CHALMERS
UNIVERSITY OF TECHNOLOGY

Improving Local Sustainability in Manufacturing Industry

A benchmarking study

Master's thesis in Industrial Design Engineering

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CHALMERS UNIVERSITY OF TECHNOLOGY
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Abstract

Because of the ongoing climate change and governance initiatives such as the UN's Agenda 2030, the manufacturing industry transitions towards more sustainable manners, both on a local and global scale. On behalf of Hilti Svenska AB, a supplier of products, systems and services for the professional construction industry, the thesis performs a benchmarking study on different actors regarding their goals and reporting of environmental aspects including emission, circularity, and material handling. Findings from the benchmarking, together with observations in Hilti Svenska AB’s stores and interviews with employees form a basis for a concept improving Hilti Svenska AB’s sustainability work in stores. A concept for improved recycling, decreasing mindless activity, was proposed as well as future recommendations regarding Hilti Group and Hilti Svenska AB’s sustainability work.

Acknowledgement

We would like to express our sincere gratitude to Hilti Svenska AB for providing us the opportunity to conduct our master thesis in collaboration with their organization. We are truly grateful for their support, resources, and the valuable insights they shared throughout the project.

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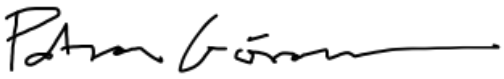

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Terminology

Circular economy
Circular economy (CE) is an economic system companies can adopt to improve in regard to environmental sustainability (Kirchherr et al., 2017). The system proposes that resources should be reused, recycled, or recovered when they have reached their end-of-life. This creates a circular use of resources, in contrast to a linear economy, while still giving economic prosperity.

Environmental sustainability
Sustainability is often divided into three different pillars (Peterdy, 2023). These are Social, Economic and Environment and together they constitute all aspects for a sustainable world. Environmental sustainability includes greenhouse gases, how companies manage natural resources and other physical aspects that affect the climate (Peterdy, 2023).

Key performance indicators
Key performance indicators (KPI) are sets of measurables that can help an organisation to quantify different aspects through monitoring and enhancing specific manufacturing operations (Sherif et al., 2022).

Science based target initiative (SBTi)
This is a corporate initiative where companies can sign themselves up to limit their contribution to global warming by setting emission reducing targets that are aligned with the Paris agreement (Science Based Targets, n.d.). There are experts supporting the companies during the process of getting a target validated to ensure the companies will take appropriate actions to achieve desired outcome.

Actors
In this project an actor is defined as a company whose environmental sustainability work is to be benchmarked and analysed. This includes competitors, resellers, customers, and others. Other stakeholders who have interest in companies' sustainability work but are not a company or are an organisation will be referred to as a stakeholder.

List of Acronyms
- CE - Circular Economy
- GHG - Greenhouse Gases
- GRI - General Reporting Initiative
- KPI - Key Performance Indicators
- NGO - Non-Governmental Organisations
- SDG - Sustainable Development Goals
- SR - Sustainability Report

1. Introduction

Through the last decades, the work for a sustainable environment and societies has accelerated, both on social, economic and environmental levels (UNDP, 2023). Reports have shown that humans impact climate change in a problematic way (IPCC, 2023). Since 2015, all United Nations Member States have adopted the universal agenda of Sustainable Development (UN, 2023a). This to have common sustainable development goals (SDGs) on what to improve and to be able to track the progress. The SDGs contain 17 goals and 230 indicators for how to reach the goals and measure the progress. In addition, the agenda emphasises that the private sector has as big responsibility as governments and civil society for creating change (UN, 2023b).

While the SDGs target changes within poverty, peace, climate crisis and inequality, there are also initiatives and global agreements with a narrower scope. The Paris agreement is a more concrete action plan, compared to the SDG, as it is legally binding and considers how countries should reduce their greenhouse emissions to limit global warming (UNFCCC, 2023). In addition, there are other initiatives that work with even more narrowed missions, such as the United Nations Global Compact who organise and educate companies on how to become more sustainable (UN Global Compact, 2023), and Global Reporting Initiative that is a framework for how companies can report their sustainability work in a transparent way (GRI, 2023).

One initiative for corporate social responsibility is Science Based Targets which are made for companies to reduce their greenhouse gas (GHG) emissions (Science Based Targets, 2023). Another, national initiative is the *Färdplan för fossilfri konkurrenskraft inom bygg- och anläggningssektorn* which is a plan where different big actors in the construction industry in Sweden have coordinated themselves to strive for a net-zero emissions value chain (Byggföretagen, 2018). But even if initiatives such as these encourage change, challenges still remain with transitioning sustainability in a transparent way (Rashed & Shah, 2021), implement the initiatives and, for the individual actors to understand how their actions can make a difference (Rocha et al., 2007). There are also competitive advantages in working with sustainability. Research has shown that there is both a link between how companies perform within environmental, social and governance sustainability and their financial performance (Ortas et al. 2015), and how a circular economy (CE) unites the business sector and policymaking (Rashed & Shah, 2021). Thus, there is an interest in sustainability within the industry.

This thesis will be executed in collaboration with Hilti Svenska AB. Hilti Svenska AB is a part of the Hilti Group which is a company within the manufacturing industry that strives to become more sustainable. They develop power tools, installation systems, anchors, and fire stops, and provide services for professional end-users in the construction industry. They work closely with their clients to create customised solutions worldwide. Hilti Group is a global actor, established in more than 120 countries and they own the entire value chain, including direct sales. On average Hilti Group launches around 60 new products and services yearly, and more than half of machines are sold through their service Fleet Management where they reclaim products after four years to recycle or reuse the components. Hilti Svenska AB is the local affiliate of Sweden and works with a direct sales model as well as proactive engineering services. The Swedish branch rents facilities where they have their offices, 13 stores, warehouses, and a repair shop. The production of tools and recycling of components is in other countries.

Hilti Svenska AB has identified a need to benchmark themselves regarding sustainability in their industry against other actors on the market, as well improve their sustainability work on a local level. On their behalf, we as Industrial design engineering students will in this thesis deliver a sustainability benchmarking as well as a design concept for a local store context.

