acceptable level.
SCI 1	Lowest level of sustananability compliance. Not acceptable level.
0	No information to score a SCI value. Need more research and investigation.

Figure 5.5: The Sustainability Compliance Index and the specified levels included in the Sustainability Fingerprint tool. Source: [59, p.258].

The aim of the tool is to score a product or concept and on each criterion determine at what sustainability level it is. This tool could therefore be included as a step in the FS to evaluate how sustainable the generated concepts are and somewhat how sustainable the overall project is. Besides providing a score the tool also provides information on what is seen as important for the project and the sustainability of the solution. The criteria have a nudging effect and raise awareness of what needs to be considered in the project. Also, the levels make it clear what can be done in order to increase each score and thus improve the sustainability profile of the solution. The scoring of each criterion is visualized in a spiderweb diagram and in

this tool called a fingerprint, see Figure 5.6.
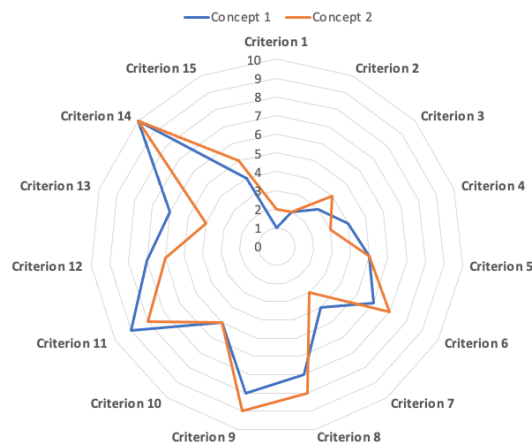
Figure 5.6: Example of the result from a Sustainability Fingerprint Tool scoring of two different concepts.

5.3 Development of the Feasibility Study Concept

Based on the information from the literature, the interviews, and the knowledge gained on EWB-SWE an initial outline for the FS Report is created, see Figure 5.7. The steps of the FS Report are;

1. Project Background & Pre-requisites

2. Context Analysis

3. Needs Identification

4. Sustainability Criteria and Social Impact

5. Solution Exploration

6. Project Risk Analysis

7. Sustainability Evaluation

8. Project Recommendation & Next Steps

The first step is to define the project and identify the problem as well as to set a scope of the study. Also, the stakeholders within EWB-SWE and the partner organization are written down to get an overview. The second step is concerned with finding and understanding the contextual aspects, such as cultural and social aspects, of the project, the partner, and the potential user. The third step is about finding, evaluating, and verifying the needs and aspirations that are related to the solution of the project. Step four is where the SFT is introduced for the first time, and where the project team defines the goal of the project as well as states what

social impact that is concerned with this project.

After that, the exploration of solutions can start. This is done by dividing the problem into sub-problems, which are translated into functions that are then solved by sub-solutions. These sub-solutions are then combined into concepts that could solve the overall problem and that could be the solution at the end of the project. Step six is concerned with the risks involved with the project, potential solutions, and the partner. Step seven is where the SFT is revisited and used to evaluate each concept against the criteria. The last step is to write recommendations for the next steps of a potential implementation project. It's important to think of this study as a project in itself and that if the recommendations are that there shouldn't be a continued implementation project then that is it. Only projects that are likely to have a positive social impact and that would make use of EWB-SWE's resources in the most efficient way should move forward to become implementation projects.
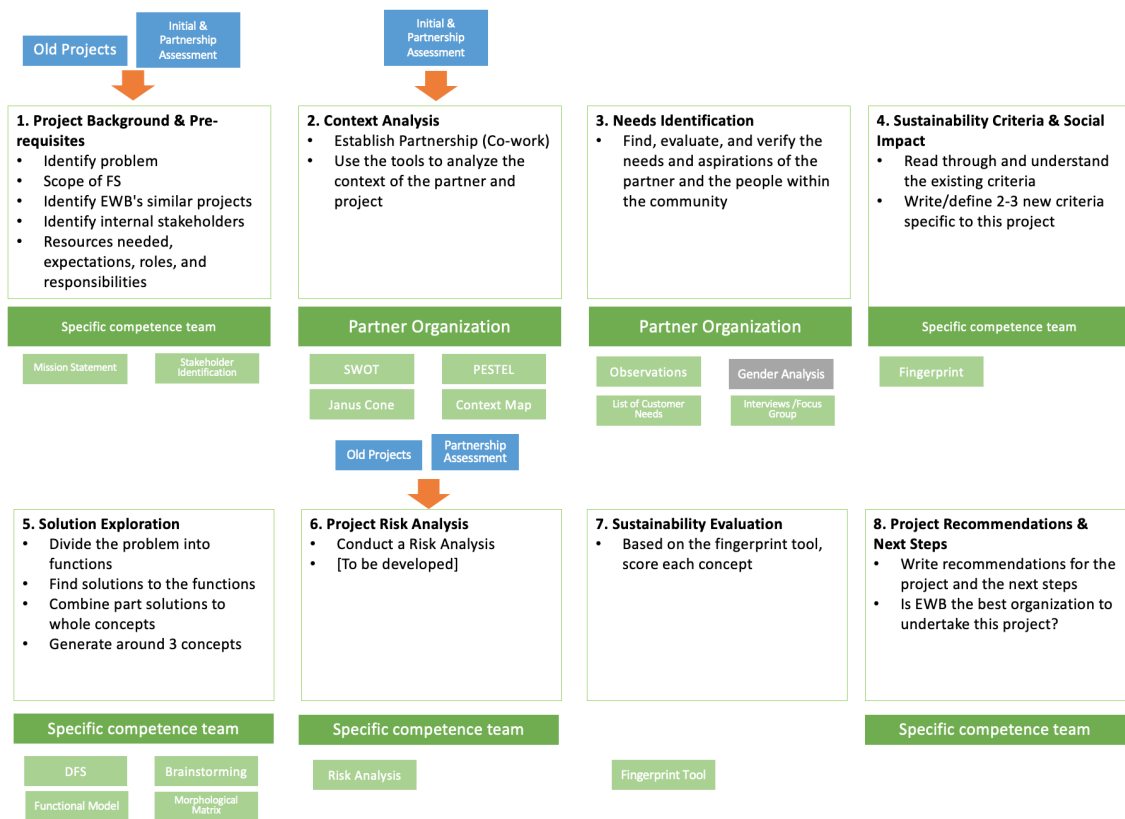
Figure 5.7: Outline of the FS Report with each step and its related activities. The blue rectangles represent documents that could be used, the dark green rectangles illustrate what stakeholder (except the project team) to involve, and the lighter green rectangles represent the methods and tools to use in that specific step.

During the development of the outline for the FS three methods and tools were eliminated, these are **The Kano Model**, **Requirement Specification**, and **De-**

cision Tree Diagram. The Kano model was eliminated due to that it was seen as redundant in the process and it would require unnecessary time and resources compared to its outputs. The requirement specification was eliminated from the FS process due to that it was also seen as time-consuming as well as not a fit for this stage of the development process. However, the FS report will have recommendations for creating a requirement specification at the beginning of the next stage of the overall development process. Lastly, the Decision Tree Diagram was eliminated partly because the mission statement aids in defining the scope of the FS as well and partly because it could not be delivered as a fully developed tool to EWB-SWE.

5.4 Initial Evaluation of the Concept

A result of the initial evaluation is that a budget and resource estimation for a potential implementation could be beneficial to include in order for the decision committee to be able to make an informed decision. Another result was that it is important to ask for and gather baseline data as early as possible in a project. Furthermore, they want to assure that their projects are in line with their new strategy for efficiency, effectiveness, and quality and that the process assures that social aspects are considered. An additional reflection from the meeting with the International Projects Secretary was that the SFT seemed too complicated at first sight. However, once the purpose of it had reached through the potential benefits of it were understood. For example, it was perceived as useful to have in the FS in order to score the concepts and aid in decision-making.

After the initial concept had been developed a workshop focused on the SFT was arranged with participants from the competence teams in EWB-SWE. The workshop was arranged to get opinions and feedback from people with more experience and expertise in different areas of EWB-SWE projects and HE to evaluate what could be improved.

The purpose of the workshop did not reach through to the participants and therefore it did not proceed as expected. This can be because the questions were too complicated, that it was a remote meeting in the evening resulting in less motivation and attention, or they were too focused on the SFT as a whole and not it's content. Each category of criteria was presented, however, the discussion got stuck on the definition of the criteria and the intention of the overall use of the SFT. Thus the main result from this workshop was that the SFT might be too complex and require too much information to be included in all FS projects. Instead, one proposal was that it could be something that the competence teams use to evaluate different solutions.

During the workshop, the difficulty of understanding and scoring the level of each criterion was pointed out, and that finding the right information could be time-consuming. For example, identifying the supply chain of a component or material to score local availability. Since the purpose of the SFT is to make the project teams aware of important aspects to consider and not that all of the criteria have to be

fully met, it is still seen as a suitable tool to implement in the process. However, one takeaway from the evaluation is to make it easier and less time-consuming. Thus the levels of the criteria, that were defined to enable the solution to be scored on its sustainability profile, were removed. Instead, the criteria in the SFT are going to be used to clarify and draw attention to the important aspects to consider in the solution and in a project.

6

Final Results

This chapter presents the final Feasibility Study (FS) Report, its structure, a thorough description of each step, and why each activity has been included. The following section is structured in the same order as the final FS Report, see Figure 6.1.
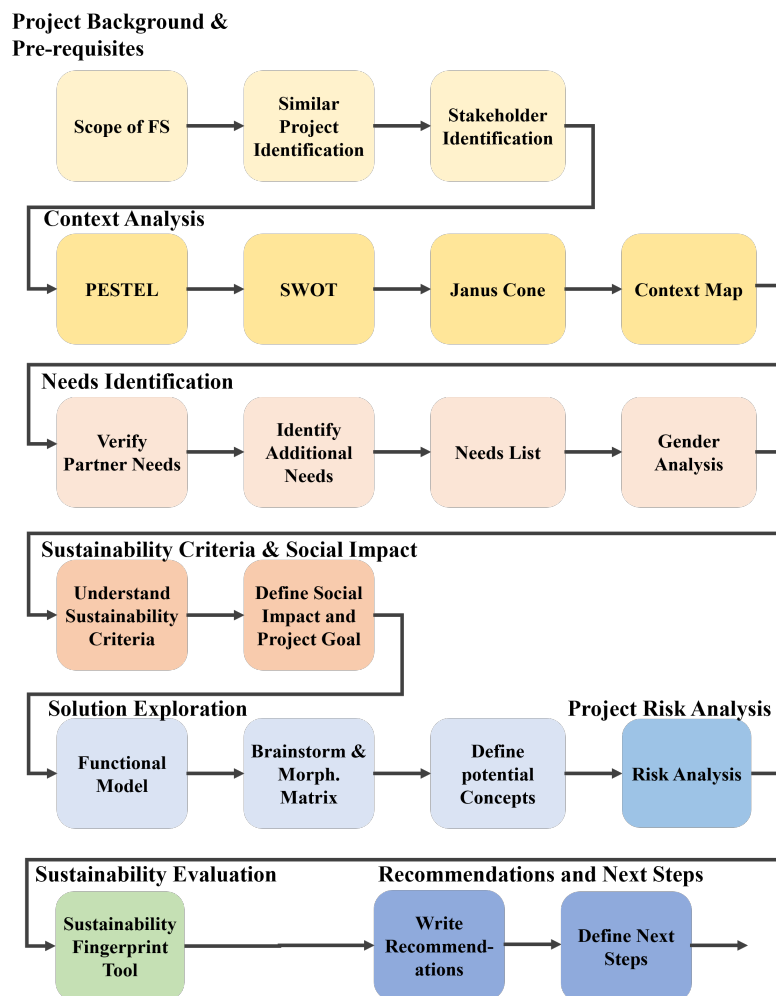
Figure 6.1: The structure and content of the final Feasibility Study where each step has a specific color in the figure.

The developed FS process will aid EWB-SWE in understanding the context of the project, the needs, and aspirations of the locals in the communities, explore solutions, and evaluate what social impact the project will contribute to and its sustainability profile. The process will aid EWB-SWE in choosing suitable projects for them, which is essential to achieve sustainable development. This involves ensuring that EWB-SWE has the capabilities and resources to conduct the project, evaluating if the partner organization is one with which EWB-SWE sees the potential for efficient collaboration, and ensuring that the project will result in a solution that can be sustained, maintained, and properly discarded at end-of-life by the local community. This corresponds to their aim of working efficiently, effectively, and qualitatively.

6.1 Project Background & Pre-requisites

To define the scope of the study and ensure that all project members are aware of the why and the how of the FS, such as deciding on when the study will be considered finished, the report is initiated with writing the scope of the study. To aid the project team in writing and determining the scope a guiding scope has been written with spaces to answer and fill in, see Figure 6.2.

Answer:
The study is in collaboration with *[insert partner]*, the intended beneficiaries are *[insert intended beneficiaries]* and the potential project will align with the strategy of:
☐ *Healthy Hospitals*
☐ *Safe and Sustainable learning*
☐ *Self-sustainable Communities*

The partner wants to address the social challenge of *[describe social challenge]* and this study will investigate the potential of the project and its social impact. Addressing the social challenges should result in the social impact of *[insert possible social impact stated by the partner]*.

The goal of the Feasibility Study is to explore *[insert your goal]* ex: "the geographical location of the suggested project, understand what type of solutions could be implemented etc.".

To reach the objectives, the Feasibility Study will span over *[x weeks or months, etc.]*, it will *[require/not require]* a field trip to be conducted, and it will require *[insert if any additional resources will be required in terms of expertise or similar]*.

The project will be in the Competence area*(s)* *[insert competence area(s)]* and the category within the competence area is *[insert category]*. This project will work towards the Sustainable Development Goals *[insert goals]* which aligns with the competence areas work towards these.

(If needed, add additional information that is necessary to describe the scope of the project...)

Figure 6.2: Template to determine and write the scope of the Feasibility study. The red brackets are to be exchanged with project-specific information.

Thereafter, the project team members are to contact the relevant competence team

to acquire similar projects that could be of help. This is to make the study efficient and utilize internal resources, and not reinvent the wheel. It is important to make use of the knowledge that already exists in the organization. Lastly, a project stakeholder identification is conducted to discuss what the project stakeholders' responsibilities are, in what frequency and how communication will be done, and what their expectations on the FS are. This should be decided through a meeting initiated by the project team as early as possible. To gather all information and make it easily accessible a table in the report should be filled in with contact information and what is decided upon. Potential project stakeholders are the project coordinator, the project team members, the competence team, the partner organization, a mentor, the partner coordinator, etc. This step is related to EWB-SWE's need of clarifying responsibilities and communication procedures presented in chapter 3.3.2.

6.2 Context Analysis

The research presented in chapter 3.1 emphasizes the importance of understanding the context that the solution will be a part of, both in terms of implementation, solution usability, and maintenance, but also in terms of efficiency during the project. The context analysis is intended to get this understanding and to gain knowledge what the cultural and social aspects that need to be investigated and incorporated into the project and a potential solution. This part of the FS includes a PESTEL analysis, a SWOT analysis, a Janus Cones, and a Context Map. These analysis tools can be used to evaluate some of the OECD criteria presented in chapter 3.1.2. The "Relevance" criterion is related to the context analysis in terms of finding the needs, policies, and priorities of the locals. All of the methods and tools have been tailored to fit the work format of EWB-SWE and, to the extent possible, its partner organizations.

6.2.1 PESTEL analysis

The PESTEL analysis considers the context's political, Economic, Social, Technological, Environmental, and Legal factors that can affect the partner organization and the project. The PESTEL analysis is to be conducted together with the partner organization since they are the experts on their own situation. The recommendation is that the analysis is made by the partner, with the relevant expertise present, and that it is facilitated by the project team from EWB-SWE. A specific PESTEL template is created and included in the FS and it includes specific questions and gives suggestions for aspects to investigate and find information about. This is to ensure that all project teams focus on the relevant areas and that the full potential of the PESTEL is utilized. However, the questions are only recommendations for what to consider, if some of them are seen as unnecessary, and if other parts outside the scope of the questions are seen as more important, these should be investigated instead. The complete PESTEL template can be seen in Appendix D, but a handful of questions, for each aspect, are displayed in Table 6.1.

Table 6.1: Example of questions that are included in the PESTEL analysis.

Political	- How will the current political climate impact the organization? - Will a particular political party influence your ability for growth? - Which government policies help or hinder you? - What funding grants, tax rebates, or initiatives are there that you could apply for?
Economical	- Can the consumers and users afford the product/solution? - How is taxes scheduled to change? - Does any minimum wage increase affect your ability to make payroll?
Socio-cultural	- What are the current opinions on the organization, similar organizations, businesses, or competitors? - What lifestyle, opinion, culture, or demographics could change and cause issues? - Is there consumer confidence in your industry?
Technological	- What do the current infrastructure and the geographical location look like in the area? - Does the organization or the community have the technical assets to maintain a potential solution? - What resources and expertise are there related to the project within the organization and the local community?
Environmental	- What does the waste management look like in the area today? - Are climate change and its consequences affecting the operation? - Are any environmental laws being considered that could cause you issues?
Legal	- Could any existing or new laws, regulations, or policies impact your ability to implement the project, sell the product, or provide the service? - What safety standards need to be adhered to? and is it easy to abide by health and safety laws? - What employment laws impact the project?

The questions related to the **Political** aspect are important to investigate in a Humanitarian Engineering context. The political climate in a region or country can impact development projects and thus it is important to be aware of that. There could be policies that hinder the project or a specific solution, but there could also be ones that support the project. Furthermore, funding is a critical aspect of Humanitarian Engineering and if there is a possibility to get financial aid within the country or by the government instead of applying for funding through EWB-SWE then that should be considered.

The questions related to the **Economic** aspect will provide an understanding of the economic stability or instability that the solution and project will be a part of. Related to the criteria "Affordability" stated in chapter 3.1.2 it is important to consider if the solution could be affordable by the intended users or else this question might spark the notion of the project team that something needs changing in order to get to an affordable solution. Also, investigate if changes in minimum wage or taxes are going to happen in the near future and if this will affect the project or the solution. Then it can be investigated if the taxes could be a possible benefit for the project by it resulting in more funding or, for example, more financial aid or if it will affect the project negatively, and changes are needed to mitigate the consequences.

The **Social and cultural** aspects of the PESTEL are the most important ones to understand and get insight into when helping a community from the outside. Since these factors cannot always be foreseen or even found during the project.

Therefore, it's important to try to understand what the partner organization and locals are saying in regard to this. Also, these questions are rather general, therefore it is up to the project team to find additional questions and follow-up questions to investigate as well as to get a deeper understanding of their specific social and cultural factors. However, one question is related to the opinion on the partner organization and similar organizations. If the organization is working with subjects related to marginalized people or questions that divide the opinion of the locals, then people might have different opinions and sometimes not be as prone to helping solve the problem. This could be important to know in order to understand how to mitigate the effects of it.

Furthermore, the question about lifestyle, opinion, culture, and demographics and how these can cause issues is rather broad, but nevertheless an important one. If the demographics are to change drastically in the future then this needs to be considered when investigating the feasibility of a project. The lifestyle of the intended users and beneficiaries' i.e., what their current habits are, and how these could change, needs to be understood in order to adapt the solution to their lifestyle. A solution that requires a change in the user's lifestyle might not always be as desirable, which was discussed in chapter 3.3.2. However, it could also be that the purpose of the project is to make a change in people's habits in order to achieve sustainable development and then that will require a strategy on how to achieve that change, which is why it should be investigated at this stage of the process.

The **Technological** aspects of a project are beneficial to investigate to get an understanding of what the prerequisites are for a specific solution. However, in this stage of the FS, there is no solution in mind yet and this information is therefore more general. Still, it will serve as a basis for what solution could be feasible to implement in the area. For example, the infrastructure and the geographical location of the area of implementation are of interest to gain knowledge of what is able to be transported and how already existing buildings and infrastructure can be of help to or hinder the implementation or the usage of a solution. Also, the partner organization or the community's existing resources and technical knowledge are beneficial to investigate to determine how and if they are able to take care of the solution long term. This concerns the aspect of local ownership as well, which was previously identified to be an important aspect in chapter 3.3.2.

The **Environmental** aspects are concerned with the environmental changes that could affect the project, for example, climate change such as high winds, droughts, and rising water levels. It is therefore beneficial to investigate how these could affect the project and the potential solution and to determine how to mitigate these. Furthermore, the potential waste management system in the area should be investigated. This relates to ensuring that there is a system in the community to take care of potential waste created by the solution. It also includes information about the ability to recycle a product or not as well as if there are laws in the area that regulates the environmental impacts of a solution.

Lastly, connected to the **Legal** part of the PESTEL, the first question stated in

Table 6.1 is beneficial to answer to get an understanding of what is needed legally to implement certain solutions, to be able to sell products, or services in a specific region. It is also necessary to understand the health and safety regulations that are affecting the solution and the project. By answering the second question, information about the differences between the safety standard procedures in Sweden and the area of implementation can be identified. This is important contextual information that needs to be taken into account.

6.2.1.1 SWOT analysis

The SWOT analysis is then used to interpret the information and knowledge gained from the PESTEL analysis to determine the strengths and weaknesses, as well as the opportunities and threats of the partner organization. The SWOT analysis is also recommended to be conducted together with the partner and facilitated by the project team from EWB-SWE. While the PESTEL focuses on external factors, the SWOT analysis focuses more on internal factors. The SWOT analysis is also tailored to fit EWB-SWE and includes guiding questions specifically stated to ensure that social and cultural aspects are considered. The SWOT analysis template can be seen in Appendix E, but some of the stated questions are presented in Figure 6.2.

Table 6.2: Example of questions that are included in the SWOT analysis.

Strengths	- Is the partner well-established in the community? - What is the organization's market reach? and the organization's awareness of the market? - What type of education and knowledge-building skills and capacities do you have? give an example of when these have been used.
Weaknesses	- What disadvantage does the partner have in terms of resources, capacity, and community engagement? - What is the reliability of potential baseline data? or general data collection from the community? - What areas does the partner need improvement on?
Opportunitites	- How can the strengths and weaknesses be turned into opportunities? - Are there initiatives in the community or region to meet social challenges and how can theses be taken advantage of? - Can contacts help with the project (such as other NGOs, local entrepreneurs, local experts, the government, etc.)?
Threats	- Could any of the weaknesses prevent the partner from succeeding? - Are there troubling changes in the business environment and will government regulations affect the project in any way? - Is there a risk for key people to leave the project?

Based on the findings, the **Strengths** connected to the benefits of co-creating with the partner organization, in chapter 3.1.2 and the internal needs, related to collaboration with the partner, from EWB-SWE in chapter 3.3.2 it can be stated that a well-established partner organization in the local community is of importance. Therefore, this is seen as a strength if that is the case. By defining how well-established the partner is, it is possible to draw conclusions on how well-rooted the project is within the community. A project that is seen as well-established is when the community is well aware of the project and is continuously engaged in

the project in, for example, workshops, feedback sessions, and interviews. This also relates to the next question about the partner's market reach and their awareness of the market and its related needs. If a partner is well aware of the market and has a good understanding of what needs and aspirations that are present in the project, then that is seen as a great benefit for the project.

The last question in the figure, related to the strengths, relates to the identified importance of community engagement, and local ownership and how well the partner can contribute to knowledge creation and educate the locals to take care of and maintain the solution. Assessing the partner's ability to educate the locals is important for the future success of the project and the continuous use of the solution. It also increases the chances that the solution is successful after EWB-SWE leaves the project and the area. Also, based on the collected information in the PESTEL, an analysis of if there are any other strengths that could be extracted and utilized should be done.

After that, the **Weaknesses** are investigated and since the SWOT analysis is done together with the partner it is important to let them tell their story and be open to listening to them. Some of the weaknesses might be evident to them and to you but there needs to be a safe space for them to open up about it. By knowing the weaknesses they can be taken into consideration and actions can be taken to decrease them. One example could be to ask the partner where they need support instead of asking what they do badly. This is important information to have when doing a collaborative project.

The first question refers to the partner's disadvantage in terms of resources, capacity, and community engagement. This might bring to the surface information about how much time the partner is going to put on the project, the number of people involved, and what resources in terms of knowledge they might be lacking in. If the partner has gathered baseline data, then the reliability of this could be beneficial to investigate in order to understand if the data is well represented in the community. Also, the partner might have areas that need improvement and these areas could be good to establish in the partnership. These improvement areas could be the same reason why they decided to contact EWB-SWE in the first place since that is most likely due to a lack of resources, knowledge, etc.

The next part of the SWOT is the **Opportunities** and the first question here is concerned with turning strengths and weaknesses into opportunities. Therefore, specific opportunities should be stated for the areas identified in the previous parts of the SWOT. The next two questions are concerned with finding outside opportunities within the community or country that could be beneficial to make use of. For example, it should be taken advantage of if there are other initiatives related to the social challenge or the technical solution that could support the project or the partner. Furthermore, there could be opportunities for how to maintain and sustain the solution through local ownership. Finding ways to empower and increase the independence of the locals in a community was identified, in chapter 3.1.1, as a key aspect to develop a sustainable solution.

The last part of the SWOT is the **Threats** and some of the threats to the project and the partner are connected to the weaknesses. Therefore, these threats need to be identified and a plan of how to mitigate the risks or action plans on how to deal with the threats could be developed. The second question is closely related to the political and legal parts of the PESTEL analysis and the threats that might have been found there are to be evaluated at this stage. The last question is related both to the partner organization, but also the project team. As stated before, there is a high turnover of people within EWB-SWE and this means a threat of people leaving the project. Therefore, key people or competencies need to be identified and a plan of what to do if these were to leave should be made to mitigate the consequences.