1.1 Aim and Objectives

The aim is to contribute to future sustainability improvements regarding environmental sustainability and circular economy in the manufacturing industry by comparing Hilti Svenska AB to their competitors and other actors in a sustainability benchmarking, and based on the findings, develop a design concept of an artefact that affects employee behaviour for Hilti Svenska AB's sustainability work within one of their areas of operation.

The project has two separate deliverables where the second is based on the findings of the first. The first deliverable is a sustainability benchmarking and the second is a design concept.

1.2 Research questions

- What environmental sustainability aspects are important in the manufacturing industry and how does Hilti Svenska AB perform in comparison to other actors regarding these aspects?
    - Investigate the landscape of competitors and other actors relevant for the sustainability benchmarking.
    - Identify KPIs that measure different aspects of sustainability and future trends within environmental sustainability.
    - Map out how Hilti Svenska AB performs in sustainability reporting in relation to the actors included in the sustainability benchmarking.
    - Research and grade values that are not clearly, objectively measurable for sustainability targets

- What can Hilti Svenska AB implement to improve environmental sustainability?
    - Perform an empirical study of activities in Hilti Svenska AB's stores to find what practices or behaviours can be improved.
    - Define a list of requirements based on an identified problem.
    - Use the design process to develop a concept for one of Hilti Svenska AB's areas of operation that facilitates employee's ability to behave sustainably.

1.3 Delimitations

Of the three pillars of sustainability - economic, social, and environmental - only the third pillar, environmental sustainability, will be considered in this project. Circular economy will be included as a compliment to study how the companies work with circular economy affects their environmental sustainability.

Geographical delimitations consist of a solution space limited to Sweden. However, the sustainability benchmarking scope includes several global companies, even though the number of Swedish actors is overrepresented due to the operating market of Hilti Svenska AB. When accessible and comprehensive, data from the Swedish companies has been primarily used over group data.

Moreover, the number of actors included in the sustainability benchmarking will be limited due to the size of the project. However, the actors included will be carefully selected to assure the relevance of the sustainability benchmarking. The total number of actors included in the project is eighteen, including Hilti Svenska AB and Hilti Group.

Lastly, the design concept presented will be a suggestion where the level of detail of the design will be limited mainly to focus on functions rather than technical specifications. Also, no testing of the concept will be carried out in stores. The solution space will be within Hilti Svenska AB's areas of operations but will not interfere with the organisational structure, business model, partners, or customer interactions.

1.4 Ethical Considerations

In this project several ethical aspects are relevant to consider. The importance of objectivity will be central as data and written text from the included companies will be collected and interpreted. Objectivity is reinforced through transparency through disclosure of methods and data collection. The collected data originate from public information, called "Communicated information" in this report and includes goals and data. Thus, the actors can have more sustainability information internally which is not accessible for the benchmarking. Still, it is important to present the company information in a proper way, i.e., it is necessary to disclose when data is missing.

This project is conducted on behalf of Hilti Svenska AB and the result will show how they position themselves compared to competitors, customers, and other actors. Although, the project is to be objective and not be partial to the commissioner. Therefore, it is important to present the actors without bias, especially when interpreting written information presented publicly by actors.

Lastly, what is also important to have in mind is that the actors included in the benchmarking is only a selection of actors possible to include in a study like this. Therefore, the result is not applicable to the manufacturing industry. Meaning it is possible that there exists both better and worse actors than those included in the benchmarking.

Regarding the concept development part of the thesis, it is important that the observations and interviews are kept anonymous, as well as not interpreting information in such a way that it does not correspond to the intended meaning of the participants. This, to protect the integrity of the employees.

2. Theoretical Background

This chapter provides the theoretical background necessary for this project, laying the foundation for the subsequent work. It explores the concept of benchmarking, and it delves into the principles and practices of sustainability reporting. Lastly, the chapter examines the concept of nudging and its application in the context of this project.

2.1 Benchmarking

Benchmarking is a method which is commonly described to improve performance and is conducted by companies and organisations which want to use existing ideas to make progress (Lankford, 2002). The method enables companies and organisations to learn from each other to add value to the products and it can differentiate from competitors, to find market gaps and create innovation (Lankford, 2002). Different researchers present different ways to divide the types of benchmarking, but common is that a benchmarking can be performed internally or externally with the purpose of comparing, among other, processes, technology, strategies, or competitors (Lankford, 2002; Bhutta and Huq, 1999; Elmuti and Kathawala, 1997).

2.2 Sustainability Reporting

This section will present different aspects regarding sustainability reporting that are of relevance for this project.

2.2.1 Sustainability reports

A sustainability report (SR) is a company's declaration of its environmental, social, and economic impact (PwC, n.d.), including goals and actions for improvement. Larger companies in Sweden must conduct SRs under the Årsredovisningslagen law if they have over 250 employees, 175 MSEK in balance sheet total or 350 MSEK in net turnover (PwC, n.d.). The Corporate Sustainability Reporting Directive from the European Union, effective from 2023, requires benchmarked companies to comply in their next SR (European Commission, n.d.).

2.2.2 Scope 1, 2 and 3

When working with their sustainability impacts many companies report their emissions through three different scopes. The three scopes were first formulated by the World Resources Institute in their Greenhouse Gas Protocol and has since become an accepted way of classifying and tracking environmental impacts (World Resources Institute & World Business Council for Sustainable Development, n.d.a). The different scopes put different boundaries on how they measure emissions. Scope 1 emissions are direct emissions of the company from controlled or owned sources whereas scope 2 includes indirect emissions from the generation of purchased electricity (World Resources Institute & World Business Council for Sustainable Development, n.d.a). Lastly, scope 3 is other indirect emissions that are a consequence of the activities of the company, both upstreams and downstreams, but occur outside of the company’s control (World Resources Institute & World Business Council for Sustainable Development, n.d.b). Scope 3 often constitutes most a company’s total emissions.

In the three scopes, the emissions from the different activities the scopes cover is being recalculated to CO_2-equivalents so the companies can present a clear number of how much they emit (World Resources Institute & World Business Council for Sustainable Development, n.d.a). The CO_2-equivalents includes, in addition to CO_2, also gases such as CH4 and N_2O which have been recalculated. There are 15 categories in scope 3 covering emissions from both upstream and downstream activities in the value chain.

2.2.3 Definitions of Different Climate Goals

There are several different ways a company or organisation can describe their sustainability goals. These often include expressions and terms which can be hard to differentiate and commonly adopted definitions of these are lacking (Bernoville, 2022). In this project the definitions from Plan A, a software provider for measuring emissions, have been used (Bernoville, 2022).