6.2.1.2 Janus Cones

The next step in the context analysis is to conduct a Janus Cones analysis together with the partner. As stated in the concept development, chapter 5.2.2, the Janus Cones is used in a workshop format, by involving relevant people. The Janus Cones template can be seen in Figure 6.3. The intention with this is to generate a good understanding of the technical pre-requisites of the project and the solution. As stated in chapter 3.1.1, the technologies that are present in the lives of the beneficiaries are an essential factor to investigate. For example, if a computer is to be installed in a school, then it is of interest to state all the relevant aspects connected to that in the Janus Cones. For example, when the internet and WiFi were introduced, when other computers were installed, and when the basic knowledge of how to use computers was well-established or not in the community. Also, to state their aspirations of using computers in the future and what they want to achieve with the project long term. All of these aspects will bring insights into what could be feasible to propose in terms of the solution of the project. It will also result in some needs and aspirations being expressed and identified.
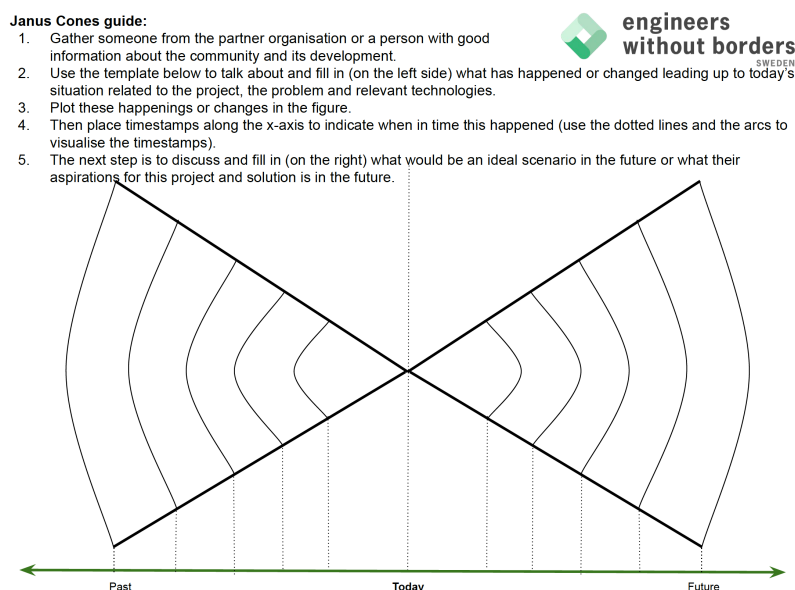
Figure 6.3: Template for the Janus Cones with the guidelines of how to use it.

6.2.1.3 Summary of the step & Context Map

The last step of the context analysis is to summarize the findings in a short text and to visualize the most important contextual factors in a context map. The template for the context map can be seen in Figure 6.4. This context map can both be seen as a way to remember the contextual factors found in the project and to show and explain to potential new people the project, but it could also be presented to the decision committee and be used in the decision document to create a better understanding of the specific project.
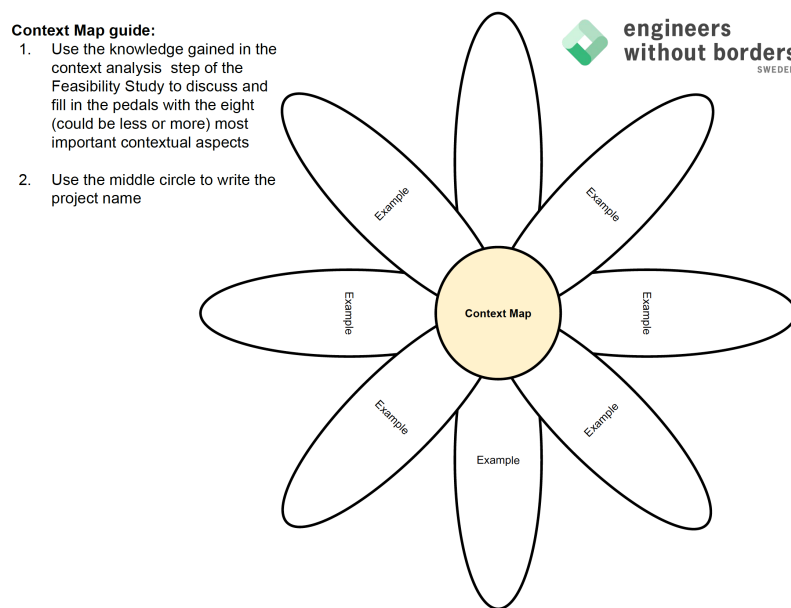
Figure 6.4: The template for the context map with its related guide.

6.3 Needs Identification

The purpose of the needs identification step is to verify and/or find and evaluate the needs and aspirations of the intended users and beneficiaries of the community. The studied literature indicated that involving the locals of the community and finding their needs is a crucial activity for finding a long-term and sustainable solution. The first step of the needs identification is to ask the partner to provide a list of identified needs, and if one exists the next step is to verify that the needs are correctly and thoroughly identified. To aid the project team in determining if the needs and aspirations from all perspectives have been found, a needs list template with suggested categories to be filled in is provided, see appendix F. The suggested categories are presented in Figure 6.3.

Table 6.3: Suggested categories to include in the needs list.

Functionality	The product or service has to function the way the user needs it to in order to solve their problem or desire.
Performance	The product or service needs to perform correctly so the users can achieve their goals with it.
Compatibility	The product or service needs to be compatible with other products of the user.
Design	The product or service needs a user-friendly and appealing design.
Accessibility	The product or service needs to be accessible both in terms of using it and providing accessible service.
Information	Users need information, from the moment they start interacting with the product or service to days and months after making the purchase. Thus there is a need to know what type of information they will or could require.
Experience	The needs of the user experience of the product or service and the expectations on it.

The next part is for the project team to, by themselves or together with the partner, conduct an additional user study to complement the already identified needs. To ensure that the solution will address a social challenge it is important that the most urgent needs have been identified but also the aspirations related to the needs. This is recommended to be done through different qualitative studies such as arranging focus groups, interviews, and/or direct observations. However, the format of the user study will depend on if the FS includes a field trip or if it is conducted remotely. A digital setting will require the partner to do more of the work and the project team will have to rely on pictures, videos, remote workshops, and notes to understand the user and its context. Lastly, a Gender analysis is to be developed and included in the FS. However, its development is not included in this master thesis and will instead be developed by EWB-SWE.

6.4 Sustainability Criteria and Social Impact

This part of the FS Report has the intention to put the project team in the right mindset and create an understanding of what criteria are important when conducting a Humanitarian Engineering project. The step also makes the team create their own understanding of the problem and define indicators connected to the defined project goal and elaborate on what social impact the project is to contribute to.

The first step in this part is to read through the defined criteria that have been developed through the LEASA workshop. These are presented in the Sustainability Fingerprint Tool (SFT) and are presented further in Chapter 6.6, but an overview of them is presented below:

- Local Materials & Components
- Renewable Materials
- Equal/equitable Suppliers
- Community Engagement
- Solution Affordability, Desirability, & Accessibility

- Solution Safety & Health Risks

- Environmental Risks

- Increased Opportunities for Jobs & Education

- Equality Promotion

- Responsible & Renewable Energy Sources

- Available materials & components

- End-of-life Procedures

The next step is to define the goal of the project and state one or more indicators of how to measure when that goal is reached. To help the project team state the overall goal of the project, the question "What problem are we trying to solve?" can be discussed and answered. Also, the five whys approach can be used to get to the root cause of the problem. Based on the project goal, the social impacts that the solution is to contribute to can be defined. This part of the step can be related to the OECD criterion "Impact" previously stated in chapter 3.1.2. This criterion is related to finding what difference the invention does and the extent to which the intervention is expected to generate a positive or negative impact. Information about the social challenge and possible social impact of the project can be found in the first step of the FS as well as the partnership assessment documents. However, at this stage, the project team should be able to further specify the potential social impact and understand what it means.

6.5 Solution Exploration

One purpose of the FS is to promote a wider solution space and explore different solutions. The summary of the studied literature, chapter 3.1.5, pointed out the importance of developing the solution to the context of the community. Therefore the exploration of different solutions is suggested to be done as one of the later steps in the FS. In that way, the project team and partner will have gathered enough knowledge about the community and the social challenge they are trying to solve before starting to explore different solutions.

The first part of the solution exploration is to do a functional breakdown of the problem/social challenges they are trying to solve to enable the exploration of different sub-solutions. This involves breaking down the problem into sub-problems and then translating each sub-problem into a sub-function and either documenting it in a list or as a simplified functional model. To guide the project team in what a functional model is, an example of a simplified functional model is visualized in the FS Report, see Figure 6.5.

The second step is to contact the relevant competence team and revisit identified similar projects and solutions. The competence team has valuable experience and knowledge in the area that is important to make use of. As identified in chapter 3.3 there is a gap in knowledge sharing between projects and between project teams and
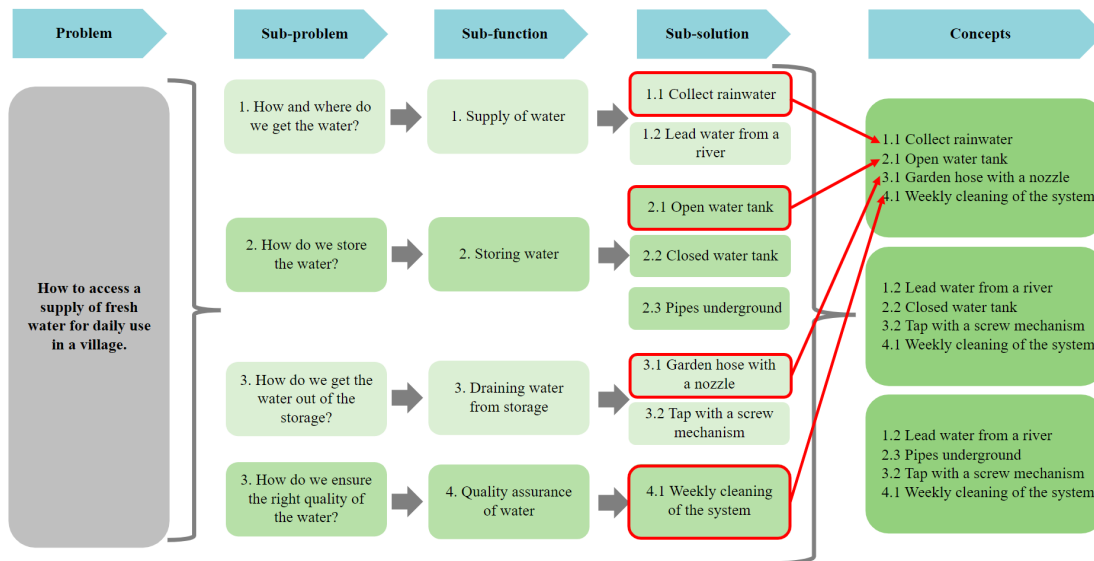
Figure 6.5: An example of a simplified functional model for a problem regarding access to a clean water supply.

competence teams in EWB-SWE, and a step that requires the project team to seek input from others is to address that issue. Thereafter, the third step is to brainstorm and explore different sub-solutions. For this step a morphological matrix template is developed, see Appendix G, with the purpose to make it easy to list sub-functions and differentiate the suggested sub-solutions.

The last step is to generate a minimum of three potential concepts of the whole solution from the morphological matrix and then describe the most promising concepts with a more thorough description which should include sketches and pictures. The concepts can be distinguished in terms of different budget levels, ease of maintenance, ease of implementation, technical difficulty, etc. The aim is not that the concepts of solutions have to be technically different, it could be that they differ in required budget and resources.

6.5.1 Project Risk Analysis

Based on the information gathered and the knowledge gained during the FS it is possible to have discussions on and conduct a risk analysis. However, due to limitations in time, this step is not developed in detail in this master thesis, but a recommendation to EWB-SWE will be made to further define this step. The FS Report does however include aspects to consider, these are taken from the old FS Template.

6.6 Sustainability Evaluation

To evaluate the sustainability of the solution a SFT template is included in this step of the FS. The purpose of evaluating the solution is to become aware of what

aspects are sustainable and which are not and to define what actions could be taken to improve those sustainability aspects of the solution. It can also be used to compare the sustainability of different proposed concepts to help determine which concept to develop further. The purpose of using it at the end of the FS is to make use of all the information that is collected in the earlier steps. Thus during the FS process information and knowledge is gathered and will enable the sustainability criteria to be evaluated. For example, the question that is written in the PESTEL analysis "What does the waste management look like in the area today?" coheres with the criterion for end-of-life procedure in the SFT. The tool should be used as an analysis tool to qualitatively evaluate the sustainability of a solution. The task is to make a comment on how well the solution fulfills each criterion and what parts are good or bad in the solution concerning the criterion, and then to formulate what actions to take, if possible, in order to improve the sustainability aspects for each criterion.

The final SFT contains 15 sustainability criteria, see list in Chapter 6.4, and they are developed to be applicable to all of EWB-SWE's international projects and in all competence areas. Each criterion is defined with a heading, a text explaining what it means and why it is important, and an indication of how to fulfill it. As the purpose of the SFT is to consider sustainability at all phases of a product's lifecycle, the criteria are divided into Material acquisition, Implementation of a solution, Usage & Maintenance, and lastly end-of-life procedures.