- The term that covers most is **Climate Neutral** which both include a total reduction of all GHGs, but also eliminate other negative impacts an organisation has on the environment, not limited to emissions.

- **Net-zero emissions** aims to have a balance between released and removed GHGs in the atmosphere. However, **Net-zero carbon emissions** only include carbon dioxide.

- **Climate positive** describes activities that achieve net-zero carbon emissions but also goes beyond and removes additional carbon dioxide from the atmosphere. **Carbon negative** is often used as a synonym for climate positive.

- **Carbon neutral** is a term that describes when activities of a company remove as much CO_2 into the atmosphere as they release.

- Bernoville (2022) recommends avoiding the term **Carbon Positive**. This is because it is often used as a marketing term for describing climate positive and carbon negative.

2.2.4 Reporting Standards in Industry

Through the industry, companies have adopted different ways of reporting their sustainability work. Some do it more extensively through sustainability reports while others present information on their website. Different standards for reporting sustainability work are becoming common, and there are a few different standards used among the actors in this project. This section presents four standards for reporting: General Reporting index (GRI), GHG Protocol, NASDAQ ESG 2.0 and the International EPD System.

The GRI standards are tools for businesses and other organisations to communicate how they practise sustainability development and give them a common language for reporting this (GRI, n.d.a). The purpose of the standards is for the companies to be transparent when reporting towards their stakeholders and the standards are divided in three categories; Topic, Sector and Universal standards (GRI, n.d.b). If one chooses to report according to GRI Reports it must contain a GRI content index stating what they do and what not, to be able to track and disclose data and omissions (GRI, n.d.b).

The different indicators within the GRI Topic standards cover areas as environmental and social factors (GRI, 2022). So, when a business decides to report according to the GRI they ideally should cover all aspects. The GRI Topic standards include core business subjects as Economic performance but also environmental topics as Materials, Energy, Water and Effluents, Biodiversity, Emissions, Waste and Supplier Environmental Assessment. In addition, there are also social topics as Non-discrimination or Employment.

Another internationally used standard is the GHG protocol (Greenhouse Gas Protocol) which offers standards for measuring emissions. With origins from the 90s, GHG protocol is widely used, offering standards for both the business sector and on a governmental level (World Resources Institute & World Business Council for Sustainable Development, n.d.). Since the focus of the GHG Protocol, the standard provides extensive tools for tracking and reporting different emissions divided into the scope 1, 2 and 3. The standard also provides tools for calculating GHG emissions.

The guide NASDAQ ESG 2.0, provided by the stock market NASDAQ, provides companies with considerations within the three sustainability aspects Environmental, Social and Governance (ESG) to increase the company's ability to create business strategies and long-term value with focus on sustainability (Nasdaq, 2019). To use the guide is voluntary but can be included in what potential investors evaluate.

The Environmental part of the NASDAQ ESG 2.0 includes KPIs regarding Emissions, Energy, Water Usage, and different aspects which considers environmental operations, management and Climate Risk Mitigation. When the GHG emissions are reported in the NASDAQ ESG 2.0 the GHG Protocol standards for scope 1, 2 and 3 are used (Nasdaq, 2019).

Lastly, the International EPD system is a framework containing an environmental product declaration which describes different sustainability aspects based on a life cycle analysis of environmental performance of a product or service (EPD International AB, n.d.). The framework developed from the ISO 14025 and is verified by a third party.

2.2.5 Trustworthiness of Sustainability Reports

Sustainability reporting is becoming more important for companies, however that does not mean that global climate problems are decreasing. (Pucker, 2021) In recent years, the number of companies reporting according to the GRI standard has accelerated but CO_2 levels have continued to rise. When it comes to the reports, most companies lack auditing by an impartial part. Further, aims set by companies are usually based on their own ambitions rather than what science says, however initiatives such as *Science Based Targets Initiative* strive to align goals with science. Pucker states (2021) that the consumer might also be confused by the numbers presented in a report since it can be hard to understand a value without a comparison that is understandable to the consumer.

2.2.6 Trends in Sustainability Reporting

Sustainability reporting is constantly evolving as its importance continues to grow and several trends can be identified. In research made on sustainability reporting, some recurring characteristics of sustainability reporting have been recognized (Zrnić et al., 2020). Zrnić et al. (2020) describes Impact as the leading characteristic. However, the authors state there are some characteristics that are not yet explored to a higher extent. These characteristics are *indicators, materiality, communication,*

assurance, and boards. Presenting these as relatively unexplored, they are pointed out as a starting point for identifying new trends in sustainability reporting (Zrnić et al., 2020).

Sustainability reports are usually only audited by an accountant, especially when conducted together with the annual report. (Alsahali & Malagueño, 2022) However an emerging trend is to have them audited by a third party that is not only an accountant. It is further stated that having a sustainability report audited by a firm that is not only from the financial side but has other qualities in understanding the complex nature of the content of a sustainability report, that is also becoming increasingly extensive, is key to having a higher level of auditing.

An article from *Forbes* (Galer, 2023) forecasts that 25 percent of companies globally will spend more on technology for sustainability in 2023 compared to past years. Another trend Forbes presents is the increase of companies using "digital product passports". The digital product passports are described as *"Essentially a digital thread, passports will track the product's carbon footprint, waste, liability and risk, and more, sharing information company-wide and with suppliers and regulatory agencies."* (Galer, 2023).

2.3 Nudging

Caraban et al (2019) describes 4 categories of nudging: *manipulate choice, manipulate behaviour, prompt reflective choice, and influence behaviour*. These can be used to change practices of people. Further Caraban et al describe several nudging approaches. One of them is throttling mindless activity, where the user is given the option to reflect on a choice, enabling change of the choice or cancellation of the choice. This theory has been relevant in this project when developing a concept for better environmental sustainability in the stores.

In a study made by National University of Singapore, so called "speedbumps" were added to recycling bins to prevent individuals from sorting waste incorrectly. This resulted in a 14 percent reduction of incorrectly sorted materials in the bin for metals, however the same "speedbump" resulted in no change in correct sorting when it came to bins where plastics should be recycled.

Berlin and Adams (2017) states that when using colour coding informative content, it is important to not fully rely on colours when designing due to individuals that might not perceive the difference of the colours in the way that would have an effect, such as colour blind individuals. It is therefore an idea to add other elements that can inform alongside colour coding. Further Berlin and Adams explains the importance of taking a human's vision field into accountancy when designing. Informative elements should be designed so that the human can perceive it from their perspective. The author also states that different stimuli should be clearly distinguishable when corresponding to different functions.

3. Methodology

This chapter begins with a description of the procedure. This includes the proportions between the different stages of the project and how the stages relate to each other. After that follows the different methods that have been used in this project.

The procedure of this project went through several different stages (Figure 1). As mentioned in the introduction and aim, there are two main deliverables of the project: a sustainability benchmarking and a design concept. The second deliverable is based on the findings from the first deliverable.

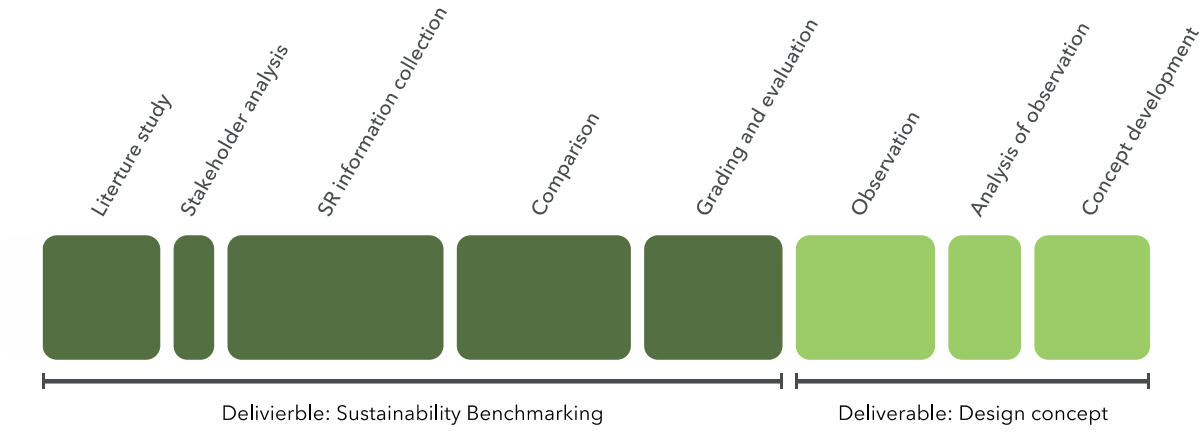

Figure 1: The different stages of the project have varied in extent.

The outputs from one stage became inputs for the next (Figure 2). A literature study and stakeholder analysis conducted at the beginning provided insights on environmental aspects and relevant actors for benchmarking. From studying sustainability reports, data was collected to grade and evaluate the position of Hilti Group and Hilti Svenska AB compared to the other actors.

Thereafter, the sustainability benchmarking insights were applied to identify areas for improvement in Hilti Svenska AB. These areas were observed in stores to determine the most impactful and feasible problems. A concept development process was then conducted to address the selected problem.

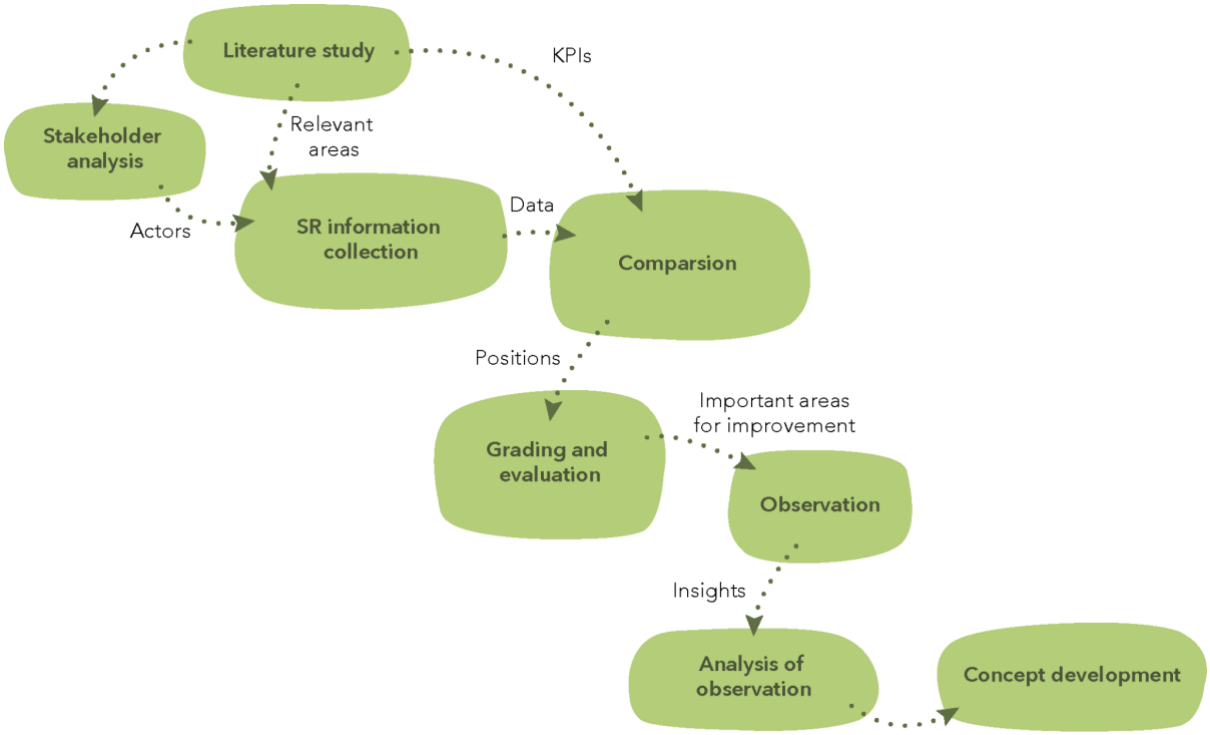

Figure 2: The output from one stage became input in the next

In the following sections the different methods used in the project will be presented. First comes methods regarding research such as data collection and literature study. Then, methods used for benchmarking and lastly, methods used when developing a design concept.