Life-cycle phase	Materials acquisition		Implementation of solution	
Criteria	Local Materials & Components	Renewable Materials	Equal/equitable Suppliers	Community Engagement
Explanation of Criteria	Local materials and components are obtained from a defined radius around the project site, which helps to support the local economy and reduce transportation costs and energy consumption in the community.	Renewable material's rate of growth is not larger than their rate of use, their environmental impact is lower than non-renewable materials and their availability is not threatened by their use. Examples are bamboo, wood, cork etc. Recycled materials are measured as the total percentage of recovered materials in a product.	Equal and equitable suppliers refer to, the extent that the suppliers are working towards equality and inclusivity within the workspace. When marginalized groups are empowered and included in decision-making processes, they can contribute with their unique perspectives and knowledge to create more effective and sustainable solutions.	Community engagement helps the implementation of a solution that is culturally appropriate, effective, and sustainable. The project team builds relationships, understands cultural context, and enables co-creations by arranging workshops and seeking continuous feedback.
Indication	The solution maximises the use of locally sourced and produced materials and components.	The solution maximises the use of renewable or recycled materials (recycled materials can be non-renewable).	The solution maximises the use of suppliers that promotes and are actively working towards equality and inclusivity with 50/50% of women and men in their workforce.	The solution maximises community engagement during the EWB project process, implementation, and use stages.

Figure 6.6: Criteria, explanation, and indication for material acquisition and implementation of the solution.

The purpose of the criteria in the first phase, Material acquisition presented in Figure 6.6, is to make the project teams estimate the use of locally available materials and components and renewable materials in the solution. These were determined in the LEASA workshop as important material characteristics to consider in all

projects. Furthermore, there are two criteria for the implementation of a solution. The first criterion raises awareness on what suppliers will be contracted for the implementation, even if the partner hires the suppliers, it is important to make the partner promote an equal and equitable work environment. The Community Engagement criterion is important throughout the whole life-cycle but if the community is involved already at the development and implementation stage the solution's possibility of being used long-term increases since it is part of creating local ownership.

The majority of the criteria for usage and maintenance, see Figure 6.7 and 6.8, are focused on the social aspects of a solution but also some economic and ecological aspects. This includes criteria for if the intended solution fulfills the needs of the users by analyzing the accessibility, desirability, and affordability of the solution. How it can be safely and sustainably used and maintained without the risk of harming the user or the environment, where the results of the risk analysis conducted in step five will be applicable. Also, it is important to aim at developing a solution that uses renewable and responsible energy sources throughout the whole life cycle. The usage and maintenance criteria also include criteria for assessing what social impacts the solution could have by raising awareness of if the solution increases the opportunities for jobs and education and if it promotes equality in the community which are factors that can contribute to a social impact.

The end-of-life procedures concern two criteria, see Figure 6.8 to ensure that the project team has considered how the solution will affect the community at its end-of-life stage and to find solutions to how a sustainable end-of-life procedure could be ensured.

Figure 6.7: Criteria, explanation, and indication for Usage & Maintenance.

Increased opportunity for Jobs	Increased opportunity for Education	Equality Promotion	Responsible & Renewable Energy Sources	Solution end-of-life procedure	
				Available materials & components	End-of-life Procedures
Increased opportunities for jobs in the local community help to tackle unemployment and reduce poverty. By building local community capacity, engineers can design and implement solutions that are culturally appropriate, economically sustainable, and community-owned.	Increased opportunities for education and knowledge creation create new opportunities for individuals and communities. Acquiring new skills and knowledge can create new economic opportunities and contribute to the development of local communities.	Promoting equality helps to create a more sustainable and resilient society. A solution should empower and strengthen women and other minority groups' rights in the community. For example, it can be to provide education for persons with disabilities and to include economic mechanisms that create entrepreneurship opportunities for women.	Sustainable renewable energy sources such as solar, wind, hydroelectric, geothermal, and biomass can be replenished or renewed over time but they must also be environmentally and socially responsible. Not all renewable sources are responsible for example if wildlife, forests, etc. are negatively affected.	Available materials and components are not threatened by their use. Long-term available components and materials are especially important for critical components of the solution and the availability of spare parts. Otherwise, it can negatively affect the long-term use of the solution.	The end-of-life procedures refer to the extent to which the solution produces waste and GHG emissions during end-of-life procedures., and to what extent it is part of a circular economy (this involves a sustainable take-back system). Not considering this increases the chances of it not being safely or sustainably taken care of.
The solution maximises the amount of job opportunities for the local community.	The solution maximises the opportunity to provide training, education and knowledge sharing in the local community.	The solution actively works towards achieving gender equality.	The solution maximises the use of energy from responsible and renewable sources throughout the whole lifecycle.	The solution maximises the acquisition of materials and components that are long-term available.	The solution is part of a circular economy where the number of components and materials that are reused and reproduced is maximised.

Figure 6.8: Criteria, explanation, and indication for Usage & Maintenance and End-of-life procedures.

6.7 Project Recommendation & Next Steps

The last step in the FS is to write recommendations about the project and the partner as well as to state the next potential next steps if the project were to continue. One of the aspects that EWB-SWE wants to establish during the FS is to determine if the partner is one with which EWB-SWE should collaborate or if their resources are best used in other places. If the project is to be continued then what might need changing in relation to the partner and what other resources are needed to, in the most efficient and effective way, conduct the project. Are there other organizations or people that need to be involved to solve the problem? Ultimately the project team should answer the question if EWB-SWE is the right organization to help with this problem/project or if there are other organizations more suited for this type of project. For example, EWB-SWE should not undertake a project where they only have a funding role and where the engineering part is suppressed, in that case, other fundraising organizations are a better fit.

The other part of the recommendations includes answering the following questions;

- What is needed to decide on what concept to choose as the solution to plan and implement?

- What is the next step in order to plan the implementation of the solution?

- Who should be involved in the next steps?

- What resources will be needed in terms of time, people, and equipment? Make an estimation.

- What is the estimated budget for implementing the project? Write down basic information connected to the financial aspects.

These are to help the project team get a good start on their continued work but also to give information to the decision committee that they can use to base their decision on if the project should be implemented or not.

7

Evaluation

This chapter is concerned with evaluating the final Feasibility Study (FS) process and the report created to document it, based on the criteria presented in Table 3.2. Figure 7.1 illustrates how each criterion is fulfilled by different parts of the FS.
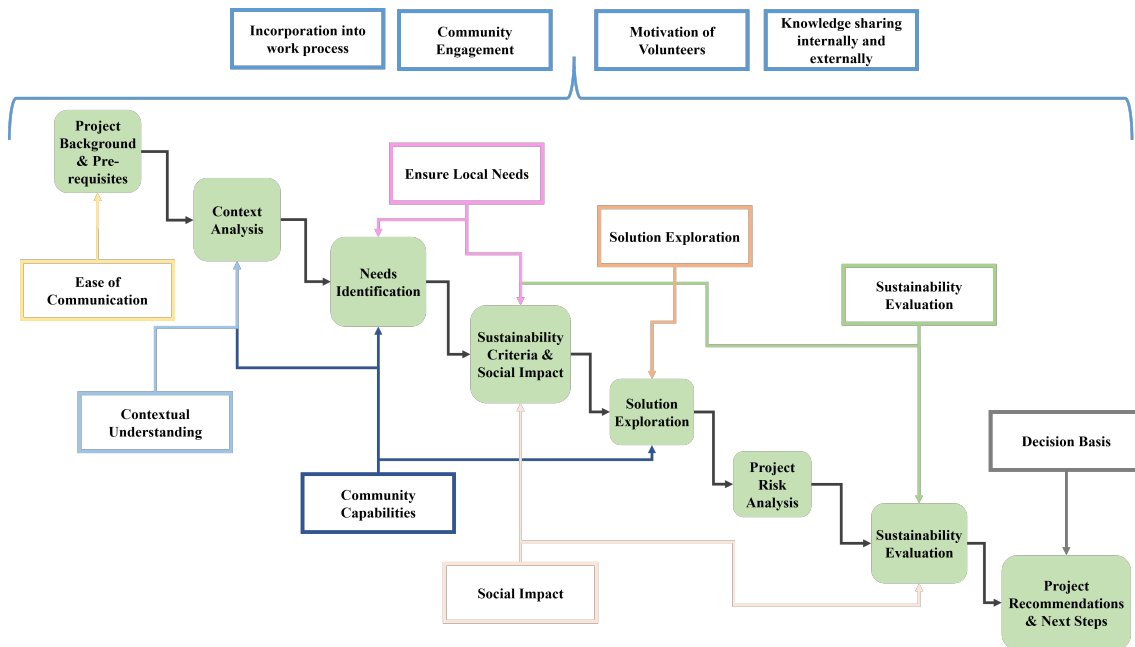
Figure 7.1: An illustration of how each criterion connects to the different parts of the FS process. The criteria are written in color-coded boxes with arrows connecting to the concerned steps. Some of the criteria are a result of the whole process and these are presented in the blue boxes at the top of the figure.

In regards to the criterion **Community Capabilities**, the FS does not per se contribute to improved capabilities within the community. However, the study ensures that the capabilities present in a community are investigated and from that result conclusions can be drawn about what capabilities needs to be added or strengthened in order to sustain and maintain the solution. The activities that are involved in investigating and understanding the capabilities are SWOT, PESTEL, Janus Cones, and Needs identification. During the evaluation meeting, it was stated that the process contributes to building community capabilities by ensuring that there is a plan

for local ownership so that the solution can be maintained and sustained.

The fulfillment of the criterion **Incorporation into the work process** is dependent on how the rest of the stages involved in the old project process is restructured. As the FS is developed as part of EWB-SWE's work to improve their International Project Process it cannot be directly incorporated into the old project process since that will be updated as well. Therefore, the FS does not follow the old process steps and as it stands at the moment, there are a few aspects in the project charter, for example, the theory of change that is not included in the FS but later required in the project charter. Thus it will be up to EWB-SWE to decide and adjust how it is incorporated into the whole project process so that it is not repetitive. This is therefore a criterion that will need further evaluation and improvements by EWB-SWE through, for example, a case study. This was also discussed during the evaluation meeting as something that is on EWB-SWE themselves to ensure. Furthermore, it was said during the meeting that the proposed FS process has created a new way to think of projects and that The FS process can be something that the project process is adjusted to instead of vice versa. Another concern that was brought up during the evaluation meeting was how the FS process is feasible to use for larger projects with multiple social challenges in multiple competence areas. Thus, to fully ensure that the FS aligns with the rest of the project process and is feasible for different types of projects it needs further evaluation.

The aim of the Solution Exploration step in the FS is to enable a process that explores a variety of different solutions to ensure that the most suitable solution is found. The methods and tools included in that stage do so and thus the criterion **Solution Exploration** is achieved. By focusing on context analysis and needs identification in advance of exploring solutions in the FS, the project team does not get stuck on one solution at the beginning, enabling them to discover needs related to the problem without a specific solution in mind. Thereafter, the functional breakdown allows them to explore different part solutions and then create multiple promising concepts. At the evaluation meeting, it was said that the step and its methods and tools contribute to ensuring quality in EWB-SWE's work.

A suggested improvement was to incorporate the maintenance aspect in the solution exploration so that the project team has to consider how the potential solutions can be maintained. This concern was related to their experience of volunteers taking things literally word by word and thus they wanted to ensure that no part will be forgotten. It was also discussed that it can be difficult for someone new to the process to understand why and how, for example, a Functional Model or a Morphological Matrix should be used. However, these methods and tools are established methods within product development and thus they can easily be researched for further guidance which could aid people in understanding. When developing the FS report the guides were written to support understanding of the methods and tools, but a case study would be needed to test if they actually contribute to qualitative and suitable solutions. At this stage, it can only be evaluated that they are intended to do so.

The criterion of **Motivation of the volunteers** is critical to the future use of the FS and needs further evaluation to determine if it fulfills it or not. In the evaluation meeting, it was discussed that the motivation of the volunteers is dependent on how the new process is introduced in the organization. EWB-SWE needs to promote the new process as part of its new strategy of doing more work at the beginning of the projects in order to "front-load" the process and to do less of this type of work in the later stages. However, the explanation in the FS report of why each activity should be done is argued as something that will motivate the volunteers to understand why its important and ultimately motivate them to use them. Also, it will be important to ensure that the project team is trained correctly in using the FS and that they have people to support them in how to do specific tasks when needed. What was seen as difficult, confusing, or too time-consuming in the old process might not be so in the new process with the support from others, such as the competence teams and the templates to guide the work. Thus the intention is that this process will be more user-friendly and motivating to use.

The criteria for **Knowledge sharing internally and externally** and **Ease of communication** is assured through the involvement of both the competence teams and the partner at the different stages in the process. The step in the FS which includes stakeholder identification also concerns stating when and how meetings should occur. This helps to ease communication by having all involved people on the same page regarding what each party expects of the other. By involving the competence teams, it is possible to gain knowledge from previous projects as well as to continuously share findings from the ongoing project. Also, by involving the partner and by having regular meetings it is possible to share knowledge, voice concerns, and learn from each other. The new FS report also describes how to correctly store created documents during the project to ease for others to find the projects and the related documents in the future. At the evaluation meeting, it was said that an improvement in communication will also lead to a better contextual understanding. However, regarding external and internal communication an improvement suggestion was mentioned to ease the communication. It was to state, already at the beginning of the FS report, how many workshops will be conducted and with whom in order for the project team to be aware of it and inform the concerned stakeholders in time. However, specifying the exact number of workshops to conduct is not feasible since it is dependent on the scope of the FS. What could be beneficial is to state in the introduction what stakeholders will be involved in what activities.

The **Decision basis** criterion refers to the deliveries of the FS and should be an information basis for the Decision Committee to make a well-informed decision on whether the project should be approved or declined. During the evaluation meeting, it was concluded that the FS process, if correctly followed, should result in enough information to make a decision. It was also discussed that budget, time, and resource estimation are important information to have in order to take decisions. Thus, how to estimate these aspects might have to be further described in the FS report, and not only in the last step about recommendations. It was also suggested to clearly define or classify the size of the potential projects as small, medium, or large based on the gathered information. However, the characteristics of each size group need

to be determined by EWB-SWE before the classification can be included as a part of the FS report.

As understanding the context is a critical factor in a successful solution the FS has multiple methods and tools for **Contextual understanding**. These are mainly presented in the Context Analysis section but the findings of it are supposed to be revisited multiple times in the study such as in solution exploration and in the sustainability evaluation of the solution. At the evaluation meeting, it was stated that this section in the FS contributes to a lot more contextual understanding than the old process since it requires the project team to collaborate with the partner and analyze the context thoroughly.

The criterion to **Ensure local needs** is mainly assured in the Needs Identification chapter where needs are identified and verified with the support of a needs list, workshops, interviews, and collaboration with the partner. However, the extent to which a project team finds the true local needs is dependent on their ability to elicit these and their experience of investigating needs. Identifying needs, aspirations, and contextual aspects such as cultural and social requires **community engagement** and that the partner is established in the community. To ensure this criterion the Needs Identification promotes the project team and the partner to conduct interviews, observations, and focus groups with the locals. The FS process aims to enhance the importance of developing a solution that engages the community, not only during the development stage but also during implementation, usage, maintenance, and end-of-life. This is assured by promoting the project team to include mechanisms in the solution that involve capacity and knowledge building and create local ownership. This means that the solution is evaluated on its possibilities to create opportunities for education, training, or jobs and if it can be locally owned. These are activities that promote or require community engagement. However, this criterion needs further evaluation through a case study to determine if the FS process actively promotes community engagement.

The main tool that has been developed to meet the criterion **Sustainability evaluation** in the project is the Sustainability Fingerprint Tool (SFT). This tool was evaluated in a follow-up meeting to the initial evaluation, chapter 5.4. The criteria discussed were how it was perceived in terms of the time required and the complexity to understand it. The results were that removing the scoring levels for each criterion made the tool easier to understand and less complex to use. It was also stated that the SFT by itself does not have to be too time-consuming if the FS has been conducted correctly. Since the different steps of the FS are developed to find the information needed to make a comment on each criterion. During the evaluation meeting, it was stated that this tool could be revisited throughout the rest of the project process to ensure that the criteria are considered and to create a red thread throughout the process. It was also seen as beneficial in order to make people consider and possibly redevelop parts of the solution to enable a more sustainable solution to be developed.

An additional evaluation meeting was held with one of the professors behind the

SFT to ensure that the conducted modifications of the tool were approved and to receive some general input on what could be improved. It was decided that the tool is okay to be used and that it should be called a "Simplified Sustainability Fingerprint Tool". A suggestion was made to include a simple grading scale for each criterion without defined levels which could be a scale of 1-10 where the project teams grade the fulfillment of the criteria. Thus it would be up to the project teams to decide what their solution should be graded as for each criterion compared to the other criteria i.e. it would be a relative scale. A discussion that could be made from this is how reliable the scoring would be. Since all project teams would score their own solutions it could be hard to compare scoring results since they are not based on specific measures, but rather the specific project teams feeling and knowledge about the solution. However, the change to add the scoring is one that EWB-SWE needs to do themselves if they see fit.

In order to determine a project's **Social impact** and how it can be evaluated the FS asks the project team to clearly define what the intended social impact is, so that, if it becomes an implementation project it could be evaluated. This will be evaluated further by EWB-SWE to ensure that important aspects are included when defining the social impact.

8

Discussion

This chapter contains a discussion on aspects related to the objectives and a separate discussion on aspects related to the process of working with a volunteer organization and the challenges and benefits of it.

8.1 Objectives

The main objectives of this thesis were defined in chapter 1.3 as;

- Provide an improved process to broaden the solution space by assessing partners, social constraints, and needs that would ensure a sustainable solution throughout its life cycle.
- Define criteria based on Humanitarian Engineering research and incorporate it with EWB-SWE's way of working to enable decision-making and ensure a positive social impact.

In relation to the first objective, how well the new process contributes to a broadened solution space and ensures sustainable solutions, it can be discussed if the sustainability of a solution can actually be ensured at the Feasibility Study (FS) stage of a project without having developed a functioning solution. Maybe it is enough at this stage to have thought of how a sustainable solution can be developed and to define what the social impact could be. To what extent the sustainability and the social impact of a solution can be determined and ensured in the FS will depend on how the project teams adapt to the FS process and make use of the provided methods and tools at all steps. The FS process is developed to be applicable for all EWB-SWE projects, however, depending on the size of the project it might be that a project has to be divided into multiple feasibility studies in order for the FS process to be fully applicable. As an example, if a whole school was to be developed it would be better if it was divided into smaller projects.

Furthermore, it can be discussed if the proposed simplified Sustainability Fingerprint Tool (SFT) is efficient and useful for all EWB-SWE projects. Since the tool is created on a high level and intended to be used for all EWB-SWE projects it might not be fully applicable for all projects. Maybe a SFT for each competence area within EWB-SWE with some common criteria and some competence-specific criteria could

be used instead. In that way, the sustainability of a solution can be evaluated on more specific criteria. However, this leaves an opportunity for EWB-SWE to define those by themselves. The same goes for the levels to score each criterion on, which was removed, partly due to the difficulty in defining the levels with specific targets. Thus if they were to define specific criteria for each competence area they could also define specific levels to score the criteria on. Or they could do it, without levels but with a simplified grading scale to score each criterion on, as was mentioned in the evaluation, chapter 7. The scoring would have been an efficient way to determine the sustainability profile of a solution and use it as a decision basis for the decision committee. The delivered SFT without the levels can still be used as a decision basis but it does not provide the same indicating result on the sustainability aspects. Instead, its main benefits are to make the project teams aware of what the criteria for sustainable solutions are and how well their solution meets them. Thus it can be used as an analysis tool to evaluate what has not been considered in a solution and what could be improved.

The defined criteria also relate to the second objective. The criteria are based on the important aspects of HE identified in chapter 3. Although the criteria have been evaluated with key persons in EWB-SWE and developers of the SFT, it still needs testing on a case study. This is to ensure that the criteria are relevant for determining if a project will have a positive social impact or not and its sustainability. Also, the quality of the criteria depends on the author's knowledge and research in sustainability. The conducted evaluation meetings, therefore, played a critical role in determining if the criteria are of good quality. The research on HE pointed out the complexity of understanding the cultural and social context of a community when helping as an outside organization, as well as the importance of doing so. The lack of methods and tools to do this type of contextual analysis was also evident, therefore, the tailoring of existing methods was necessary to accommodate this. However, there were some identified criteria in the literature regarding HE that were of use to the development of the FS. The reason for the lack of methods and tools in literature might be that Humanitarian Engineering is not a commonly taught or researched subject at universities. It might also be that specific tools developed for HE projects are too complicated to use or unknown and therefore volunteers tend to use standardized and familiar engineering methods and tools, with some adjustments, instead.

8.2 Developing a Process for a Volunteer-Driven Organization

As described in chapter 3.2, EWB-SWE is reworking their project process, which means that changes are made in different areas and different parts of the work process simultaneously. Thus, not everyone in the organization is aware of the recently developed or improved parts. This might have affected the results of the interviews since, even though the participants were helpful and engaged, there was a difference in the quality of the interviews depending on how well the interviewees

were aware of the new processes such as the initial assessment and the Feasibility Study. However, the interviews resulted in a thorough understanding of the work process for International Projects and thus they were helpful. The empirical study on EWB-SWE in chapter 3.2 provided an understanding of the organization, however, it was the qualitative study in chapter 3.3 that resulted in the findings that were of most use for the development of the Feasibility Study. Since many volunteers in the organization have a lot of knowledge that is not documented and accessible, the interviews helped to understand their opinions, experiences, and actual work procedures. Even though the interviews took longer time than initially planned they resulted in a deeper understanding of EWB-SWE's work procedure, which was a key factor in order to develop a Feasibility Study that could be adapted and coherent with their overall work procedure.

Another aspect of developing a process for an organization mainly run by volunteers is that throughout almost all workshops and interviews, people were supportive and thankful for the job that was done. However, it is one thing to be supportive and appreciative of the process and another thing to actually adapt and sustain it. Since the implementation of the developed FS process is not part of this thesis it is up to the management of EWB-SWE to ensure that it can be correctly implemented and that the volunteers become motivated to use it. The volunteers must want to use the provided process and the included methods and tools, the change cannot be forced on them.

Also, a commonality of all the interviews was that they experienced the Project Charter as too comprehensive and time-consuming. Thus proposing a FS process with multiple new methods and tools that will require time and effort during the projects can be seen as contradictory. However, the FS Report addresses that issue by explaining how and why each step should be conducted in order for the people to not struggle with understanding the tasks. Regarding time consumption, since the purpose of the FS is to make EWB-SWE resource-efficient and have an increased social impact, the FS should enable "front-loading" and result in that less work needed later on in the process. Thus moving the time required from the later steps to the beginning of the project in order to make informed decisions.

9

Conclusion & Recommendations

This chapter includes the conclusion of the master thesis results by concluding the objectives of the project. Also, recommendations to EWB-SWE are stated along with suggestions for further development.

9.1 Conclusion

The first main objective can be concluded as met. The new FS process includes a guide to all proposed methods and tools, it explains why the tasks should be done, and it forces the project team to analyze and understand the context, chapter 6.2, and identify needs and aspirations, chapter 6.3. Furthermore, the process broadens the solution space, chapter 6.5, and ensures the evaluation of sustainability, chapter 6.6. Thus, the new proposed Feasibility Study process improves the overall work process and front-loads the work.

Furthermore, the second main objective is likewise concluded as met, since the process includes criteria that are defined based on Humanitarian Engineering and important aspects to consider in EWB-SWE projects. The results of the Sustainability Evaluation, chapter 6.6, and the whole documented FS Report will enable the decision committee to decide whether a project should become an implementation project or not. Also, chapter 6.1 and 6.4 assures that the social challenge, intended beneficiaries, main project goal with related indicators, and potential social impact are defined. This enables/ensures that the project could have a positive social impact, aligning with EWB-SWE's way of working.

In conclusion, the aim of the master thesis has been accomplished, a process with methods and tools which support EWB-SWE's Feasibility Study and aids them in developing sustainable solutions and determining appropriate projects to implement has been developed and delivered.

9.2 Recommendation & Further Development

The developed and delivered Feasibility Study is based on literature research, interviews, and evaluated through workshops with participants from EWB-SWE. However, further testing is needed to verify and validate the process so that it can be

sustained within and bring value to the organization. Therefore the recommendations are;

- **The Sustainability Fingerprint Tool**: Conduct the LEASA workshop with each of the competence teams in order to develop Leading Sustainability Criteria for each of their areas of competence. The criteria should then be compiled into a new Sustainability Fingerprint Tool for each competence area with defined levels.

- **Incorporation into the overall work process:** Develop the remaining parts of the project charter in line with the Feasibility Study to ensure that the knowledge gained during the initial partner assessment and the Feasibility Study is used in the most optimal way and that tasks only appear once in the project process.

- **Validation of the Feasibility Study:** The new Feasibility Study process must be validated to ensure that the intended benefits are gained. This includes verifying if the incorporated methods and tools can be used as intended and how well they contribute to the process of implementing long-term sustainable solutions. If necessary this could also mean that adjustments of the methods and tools have to be made.

- **The importance of understanding the context:** For EWB-SWE to ensure that all volunteers understand the importance of investigating and understanding the context, it can be beneficial to make the volunteers, about to take on a new FS project, read the Humanitarian Engineering chapter of this thesis, chapter 3.1. This would give them a quick introduction to Humanitarian Engineering and to what is important to consider in order to achieve sustainable development.

- **Support of the Feasibility Study:** To investigate whether it could be beneficial to create a competence team for the FS with people who can support the project teams throughout the FS process and to mitigate the chances of it being incorrectly used or adapted. For example, they could facilitate certain steps, such as the Solution Exploration, and the use of the Sustainability Fingerprint Tool.

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A

Template with questions for all interviews

- What is your current role and what experience form working with EWB do you have?
    - What project have you been a part of? When?
    - Were they successful? Why? How?
- What do think about the current process? Related to your area?
    - Are there steps that are more challenging than others? If so, what steps and why?
    - Do you have any suggestions on what could be changed, and how? Certain methods etc.
- Are you aware of how your function is working towards the SDGs?
    - If so, how? and what activity would you say contributes the most?
    - If not, how could it be implemented in the process according to you?
- What areas are you responsible for and are the areas clearly defined?
- What is your experience of contacting different people within EWB?
    - For example, when needed in a step of the process?
    - When asking questions?
    - Is it clear who to contact in the different steps?