3.1 Data Collection

The data that constitute the sustainability benchmark was extracted from public resources. Table 1 declares the origin of the data. Primarily sustainability reports (SR) were collected when they were available. In some cases, additional information was retrieved from the actors' website. Where no SRs were found, information on the corresponding website was used exclusively. It differs in if the included actors do a SR or if they are included in a SR of their group. Where it was not possible to find a SR for an actor but one for the group, the SR of the group was used. Since the retrieved information is from public resources exclusively, there is a possibility that the actors do more internally than what is communicated outwards. To ensure a fair evaluation of the retrieved data, actors whose data have not been found received "Not found" or "N/A" rather than "No". This is because of the possibility that the actors are doing more internally than what they communicate outwards and thus, it is only possible to say what they do and not what they do not do.

The data collection was conducted during March 2023. This means that many actors had not published a SR for the previous year yet. Therefore, all sustainability reports except Beijer Bygg (STARK Group), whose SR contains data from 2022, contain no data newer than 2021. Fischer Group has named their SR by the year of publication, but it contains data from 2021. In addition, where information regarding goals has been extracted, goals for 2023 are perceived as short-term goals because even though it is 2023 in the time of writing, the data is from 2022 or earlier.

In two cases, Würth and Husqvarna, the information about considered SDGs was retrieved from their respective websites instead of their SR. This is because they did not include SDGs in their SR but clearly discussed them at the website. Likewise, the Circularity Goals of Patagonia Inc. was retrieved from their website.

Lastly, in the case of Hilti Svenska AB and Dahl (Saint Gobain Sweden AB) their respective global group represents the companies in the Science Based Target initiative (SBTi). Moreover, the data for SBTi was retrieved from the website of Science Based Target which is regularly updated with the latest information (Science Based Targets, 2023). Consequently, data regarding goals can differ between the Science based target website and actors SRs depending on publication date of the SRs. Therefore, the SBTi goals are not included when grading the overarching emission and circularity goals of the actors to be able to compare the actors regardless of if they have signed SBTi or not.

Table 1: Origin of data from the different actors used in the sustainability benchmarking

Declaration of data collection					
	Title of reference	**Year of public-ation**	**Region**	**Additional information**	**Note**
Hilti Group	Sustainability Report (2021)	2022	Global		
Hilti Svenska AB	Hållbarhetsredovisning 2021	2022	Sweden	Company included in SBTi of Hilti Group	
Milwaukee Tool (TTI group)	Environmental, Social and Governance Report 2021	2022	Global		
Würth Svenska AB	Hållbarhetsrapport 2021	2022	Sweden	Additional information regarding SDGs retrieved from: https://www.wuerth.com/wuerth-group/responsibility/Sustainability/Sustainability.php	SDGs retrieved 23-03-30
Fischer Group	Sustainability management by the group of companies 2022	2022	Global		Named 2022, but declares for 2021
Walraven Nordic AB	N/A	N/A	N/A		
Husqvarna Group	Sustainovate progress report 2021	2022	Global	Additional information regarding SDGs retrieved from: https://www.husqvarnagroup.com/en/sustainability	SDGs retrieved 23-03-30
Firesafe Sverige AB	https://www.firesafe.se/news/miljopolicy/		Sweden		Retrieved 23-03-30
Ahlsell	Sustainability Report 2021	2022	Global		
Beijer Bygg (STARK Group)	Sustainability Report 2022	2023	Global		
Dahl (Saint Gobain Sweden AB)	Hållbarhetsåret 2021	2022	Sweden	Company included in SBTi of Saint Gobain Group	

Skanska AB	Års- och hållbarhetsredovisning 2021	2022	Global		
Ramirent (Loxam Group)	CSR Overview 2021	2022	Global		
Bravida Holding AB	Årsredovisning och hållbarhetsredovisning 2021	2022	Global		
Best in class					
Specsavers Sweden AB	https://www.specsavers.se/om-specsavers/hallbarhet/standpunkt		Sweden		Retrieved 23-03-30
Schnitzer Steel Industries Inc	2022 Sustainability Report Recycled Metals for a Low-Carbon Future	2023	Global		
Essity AB	Års- och hållbarhetsredovisning 2021	2022	Global		
Patagonia Inc.	Annual Benefit Corporation Report FY 2021	2022	Global	Additional information regarding circularity goals retrieved from: https://eu.patagonia.com/hr/en/stories/our-quest-for-circularity/story-96496.html	Circularity goals retrieved 23-03-30

3.2 Literature Study

A literature study was conducted to identify relevant research of environmental aspects of the industry. The strategy for finding relevant research papers was done as follows. An outline of the strategy can be seen in figure 3 and table 2 shows the criteria selection for the literature review.

At the research database Scopus.com different keywords were used to find papers. An initial search with the keywords “sustainab*”, “benchmark*” and “indicator” generated 2361 results (figure 3). To narrow the result further the keyword “manufact*” was added which gave a more manageable number of results.

Since sustainability is a research area which is developing fast, the search result was limited further to only include results within the years of 2016-2023. Thereafter, the title and abstract of the top 40 most cited papers were read to identify relevant information. In addition, all titles and abstracts of papers published during 2022 and 2023 were also scanned since they have not had the opportunity to reach a high number of citations due to the limited time since their date of publication. Additionally, a few papers were selected based on recommendations from an expert on the area and snowballing from already selected articles.

The result became eleven articles which discussed information regarding KPIs in the manufacturing industry and how the industry could improve regarding environmental sustainability. The included literature focuses on processes, facilities, or product categories rather than products. Also, the geographical scope of the literature is not limited to a specific country or facility to have information of industry wide KPIs.