Interview with Competence team
- Vilka roller/kompetenser finns i WASH?
- Vilka delar i processen är ni delaktiga i? (Idea, planning, implementation, conclusion, monitoring and evaluation)
- Vilka delar i Project Charter är svåra att tolka/ använda och vilka fungerar bättre?
    - Förslag på metoder som bör tas med i FS?
- Vilka personer i EWB är ni beroende av?
    - Vilken roll har kompetensgruppen för Projektgrupperna?
- Finns de nån mall att fylla i för att spar information om behov osv?
    - Vilken information är viktig att ha tilgång till senare i processen /som lärdom för andra projekt?
    - Hur tar ni vara på information från tidigare projekt? t.ex tekniska lösningar som funkar bra/mindre bra
- Är ni med i beslutsprocessen, vilka beslut isf?
    - T.ex hur väl projekt är utförda, hur avgör ni om det finns tillräckligt med underlag för att ta ett beslut?
- Hur mycket är ni engagerad/delaktiga i projekt? Max/minsta engagemang?
- Vilka faktorer är viktiga att ta hänsyn till vid utvärdering/feedback av
    - Projekt idé?
    - Projekt planering?
- Har du koll på FS processen som är under utveckling?
    - Ser du att kompetensgruppen kan va en del av en förstudie, eller kommer ni in senare?
    - Har du tips på folk vi kan kontakta i andra kompetensgrupper?

Interview with Partnership Assessments
- Hur ser den nuvarande processen ut för Partnership Assessment?
    - Vilka kriterier baseras beslutet på?
        - T.ex kriteriet att samarbete inte får ha direkt negativ miljöpåverkan,
    - Hur försäkrar ni er om att de partnern säger är sant? Har de kapaciteten att arbeta miljövänligt
    - Använder ni idag några metoder eller verktyg för att kolla på vilken social påverkan vissa partnership kan ha?
    - Är det olika beroende på olika länder? Och om partnern är återkommande?
- Vilka är involverade i Partnership Assessment/agreement/evaluation?
    - Andra organisationer/företag?
    - Interna personer hos EWB
    - Vilken information kräver de involverade personerna? Beslutskriterier?

- Vad för typ av dokument, rapporter osv. levererar ni? Vad krävs för information till dessa?
  - Vilken typ av information eller dokument är viktig att föra vidare till de som skall göra en förstudie med en ny partner?
- Vad karaktäriserar ett lyckat partnerskap?
  - Och en engagerad partner?
- Hur säkerställer ni om en partner org. är värd att satsa på för att skapa ett långsiktigt samarbete?
- Har du varit involverad / arbetat med sponsor eller donations-organisationer för EWB?
  - Kan de isf komma med krav eller avgränsingar för projekten?
- Är du delaktig i utvecklingen av den nya processen för partnership assessment?
- Har du koll på FS processen som är under utveckling?

Interview with International Project Secretary
- Vilka delar i processen är du involverad i? (Idea, planning, implementation, conclusion, monitoring and evaluation)
- Vad är din uppfattning om den nuvarande project chartern?
  - Vad fungerar/fungerar inte i det tidiga stadiet?
- Är du med i beslutsprocessen för vilka projekt som väljs ut?
  - T.ex hur avgör ni om det finns tillräckligt med underlag för att gå vidare med ett projekt?
  - Vad baseras besluten på? Är det t.ex. information som finns i ifylld project charter?
- Vilka faktorer är viktiga att ta hänsyn till vid utvärdering/feedback av
  - Projekt idé?
  - Projekt planering?
- Hur jobbar EWB idag med social impact?
  - Hur skulle detta kunna införas eller förbättras?
  - Om EWB inte mäter det idag, hur kan de mätas?
  - hur kollar ni på kulturella aspekter?
- Enligt dig, vilket steg i processen har störst avgörande på om projektet bli lyckat?
  - Varför har det steget mest betydelse?
  - Hur kan man se till att detta steg/val görs på rätt sätt?
- Har du varit delaktig i utveckling av den nya FST?
  - Hur är den uppbyggd?
    - Vill du gå igenom den med oss lite kortfattat?
  - Vilka har varit involverade?
  - Vad ligger bakom de nya stegen t.ex teori, kompetenser osv?
  - Finns det ett mål när FS ska va klar?
  - Vem är ansvarig för att färdigställa FST?
- Frågor på FST innehåll
  - SWOT-analysen: Finns de en färdig template för SWOT
  - Hur säkerställer ni att SWOT-analysen utförs korrekt?
  - Hur ska man bestämma omfattningen av Feasibility Study?
  - Hur fås info om tidigare projekt, är tanken att kontakta kompetensgrupper?
  - Går det att hämta info från partner assessement kring tidigare projekt?
    - Any lessons from previous EWB-SWE projects which may be suitable to learn from?
    - Any lessons from projects previously carried out by other organizations which may be suitable to learn from?
  - Kanske undersöka behoven innan de verifieras, hur kopplas behov ihop med kulturella faktorer osv
  - Vad är din uppgift under våren?
- Identifiering av kriterier för att se om en lösning är hållbar/ haft en positiv påverkan (kopplat till project indicators i FS)
- Vad menas med Results Framework?

- När väljs den slutgiltiga lösningen? Är det i steg 3?
- Vem är ansvarig för att färdigställa FST?

Interview with Partnership Coordinator
- Vad är viktigt att tänka på vid utveckling av en lösning för en lokal partner/ samhälle?
    - Hur får man in sociala och kulturella aspekter?
    - Hur mäter ni social impact? Eller hur skulle det kunna göras?
- Vilka problem brukar dyka upp?
    - Kommunikation? Samarbete? Engagemang? Resurser?
- Finns det några metoder o verktyg som du brukar använda i projekt? (Delar av Project charter)
    - Hur använder du den nuvarande Project Chartern? Finns de något du vill bevara/ förbättra i den?
    - Fördelar /nackdelar med detta?
- Vad karaktäriserar ett lyckat projekt?
- Varför blir vissa projekt mindre lyckade?
- Hur skapar man en lösning som är miljömässigt hållbar i längden?
    - Under implementering, avfall och återvinning
    - Hur kan miljöaspekten inkluderas när priset är en drivande faktor?
    - Vad brukar partners ha för fokus på miljöfrågor?
- Vad finns det för barriärer till att förstå eller hitta det verkliga behovet?
- Hur engagerar man den lokala befolkningen? Entreprenörer, byggare osv
    - Hur säkerställer man en hållbar och kontinuerlig kontakt med dem?
- Har du koll på FS processen som är under utveckling?

Interview with Sustainability and Concrete expert
- Vad är viktigt att tänka på vid utveckling av en lösning för HE-kontext, utvecklingsländer?
- På vilket sätt har du/ni arbetat: Förslag på metoder, processer etc.?
- Finns det några metoder som du brukar använda i projekt?
- Vad karaktäriserar ett lyckat projekt?
- Varför blir vissa projekt mindre lyckade?
- Hur skapar man en lösning som är hållbar i längden?
    - Miljö
        - Under implementering, avfall och återvinning
    - Socialt
    - Ekonomsikt
    - Underhåll och använding, anpassa efter kontext
- Hur engagerar man den lokala befolkningen? Entreprenörer, byggare osv
- Finns det några barriärer /problem som ofta uppstår i humanitära projekt?
    - Skiljer det sig mellan planering, implementering osv?
- Har du koll på FS processen som är under utveckling?
- Har du tips på folk vi kan kontakta som kan va kunnig inom HE?
- FNs hållbarhets mål är för länder, 20% kan jobba med

Interview with Project Manager and Monitoring and Evaluation team
- What do think about the current process? Related to your work?
    - Are there steps that are more challenging than others? If so, what steps and why?
    - Do you have any suggestions on what could be changed, and how? Certain methods etc.
- How does the monitoring and evaluation team work?
    - What information do you have to work on?
    - What do you need to do the monitoring and evaluation?
    - Are you involved at the start of the projects?

- Do you use any strategies or methods to explore social impact?
    - As monitoring and evaluation
    - As project manager
    - What would be important to investigate?
- How do you evaluate/follow up on completed projects?
    - Do you define goals at the beginning of the project?
- What characterizes a successful project?
    - Long-term, short-term, EWB needs, community needs?
- What do you do to find the latent needs?
- When should a project not be conducted? What characterizes that project?
    - Do you have any experience with abandoned projects?
- What are important factors to keep a partner engaged? Can this be done with any particular methods?
    - How do you communicate with the partner? Is efficient?

Interview with Competence team and knowledgable in context (social and cultural)
- What do you think about the current process? Related to your work?
    - Are there steps that are more challenging than others? If so, what steps and why?
    - Do you have any suggestions on what could be changed, and how? Certain methods etc.
- Do you use any strategies or methods to explore social impact?
    - What would be important to investigate?
    - Are measuring any results today?
- How do you evaluate/follow up on completed projects in WASH?
    - What would be needed for an efficient evaluation?
- What characterizes a successful project?
    - Long-term, short-term, EWB needs, community needs?
- What do you do to find the latent needs?
- When should a project not be conducted? What characterizes that project?
    - Do you have any experience with abandoned projects?
- Based on your experience in working in the local context, what are important factors to consider to involve social and cultural differences?
    - How do you ensure local ownership?
    - And how do you create a long-term sustainable solution that can be maintained by the community?
- Does the partner consider environmental aspects of the solution?
    - How can the trade-off between price and environment be determined?
- What are important factors to keep a partner engaged? Can this be done with any particular methods?
    - How do you communicate with the partner? Is it efficient?

Interview with Project Manager
- Kan du beskriva erat arbete och om det särskiljer sig från de andra kompetensområdena?
    - Hur engagerade är ni i projekten?
    - Finns det några kriterier som skall uppfyllas när ni genererar/planerar en lösning?
- Vad är viktigt att tänka på vid utveckling av en lösning för en lokal partner/ samhälle?
    - Hur får man in sociala och kulturella aspekter?
    - Vad karaktäriserar ett lyckat vs inte lyckat project?
- I vilka sammanhang bör man inte genomföra ett projekt?
- Hur mäter ni social impact? Eller hur skulle det kunna göras?
- Hur ser ni till att hitta det verkliga behovet?
    - Finns det några barriärer till att inte göra det?
- Vilka problem brukar dyka upp inom projektens gång?
    - Kommunikation? Samarbete? Engagemang? Resurser?
- Hur utvärderar ni genomförda projekt?

- Finns det en dokutmentationsprocess för detta?
- Hur delar ni era kunskaper och erfarenheter med projekt team?

  - Hur skapar man en lösning som är miljömässigt hållbar i längden?
    - Under implementering, avfall och återvinning
    - Hur kan miljöaspekten inkluderas när priset är en drivande faktor?
    - Vad brukar partners ha för fokus på miljöfrågor?
  - Hur engagerar man den lokala befolkningen? Entreprenörer, byggare osv
    - Hur säkerställer man en hållbar och kontinuerlig kontakt med dem?
  - Har du koll på FS processen som är under utveckling?

Interview with Project Team in Feasibility Study
- Vad är ert projekt?
- Vad har ni gjort för undersökningar?
  - Vad gick bra/dåligt
  - Gav dom någonting?
- Hur valde ni vilka som skulle kontaktas?
  - Har ni kommit i kontakt med både kvinnor och män?
- Hur har ni upplevt FST?
  - Vad har fungerat bra?
  - Vad har varit svårt?
  - Har ni förslag på förbättringar?
- Vilket scope har ni på FS? Hur djupt ska ni gå?
- Vad hade ni kunnat göra hemifrån och vad anser ni viktigt att göra på plats?

B

Thematic Analysis on HE needs
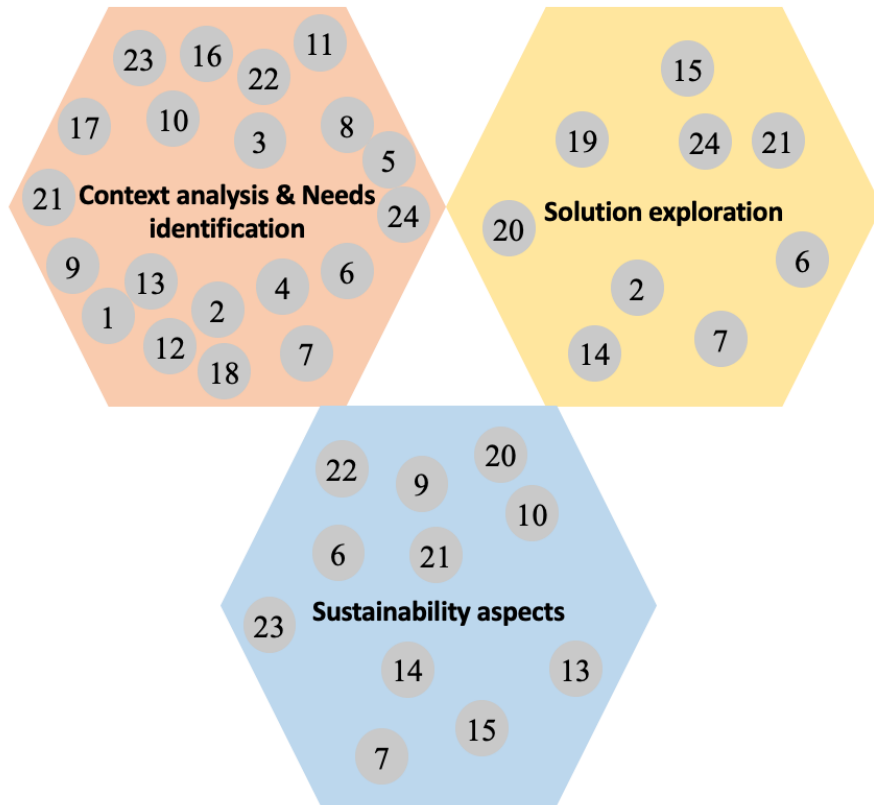
Figure B.1: Visualization of the thematic analysis of the HE needs. The numbers correspond to the numbers in Table 3.1.

C
Thematic Analysis on Interviews

PM = Project Manager
CT = Competence Team
PSA = Partnership Aseessment

UNSUCCESS PROJECTS/ FACTORS

SUCCESS FACTORS

PSA: Nödprojekt planerat för Kameruun blev avbrutet och ist implementerat i Tanzania. Ej lyckat pga fyllde inget direkt behov

PSA, Ingen krisorganisation så inga projekt i krig/krisländer, kan avbryta projekt

PSA: Vissa processer är väldigt långdragna, leder till att studenter inte hinner genomföra projelt från start till slut.

Delmål och mål sätts inte alltid upp så detaljerat och att folk inte tar hänsyn till alla aspekter (ge bra exempel på vad som ska undersökas i alla specifika projekt)

PSA: Många vet inte vad de ska skriva tex som delmål i projekt chartern då den är oklar

PSA: De skickar inte vidare jättemycket information till ett ev. projekt från assessment formuläret (delvis för att det kan vara lite konfidentiellt)

CT: Project Charter ställer inte alltid tillräckligt bra frågor eller så relevanta (som bara tar tid att svara på)

Secretary: Det kan ibland vara svårt att veta om ett mål har uppnåtts eller om en "change" har skett

PSA: Vi ska inte heller ta jobbmöjligheter ifrån de lokala personerna

Expert: Personer i annan kultur vill ofta vara till lags och svara på frågan utefter vad de tror att man vill höra.

CT: Finns inget riktigt system för hur man ska sprida kunskap mellan projekt eller olika EWB

CT: Vissa grupper (tex studentgrupper) vet inte om att WASH-gruppen finns eller vilka personer att kontakta om de behöver fråga något

CT: Mycket information från projekt ligger på personers egna datorer...

CT: Bristfällig kontakt med personer inom EWB, det behöver jobbas på

PM: The main challenge for EWB is that mainly volunteers run the organization

PM: They had intentions of how to work as a evaluation team but time was a limitation

PM: The charter is massive and complicated at the moment

Secretary: Mycket prat sker via mail utan en personlig kontakt

Secretary: Det är svårt att veta vilka som ingår i olika grupper och att hitta rätt information på drive

Secretary: Project Chartern är klurig att förstå och alla vet inte hur den fungerar

CT: Project chartern är lite väl tung

Secretary: Inga projekt har blivit help avvisade under hennes tid i beslutsmöten

Secretary Chartern kan vara lite för abstrakt ibland

CT: Personerna är vana vid att använda ved och måste ställa om i hur de använder produkten

CT: Vissa projekt har omplacerats (eller kopierats) och då blir det inte alltid så bra

CT: Dålig kommunikation med partner och kravspec från början bidrar till ett mindre bra projekt

PM: Språk kan vara en barriär

PM: kommunikation är jätteviktigt och mycket kan falla mellan stolarna vid dålig kommunikation

PM: Om partnern gör projektet parallelt eller helt själva (utan input från oss)

PM: Krav och behov ska komma från dem själva, men via en etablerad organisation

PM: viktigt att inte styra en projektledare i detalj, då kommer de inte tycka att det är kul och givande

PM: project chartern är för omfattande och tidskrävande

PSA, Komposttoalett: Utbildade personer i funktion och teknisk lösning

1 eller 2 uppföljningar visar att toaletterna används och att flickor går mer till skolan i och med detta

PSA De tog hänsyn till deras problem och försökte hitta det grundliga problemet innan de hittade lösningen till problemet

PSA: Direkta med vad vi ville få ut utav det och att mavuno var tydliga vad de ville ha

PSA: Förundersökning var redan gjord av andra personer

PSA: Chartern är väldigt detaljerad och om man fyller i den så får man väldigt mycket information

PSA: Sub-goals and goals, att tydligt ha ett mål och delmål med vad man ska göra. Sedan också hur de olika målen skall uppnås

PSA: Bättre parnterskap leder till bättre projekt och det leder till mer fokus på SDG och hållbarhetsmålen

PSA: Bra kommunikation partner, samt att de är samarbtesvilliga, dela infomation osv.

PSA: Partner med lite erfarenhet får börja med ett mindre projekt

PSA: Trycker på vikten att engagera kvinnor i projekten

PSA: Han trycker på vikten av att ha lokala partners och kompetenser som kan ge en bättre kontext,

PSA: Viktigt att vara lite kritisk mot dokument och uttalanden från partner organisationen så att man inte är för godtrogen

PSA: Att projekten som man gör har en långsiktig plan och inte bara installeras och sedan går sönder

PSA: Korruption: vem anställer man och vilka personer får ha inverkan på frågor?

PSA: Ett bra parternskap; att det som man gör verkligen gör nytta

CT: att man har olika planer (A,B,C D osv.

PSA: Långsiktiga partners är enklare för projektgrupper att jobba med. Projekten kan ta kortare tid, det blir bättre kvalitet osv.

PSA: Lokaltägandeskap: så att de själva tar hand om det! (vi vill inte vara på ett ställe och driva saker eller ha service-rollen)

Secretary: Theory of Change

CT: Finding the local needs is crucial

CT "Man ska göra stor nytta över lång tid"

PM: Satisfaction of the users

PM: Att man identifierar indikatorer och att man ser till att följa upp dessa

PM: Its important to have an engaged organization and that is well established in the community, they have the connections in the community to examine this question

PM: A suitable solution for the community

PM: Follow up properly, why did or did not something work

PM: Regular (scheduled) meetings or contacts with the partner is good

PM: Mutual trust where they know that if something is not solved this week it will be done in the near future! Both ways!

PM: Front-loading och ta reda mycket på info i början och att man kan påverka mycket där

PM: Det ska finnas ett genuint intresse från partnern att något ska lösas

PM: Det kan vara svårt ibland med språket

PM: Mottagaren ska vara väl förankrat i samhället och att myndigheter ska ha koll på organisationen och att de följer lagar osv

PM: Make sure that you understand where the ides came from and if they did workshops or other things to understand the problem, needs, and/or ideas

PM: Övertyga personer att det är lönsamt och värt att investera i

Secretary: Om man ska jämföra hur ett visst resultat blev så måste man ha kollat hur det var innan också

PM: Att det praktiskt genomförs med de aktiviteter man har satt upp. T.ex med baseline data som studenter samlat in, samt att de uppdateras

PM: Kommunikation är väldigt viktig

PM: Man måste ha en bra kommunikation med mottagarorganisationen och ta reda på vad de har för intresse med projektet

PM: Man måste se till att projektet tas emot bra av mottagaren och att det gärna finns en organisation som tar hand om projektet och en styrelse som kan ta sig an projektet och problem som dyker upp

PM: Olika nivåer på lösning för att tillgodose olika behov och ekonomiska faktorer

PM: Hitta en teknik som fungerar, men sedan får man hitta olika sätt att använda den, beroende på sina kontext

PM: Man får vara inlyssnande på vad de har att säga om lösningsförslag då de ofta har en bra bild utav kontexten och om vad som är möjligt att göra hos dom

CT: Tydligt definiera vem som ska göra vad och vem som ska betala för det

CT: Resa är inte nödvändigt i alla projekt om de fungerar bra

PM: Dokumentera mycket och från början av projektet

PM: hitta projekt som genererar pengar som sedan kan interinvesteras i projektet och byggas ut

EWB's INTERNAL ORG. NEEDS

PSA: Kriteriet environment: är svårt ibland att få in data på det

PSA: Pre-study passar inte in i chartern och vissa delar är inte relevanta för dessa projekt

PSA: Delar ej upp partners i grupper efter storlek

PSA: önskar att det fanns mer resurser för att göra mer undersökning på plats!

PSA: Viktigt att kunna engagera hela samhället i projekten, inte bara partner

PSA: Projektteamet har som uppgift att kolla på social impact

PSA: Internt: att vi som EWB får ut någonting av det, att folk som jobbar hos oss har en positiv bild utav det

PSA: Tanken är att man ska följa upp partnerskap efter några år, men det har inte gjort riktigt än (det började 2021)

CT: Processerna får inte vara för jobbiga och bara dränera en på energi

PSA: Vi ska inte bara komma och tro att vi vet bäst (viktigt att ha koll på de olika kontexterna mellan länder och kulturer)

CT: En checklista för att se så att projekt fyller upp vissa krav

CT: Att personer som har investerat sin tid i EWB och att det som folk bidrog med faktiskt fungerar och används på riktigt.

Mentor: Hur mäts kvalitén på projekt och vart saknas det info.

Mentor: Finns det projektmål och uppfylls dem?

Mentor: Fokusera på att välja rätt projekt. Grunden till att sen få en fungerande lösning.

PSA: EWB: Projekt i linje med EWBs mål och SDG

PSA: EWB: Driva projekten effektivt = satsar energi på det som gör mest nytta

PSA: EWB: teknisk kvalitet viktig, men också de sociala bitarna och vad som händer efter leveransen (underhåll osv.)

PSA: EWBs volontärer: Man upplever att man gör nytta och att man får tillbaka något själv

PSA: There is no official document on how to do Ev. & monit. work (under development)

PSA: Requests standardized way of working with room to customize to each project

PSA: Make sure that the budget is put in the right place (maybe EWB doesn't need to do the evaluation, but rather train the partner to do the evaluation)

PM: Its important to only do projects that are within EWB's area of expertise and experience

PM: Problem med uppföljningar att projekt drar ut på tiden. När ett projekt är avslutat ska det lämnas över till evaluation-gruppen, men vet inte hur det går med det!

PM: De har låtit projekt dra ut på tiden för att se till att de kan samla in uppföljningar

PM: Gör man ett projekt för att vi i sverige vill göra något eller för att de finns ett verkligt behov?

PM: Schemalägger ej möten med partner, kommunikayion fungerar hyfsat ändå

PM: Saknar "den snabba dialogen"

CT: Bara för att man har fyllt i Project Chartern betyder det inte att lösningen är bra och hållbar samt håller i längden

PM Det finns problem med att personer lämnar grupper och att det är hög omsättning på "personal" samt dåliga överlämningar till de nya

PROPOSED IMPROVEMNT

PSA: Det varierar mycket från projekt till projekt vad man ska kolla på. Kan vara bra att göra specifika saker att tänka på under vissa typer av projekt

PSA: Skapa en mall för varje specifikt projekt och område

PSA: Budget i FST??

PSA: reducera antalet partners för att kunna jobba mer med dem som redan finns

PSA: lokal kommitté som har "ägarskap" för en produkt så att de själva har ansvar för lösningen och att den fortsätter fungera

PSA: Kan vara bra att klargöra exakt vart FST tar slut! (detaljritningar, skisser, idéer osv?) vad förväntas utav den?

PSA: ha en checklista som man checkar av för att kolla att alla projekt följer och är bra

CT: Hitta frågor/ kriterier som man kontinuerligt kommer tillbaka till under projektets gång

CT: Hitta sätt att ifrågasätta Project Chartern så att fokuset inte bara ligger på att "fylla i den"

CT: Hitta verktyg att jobba med reflektion och att bli socialt och kulturellt accepterad

Mentor: Backcasting: för att få med alla relevant aspekter för att skapa en fungerande lösning

CT: Kan ibland vara mer värt at ta upp ett gammalt projekt än att starta ett nytt (i form av tid och resurser)

CT: Ett SDG tänk och en uppföljning av hur det går

CT: Uppföljning av projekt måste EWB jobba på

PM: SWASH team developing goal indicators

PM: Mavuno can collect the baseline data in the beginning of the project, then follow up on at timeplan

PM: What should be done to have a longer impact in the community

PM: Mavuno would be the best to do the evaluation in the long run

PM: Train the local teams to do certain tasks

Secretary: Se till att det i processen står tydligt vem som ska kontaktas (tex kompetensgruppen)

PM: Slå ihop projekt tex computer for schools för att kunna utnyttja och ha mer workshops tillsammans

CT: Skapa ett blueprint som man kan kopiera till andra locations

PM: Kolla upp "effektmål" kopplat till social impact

CT Kolla upp WHO, UNICEF; UNHCR och Rödakorset och inspirera/kopiera

PM: Vad är sannolikheten att man kommer uppnå det man tänker att man ska uppnå

Secretary: Uppmuntrar folk till att göra saker, men det borde kanske finnas en process som redan tillgodoser det

PM: Eco efficiency: man tittat på användarvärde vs pris och avtryck

PSA: Kolla vår egna effektivitet och kunskap: Kolla vilka lösningar och koncept som vi är duktiga på och vad vi kan hjälpa till mer (lite som en butik, där man säljer specifika lösningar)

PM: Hans åsikt om hur långt FST ska sträcka sig: Att man ska ha ett koncept Undersöka från olika håll ekonomiska möjligheter (styrka) Samhället omkring (vem har ägarskap) Vilka stakeholders finns det i projektet osv.