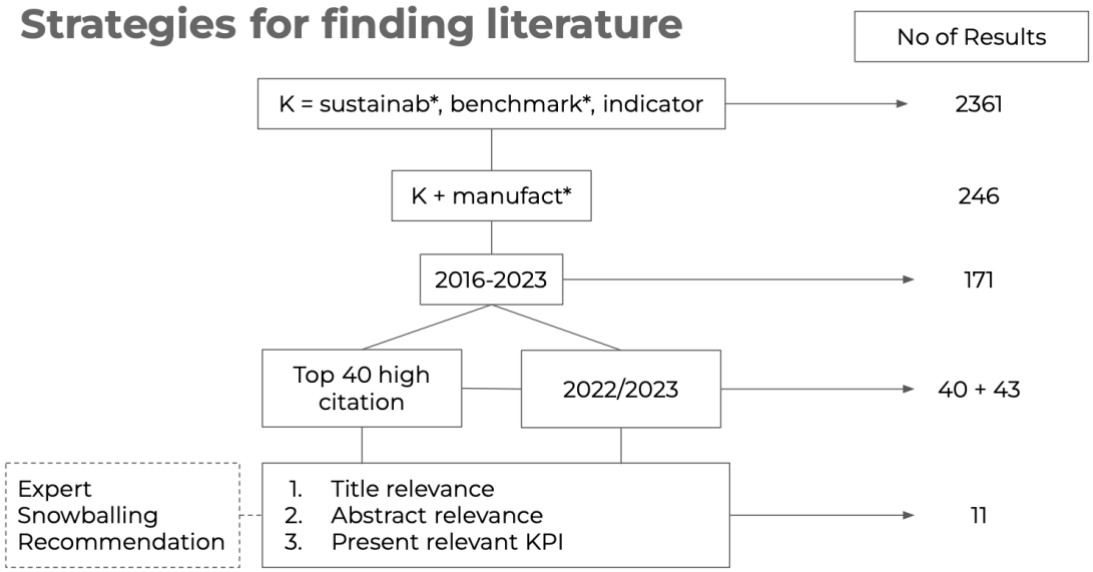

Figure 3. Strategies for finding literature

Table 2: Criteria selection for literature study

Keywords	**Year**	**Citations**
TITLE-ABS-KEY (Sustainab* AND Benchmark* AND indicator)	PUBYEAR > 2015	
TITLE-ABS-KEY (Sustainab* AND Benchmark* AND indicator AND manufact*)	PUBYEAR > 2015	Top 40 highest citation
TITLE-ABS-KEY (Sustainab* AND Benchmark* AND indicator AND manufact*)	PUBYEAR = 2022 OR 2023	

3.3 Benchmarking

As mentioned in the theoretical background (section 2.1), a benchmark can be performed in different ways depending on what is of relevance. In this project, an external benchmarking, where the position of Hilti Group and Hilti Svenska AB will be compared with other actors with focus on sustainability reporting, was performed.

Lankford (2002) describes different steps that can be included in a benchmarking. The first step is to identify what to benchmark and which actors to include in the benchmark. The actors should ideally help to discover possible improvements. Then, one should study what the actors do and collect the data for further analysis. When the data is analysed and improvements found, the last step is to implement changes in their own organisation (Lankford, 2002).

3.4 Stakeholder and Actor Analysis

There are different methods of defining what a stakeholder is. Some refer to stakeholder as only those who can have a direct impact on an organisation, while others include those who are essential but without influence.

Stakeholder analysis is important due to globalisation (Bryson, 2007). The paper presents different groups of stakeholders selecting: *"organising participation; creating ideas for strategic interventions;*

building a winning coalition around proposal development, review and adoption; and implementing, monitoring and evaluating strategic interventions." Bryson explains several methods for different purposes but as the simplest form of stakeholder analysis he presents "The basic stakeholder analysis technique", a simple technique to make a basic stakeholder analysis.

Reed et al. (2009) emphasises that not every step of a stakeholder analysis needs to be carried out depending on how well the scope of the analysis is defined from the start. It is further stated that for different contexts, the stakeholders may vary. This since not every potential stakeholder is always relevant for a benchmarking in general.

In this project, a stakeholder analysis was made through *The basic stakeholder analysis technique*, consisting of an eight-step process with the goal of identifying relevant groups of stakeholders (Bryson, 2007). The analysis was carried out with focus on stakeholders that have an indirect influence on decisions or changes connected to sustainability rather than stakeholders that are directly affected by decisions or changes.

In addition, actors in other industries whose sustainability work stands out were sought out by looking at different rankings. Shen and Liu (2014) describe these types of actors as a group of actors performing exceptionally in a specific area.

3.5 Grading and Comparison

To be able to compare the actors' sustainability goals and quality of different aspects of their sustainability reporting, a maturity model was used. Baumgartner and Ebner (2010) created a maturity model for corporate sustainability where they defined four levels of maturity to be able to apply the same grades, Beginning, Elementary, Satisfying and Sophisticated, on different aspects of sustainability with consistent proportions between the grades, regardless of sustainability aspect.

Baumgartner and Ebners' four levels of maturity is intended for corporate aspects to evaluate strategies (2010). This high-level approach is applicable on this project since the data analysed partly consists of goals and different ways of reporting, retrieved from the actors' SRs and websites, are not stated in words rather than numbers. The four levels were used as a foundation for formulating scales for grading the three aspects: Communicated overarching emission goals, Communicated overarching circularity goals and scope 3 reporting. This to ensure the grading considered how actors communicate objectively and not interpreting the content subjectively. Table 3 reproduces Baumgartner and Ebers' (2010) four levels of sustainable maturity of which was used when grading overarching emission goals, overarching circularity goals and scope 3 reporting in this project (section 4.3.2 and 4.3.3).

Table 3: A compilation of quotes from Baumgartner and Ebners' paper *Corporate sustainability strategies: Sustainability profiles and maturity levels* (2010. p 81).

Level 1 Elementary	Level 2 Beginning	Level 3 Satisfying	Level 4 Sophisticated
"...stands for a rudimentary level, maybe beginning consideration of the sustainability aspect in the company, which means that - if existing - only mandatory rules and laws are respected."	"...an elementary integration of this aspect is focused on compliance with sustainability-related laws but going slightly further (e.g., due to environmental technology, reduction and consideration of impacts of their business activities)"	"... a satisfying consideration and maturity of the specific sustainability aspect (often above the industry average)".	"Sophisticated maturity implicates an outstanding effort towards sustainability."
Baumgartner & Ebner (2010)			

3.6 Empirical Study in Local Stores

From the results from the sustainability benchmarking, the takeaways will be a starting point for the design process leading to a concept. These methods were used when performing an empirical study in the stores of Hilti Svenska AB. Johannesson et al. (2013, p. 141) describes the method where one visits the site where the problem is, or the design concept should be used. This to get an understanding of the situation, have the possibility to ask questions and observe the environment. The authors add that before making use of this method, it is good to have done some research to know what areas to investigate when visiting the site.

The study contained both observation and interview. An observation is when the researcher observes and gathers information about user behaviour (Karlsson, 2007). An observation can be performed in different ways. For this project the observation was open and natural. Meaning those who were being observed were aware of it and the observation took place in the actual environment. The observation was combined with an unstructured interview to collect qualitative data supported by an interview template. An unstructured interview lets the responder answer questions freely and is a more appropriate method when the focus is on feelings and experience (Karlsson, 2007). Unstructured interviews result in qualitative data. Employees from two stores were observed and interviewed.

3.7 Problem Definition

When the qualitative data from observations and interviews were analysed, all comments were gathered, read through and reduced. An affinity analysis, also called KJ-analysis, was conducted to structure a large amount of verbal data from empirical studies or open-ended responses in a survey (Karlsson, 2007). The purpose was to group data to identify patterns and obtain a comprehensive overview of the results in an effective way. This method is useful when searching for different groups of issues or requirements that the user has. In this project, sentences from the observation notes and interview responses were separated on interactive post-it notes.

From the affinity analysis, problems and requirements were identified and structured in a problem chart, displaying core problems and consequential problems, and their relation to each other. Then the problems were evaluated after impact and feasibility within Hilti Svenska. This led to a problem definition.

3.8 Ideation and Concept Development

Before creating a concept, a requirement list was conducted. A requirement list is a compilation of the collected information about the problem and users which is used in product development (Johannesson et al., 2013, p. 118). This list specifies the requirements and wishes the final product should meet, where the requirements must be met, and the wishes can be more or less fully satisfied. In this project, the list was also used as a tool when evaluating the final solution to the defined problem. To do so the wishes were classified 5 to 1 where 5 is most important and 1 is less important.

After the requirement list the ideation stage took place through brainwriting and brainstorming. Brainwriting is a collaborative idea generation method where individuals initially brainstorm individually before sharing their ideas with the group (Österlin, 2016). It encourages building upon each other's ideas to foster a broader range of solutions. Criticism of ideas is discouraged, promoting an open-minded approach. Unlike brainstorming, which starts as a group activity, brainwriting allows individual idea generation before group collaboration (Österlin, 2016).

To get more ideas and develop ideas the method SCAMPER was used. SCAMPER is an ideation method used to stimulate new perspectives to come up with new ideas and approach the problem from different angles (Österlin, 2016). This to enhance creativity and keep the ideation process dynamic. SCAMPER is an acronym for the set of general questions, Substitute, Combine, Adjust, Modify, Put to other uses, Eliminate, and Reverse.

After several ideas had been conducted, they were evaluated based on the three criteria’s impact, feasibility and realistic. Some ideas were eliminated in this stage.

Kesselring matrix is a method for evaluating design concepts or solutions based on the requirements from the requirement list (Johannesson et al., 2013, pp. 189-191). It helps identify the concept that closely aligns with the ideal imagined concept and identify weaknesses with the concepts. Ultimately, all concepts except the one with the highest points are eliminated, and the remaining concept is selected for final development.

Additionally, 3D-modelling tools were used to visualise the final concept. These images were then used to evaluate the concept with potential users. Lastly, to get a second round of input from the employees in the stores, a participant validation was carried out. The purpose of this step is to see what impact the employees think it would have on their behaviour, and what impact an implementation might have. Questions regarding the functions of the concept were prepared, focusing on possible behaviour change and acceptance. Further, a discussion was held with the employees regarding their view of a possible outcome, and if a success rate of 100 percent correct recycling is possible.

4. Result

This chapter presents the results from the sustainability benchmarking and the design process. It will cover a big perspective on sustainability in the benchmarking, investigate what aspects that are important for environmental sustainability in the manufacturing industry and look into different types of actors and their sustainability reporting, goals, and ambitions. This is done to establish Hilti Group's and Hilti Svenska AB's position compared to other actors regarding emission and circularity goals and scope 3 reporting.

Then the takeaways from the benchmarking were used to see how an improvement in the stores of Hilti Svenska can be proposed. The result of the design process contains a concept of a physical obstacle which is supposed to support a more thoughtful behaviour when handling material and sorting waste.

4.1 Literature Study of Key Performance Indicators

The sustainability of the manufacturing industry is influenced by many different aspects. Veleva and Ellenbecker (2001) describe sustainability indicators to address the different dimensions of sustainability. These are often called Key Performance Indicators (KPI). Several studies have tried to identify which types of KPIs that are most relevant to follow up for companies in the manufacturing industry to become more sustainable. Joung et al. (2013) has created categories of indicators for the manufacturing industry to use when evaluating processes and products. The authors (Joung et al., 2013) explain that a KPI is characterised by being Measurable, Relevant, Understandable, Reliable/usable, Data accessible, Timely manner and Long term-oriented and they collected KPIs from different indicator sets to categorise. Under the dimension of environmental stewardship, Joung et al. divide KPIs into the categories Emissions, Resource consumption, Pollution and Natural habitat conservation (Joung et al., 2013). When Cagno et al. (2019) tried to create a framework where they emphasised the need of detailed KPIs over generic KPIs for environmental sustainability. They divided the KPIs in the categories Water, Material, Energy, Air emissions, Waste and Environmental management (Cagno et al., 2019). Kravchenko et al. (2019) also divided environmental performance indicators in categories. Their categories were Air pollution, Energy consumption, Gaseous emissions, Land use, Liquid waste generation, Material consumption, Material safety, Product architecture and Soil pollution (Kravchenko et al., 2019). Common for the three papers are that they all include different emissions, energy, and material consumption.

Edtmayr et al. (2016) states that when non-renewable energy has been used, it has an impact on the GHG emissions and thus, both energy and emissions can be used as indicators for sustainability. Several papers also highlight the use of energy as an important way of determining environmental sustainability. Latif et al. (2017) states that when it comes to predicting sustainability, energy efficiency is the foremost indicator. Papetti et al. (2019) describes the need of monitoring resource and energy efficiency to be able to describe complex energy systems in a life cycle perspective. Wang et al. (2018) agrees with Pepetti et al. (2019) and identifies three sets of indicators for production systems, *Energy consumption, Energy Cost* and *Energy efficiency*.