CONTEXTUAL FACTORS

Mentor: Hållbar tillverkning för framtiden måste finnas med i tanken även om folk tycker att priset är viktigt. För att det i framtiden ska hålla och att man inte gör något nu som sedan går sönder eller måste göras om igen.

Mentor: Priset är ofta det som styr produktenskvalitet osv. Det kan ta folk 10-15 år att bygga sina hus i betong, pga ekonomiska svårigheter.

Mentor: Kontexten i Ghana är annorlunda mot build up nepal, I afrika är priset en drivande faktor. Kräver en annan lösning

Mentor: Folk gör ibland rätt projekt på fel sätt eller på fel plats

PSA: Samhället: Att projektet är till gagn för samhället. Både lösningen men också kring sociala aspekter

CT: I kontexten EWB och community dev. Finns det så mycket fler saker som kan gå snett än här hemma

CT: Förstå komplexiteten med ett projekt där nere jämfört med här hemma

PM: Kunden behöver ändra sina vanor till ett nytt sätt att arbeta på

Mentor: Värdet som skapas i projektet är det viktiga, inte om det är responsible eller humanitarian engineering

Feasibility Study

Secretary: Ska ta upp kontexten för projektet och de kringliggande faktorerna

Secretary: ska avgöra om EWB eller någon annan organisation ska ta sig an uppdraget

PM: Kräv olika omfattning från en FS beroende på dess budget

PM: FS ska va lätt att anamma, inte ta för mycket tid eller kalender tid!

PM: En specifikation på lösningen borde göras

PM: Formulera krav och mål

PM: Resande i tidigt skede får vägas mellan kostnad att åka och miljöpåverkan som den bidrar

PM: Ställ frågor som kommer åt grundproblemet och att de personer ger sina riktiga åsikter, (varför, hur osv)

Stakeholder needs

PSA: Bidragsmottagare/ slutanvändare (kan vara partner): Kvalite är att det fyller ett verkligt behov, levereras i tid och fungerar bra över tid

PSA: Samarbetspartner: Bra fungerande samarbete, tydligt vem som gör vad, leveransgränser, budget, tider mm

PSA: EWBs donatorer: De vill se att deras bidrag skapar bra nytta

PSA: donatorer: De vill också kunna peka på och konkret visa på vad de har hjälpt till med

D

PESTEL Template

PESTEL

The PESTEL Analysis Guide:

1. The first step of the PESTEL analysis is to conduct a workshop together with the partner. You can facilitate the workshop but the partner should be active in discussing the topics. Preferably the workshop should include people from different business areas/competencies of the partner organisation. Not all questions for each topic needs to be answered, the questions are only to provide guidance on what to search for and to lead the discussion.

2. The second step, once the workshop is done, is to conduct further research on the six PESTEL topics and to gather information and evidence for the answers collected during the workshop. The research can be a mix of googling, consulting, and seeking the opinions of experts in the partner organization or within EWB such as the competence team. Other people to contact could be customers, distributors, suppliers, or consultants who know the context well.

3. The third and last step, concerns refining the ideas and then drawing a conclusion to each factor on what the most important findings are (consider the impact the findings could have on the organisation and project and how likely it is to happen). Write down the answer in the Feasibility Study Template under section 2.1.

Project name:
Assessed by:

Political		Economical		Socio-cultural	
Here government regulations and legal factors are assessed in terms of their ability to affect the business environment and trade markets. The main issues addressed in this section include political stability, tax guidelines, trade regulations, safety regulations, and employment laws. (Tax incentives, FDA regulations, Employment laws, Import restrictions, Health and safety laws, Regulation and deregulation)		Through this factor, businesses examine the economic issues that are bound to have an impact on the company. This would include factors like inflation, interest rates, economic growth, the unemployment rate and policies, and the business cycle followed in the country.		With the social factor, a business can analyze the socio-economic environment of its market via elements like customer demographics, cultural limitations, lifestyle attitude, and education. With these, a business can understand how consumer needs are shaped and what brings them to the market for a purchase.	
	Answer		Answer		Answer
How will the current political climate impact the organisation? Will a particular political party influence your ability for growth?		Will interest rates or financial issues affect your organisation or your consumers' confidence?		What lifestyle, opinion, culture or demographics could change and cause issues?	
Which government policies help or hinder you?		Is the exchange rate volatile to dramatic change?		What age demographic are you targeting?	
What funding grants, tax rebates or initiatives are there that you could apply for?		Are interest rates subject to change, and will that impact your financial commitments?		Is there population growth or decline in the community/country?	
Is there political instability that could affect your ability to do business?		Does your target market have disposable income?		What are the current cultural trends and do you enhance them?	
Will the current foreign trade policy work for you?		Can the consumers/users afford the product/solution?		Is there consumer confidence in your industry?	
Will current tax legislation change? How will this impact the organisation/business?		How is taxes scheduled to change?		What are the current opinions on the organisation, similar organisations, businesses or competitors?	
		Does any minimum wage increase affect your ability to make payroll?			

engineers
without borders
SWEDEN

Technological		Environmental		Legal	
The technological factors include how technology can either positively or negatively impact the introduction of a product or service into a marketplace is assessed here. These factors include technological advancements, lifecycle of technologies, the role of the Internet, and the spending on technology research by the government.		The environmental factors include all those that influence or are determined by the surrounding environment. This aspect of the PESTEL is crucial for certain industries particularly for example tourism, farming, agriculture, etc. Factors of a business environmental analysis include but are not limited to climate, weather, geographical location, global changes in climate, environmental offsets, etc.		The legal factors have both external and internal sides. There are certain laws that affect the business environment in a certain country while there are certain policies that companies maintain for themselves. Legal analysis takes into account both of these angles and then charts out the strategies in light of these legislations. For example, consumer laws, safety standards, labor laws, etc.	
	Answer		Answer		Answer
Could new technology innovations disrupt your project/business?		Could climate change and its consequences affect the project in any way? if so, how?		Could any existing or new laws, regulations or policies impact your ability to implement the project, sell the product, or provide the service?	
Is the economic forecast of concern?		Will the decline in raw materials be of concern to the longevity of your business?		What safety standards need to be adhered to? and is it easy to abide by health and safety laws?	
Does your internet connectivity benefit or hinder you?		Are any environmental laws being considered that could cause you issues?		What employment laws impacts the project	
What do the current infrastructure and geographical location look like in the area?		What does the waste management look like in the area today?		What permits are necessary for the project and are they already obtained? This includes building permits, environmental permits, etc.	
What resources and expertise are there related to the project within the organisation and the local community?		What does the existing access to water look like? How does this need to be taken into account in the project?			
Does the organisation or the community have the technical assets to maintain a potential solution?					

E

SWOT Template

	The SWOT analysis guide:		engineers without borders SWEDEN
	1. The first step is to gather people for a workshop; people from the partner organisation, competence teams, and possible experts of interest.		
	2. The next step is to go through the previously conducted PESTEL analysis to find information and relevant findings.		
	3. Then, go through the four aspects of the SWOT; use the guiding questions to spark the discussion, but feel free to add any relevant information you see fit.		
	4. Refine and reformulate the answers in each category		
Project name: Assessed by:	5. Go back to the Feasibility Study Report and document the most relevant findings and write a short conclusion of the SWOT analysis.		

	S	**W**	
Strengths:			**Weaknesses**:
What advantages exist (education, skills, network, etc.)?			What disadvantage does the partner have in terms of resources, capacity, and community engagement?
What resources exist (financial, technical, human, etc.)?			What are people's negative habits or traits in the organisation, community, suppliers, or workers?
What is the partner's greatest achievement in terms of previous projects or as an organisation?			What gaps does the partner have in terms of capabilities or knowledge? and in what areas do you need more training or education?
What values does the partner have that may help reach the goal?			In what areas is the partner vulnerable?
What do employees or other organisations see as strengths?			Does the partner or the partner's suppliers have weaknesses when it comes to their management structure, keeping deadlines and budgets, or planning projects?
Is the partner well established in the community?			What is the reliability of potential baseline data? or general data collection from the community?
Does the organisation have a strong sense of purpose and the culture to support the purpose?			What are potential weaknesses with the robustness of the supply chains?
What type of policy influence does the organisation/project currently have?			What areas does the partner need improvement on?
What type of education and knowledge-building skills and capacities does the partner have? give an example of when these have been used.			Is the partner well-established with potential customers/users?
What is the partner's market reach? and the partner's awareness of the market?			
What strengths could there be with the partner's or the community's geographical location?			
What experiences, knowledge, and data are available about the community/beneficiaries of the project?			
How does the partner influence the community's cultural, attitudinal, and behavioural aspects?			
Opportunities:			**Threats**:
How can the strengths and weaknesses be turned into opportunities?			What obstacles does the partner face?
What could be done today that is not being done?			Could any of the weaknesses prevent the partner from succeeding?
Are there initiatives in the community or region to meet social challenges and how can this be taken advantage of those?			Are there threats to the jobs, lives, health, climate change, diseases, etc. of the locals in the community?
Are there new technologies in the local market or in the community that could serve as an opportunity?			Are there competing companies or organisations that could be a threat to the solution or the project?
Can contacts help with the project (such as other NGOs, local entrepreneurs, local experts, the government, etc.)?			Could there be threats to the technology that could impact the solution or project?
Are there changes in lifestyle trends that could be an opportunity?			Are there troubling changes in the business environment and will government regulations affect the project in any way?
What opportunities for business or local ownership are connected to the problem?			Do any of the suppliers or employees cause a threat to the implementation?
Are there any opportunities, such as, geographical, weather, or climate-related?			Is there a risk for key people to leave the project?
			Could political instability threaten the project short or long term?
	O	**T**	

F
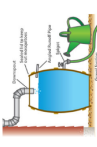
Needs List

	Needs List				
	This list can be used as a template to categorize identified needs and to see where additional information is needed. This list should be filled in continuously during the Feasibility Study until a satisfying amount of needs and aspirations have been identified and listed. Thereafter, read through, analyze, and highlight the most important needs and				
Categories	**Needs List**	**References** (who expressed the need?)	**Comment** (What needs are most important)	**Aspirations** (Related to a need or not)	**References** (Who expressed the Aspiration?)
Additional categories could be price, convenience, efficiency, fairness, transparency, control, options etc.	**1. Functionality**				
	1.1				
The product or service has to function the way the user needs it to in order to solve their problem or desire.	1.2				
	1.3				
	1.4				
	1.5				
	2. Performance				
	2.1				
The product or service needs to perform correctly so the users can achieve their goals.	2.2				
	2.3				
	2.4				
	2.5				
	2.6				
	3. Compatibility				
	3.1				
	3.2				
The product or service needs to be compatible with other products of the user.	3.3				
	3.4				
	3.5				
	4. Esthetics and Design				
	4.1				
	4.2				
The product or service needs a user-friendly and appealing design.	4.3				
	4.4				
	4.5				
	5. Accessibility				
	5.1				
The product or service needs to be accessible both in terms of using it and providing accessible service.	5.2				
	5.3				
	5.4				
	5.5				
	6. Information				
Customers need information, from the moment they start interacting with the product or service to days and months after making the purchase. Thus there is a need to know what type of information they will or could require.	6.1				
	6.2				
	6.3				
	6.4				
	6.5				
	7. Experience				
	7.1				
The needs of the user experience of the product or service and the expectations on it.	7.2				
	7.3				
	7.4				
	7.5				

G

Morphological Matrix Template

Morphological matrix

1. Gather the project team and possibly include the partner or members of the relevant competence team
2. List the identified sub-functions in the column

Take some time to go through solutions in the identified similar projects and what current technical solutions exist the area where the solution will be implemented.

3. Brainstorm and generate a minimum of two sub-solutions to each sub-function.
4. Combine the sub-solutions for each sub-function with one-another, for example sub-function 1 subsolution A + sub-function 2 subsolution C etc.

Project name:
Assessed by:

Sub-function	Sub-solution A	Sub-solution B	Sub-solution C	Sub-solution D
1. Supply of water	Collect rainwater	Lead water from river	Collect groundwater	
2. Storing water	Barrels	Closed Water tank	Pipes underground	
3. Draining water from sto	Garden hose with a nozzle	Tap with a screwing mechanism		
4.				

Generated Concepts		Picture/sketch	Benefits	Drawbacks
Concept 1. Rainwater supp	Collect rainwater, store in a closed water tank and drain the water with a garden hose nozzle.		Easy to construct and maintain. Affordable	Water is dirty and needs filtering
Concept 2. Ground water	Capture ground water, lead in pipes underground, store in a closed water tanke with a tap with screwing mechanism		Access to a steady flow of water Benefits more people	Complex requires skills and resources to implement