Moreover, related to material consumption is both resource use and waste. Despeisse et al. (2013) state that through efficient use of resources companies can reduce the environmental impact and to do so, the companies can start by preventing the use of resources, reduce waste and improve resource

efficiency and reuse the generated waste. Lastly, the authors propose to investigate changes of supply or process to improve sustainability (Despeisse et al., 2013). Latif et al. (2017) agrees with Despeisse et al. (2013) and explains that in the manufacturing industry, there are several areas that generate waste, and these must be reduced to improve the environmental sustainability.

In addition, Kibira et al. (2018) describes that to improve environmental sustainability of a manufacturing process it is important to look at organisational sustainability goals. This to identify what KPIs to measure and to assure that the objectives of the KPIs are aligned with the goals. Sherif et al. (2022) draws the same conclusion as Kibira et al. (2018), that to know which KPIs to measure, a general environmental goal must be determined. Thereafter, a company can identify what metrics to reduce or substitute within their process's input, operation, or output (Sherif et al., 2022). Kibira et al. (2018) also emphasises the importance of ranking the relevant KPIs to see which is most efficient in terms of sustainability assessment to ensure that the wrong KPIs are not measured. This aligns well with Veleva and Ellenbeckers' (2001) ideas that "...it is better to measure the right things approximately than the wrong ones with great accuracy and precision" (p. 520).

4.2 Stakeholder Analysis

The selection of benchmarking actors was explored through a stakeholder analysis. Actors refer to companies whose environmental sustainability reporting was analysed. Figure 4 illustrates the process of narrowing down the selection of actors.

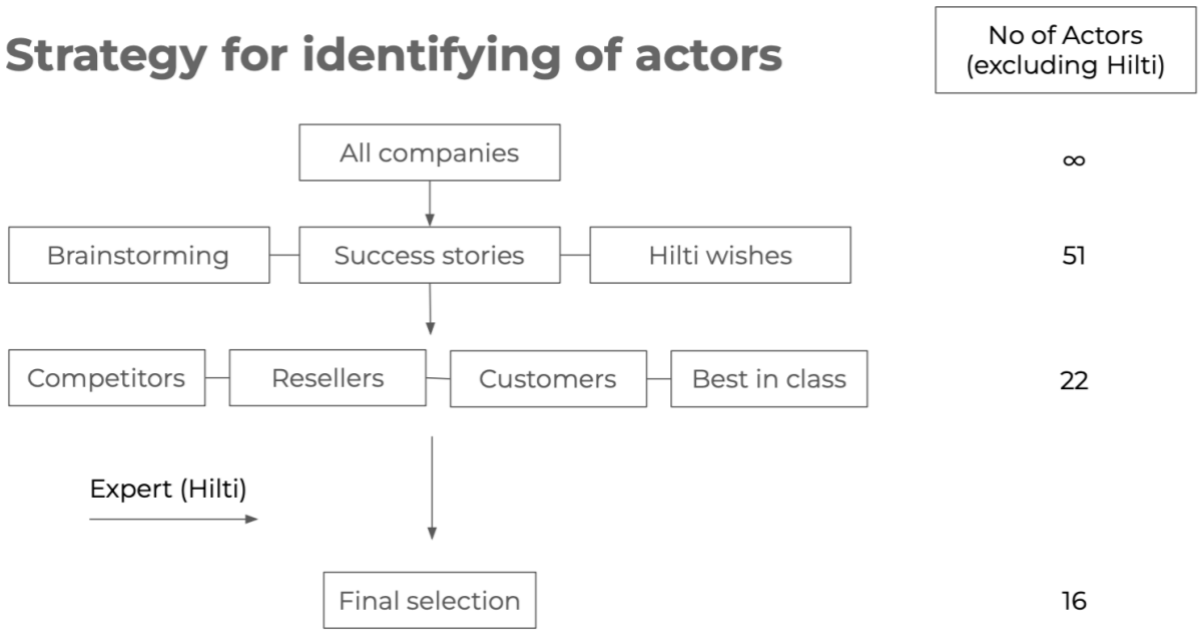

Figure 4: Strategy for identifying actors and final number of actors

Potential candidates were gathered from a sector-specific brainstorming session involving actors like Hilti Group and Hilti Svenska AB. In addition, Hilti Svenska AB had priorities on what actors to include in the sustainability benchmarking. Considering their expertise in the area, knowing their competitors, customers and resellers, the opinions of Hilti Svenska AB has been considered in the process of selecting actors from these three groups to benchmarking (table 4).

In addition, the actors in other industries whose sustainability work stands out constitute the group Best in class. One ranking was Corporate Knights' list of 100 most sustainable companies of 2023

(Scott, 2023), where the number one company, Schnitzer Steel Inc., and the highest ranked Swedish company, Essity AB, were included. Also, the top ranked company at the list of Best Swedish Employer 2022, Specsavers Sweden AB, was included (Great Place to Work, 2023). This is because Hilti Svenska AB has held this position before but fallen to third place. Lastly, Patagonia Inc. was included in the Best in Class category based on their nomination for the Entrepreneurial Vision Adward in 2019 (UNEP, 2019), and their gained reputation as a sustainable brand (Gelles, 2022).

To summarise, this resulted in 18 actors including Hilti Group and Hilti Svenska AB (table 4). Four actors constitute the group Best in Class.

Table 4: Actors included in the benchmarking

	Manufacturing and Construction Industry	**Best in Class**
Company	Hilti Group Hilti Svenska AB Milwaukee Tool (TTI group) Würth Svenska AB Fischer Group Walraven Nordic AB Husqvarna Group Firesafe Sverige AB Ahlsell Beijer Bygg (STARK Group) Dahl (Saint Gobain Sweden AB) Skanska AB Ramirent (Loxam Group) Bravida Holding AB	Specsavers Sweden AB Schnitzer Steel Industries Inc Essity AB Patagonia Inc

4.2.1 Potential Employees and Non-Governmental Organisations

The stakeholder analysis resulted in some additional stakeholders that could affect decisions and ambitions regarding environmental sustainability of a company in the manufacturing industry, that are not other companies. These are potential employees and Non-Governmental Organisations (NGOs).

Potential employees are increasingly demanding that a company prioritises sustainability for them to want to work there. According to research made by *IBM*, around 70 percent of potential employees globally would be more prone to seek a position if they see the company as a sustainable company regarding environmental sustainability. (IBM - Institute for Business Value, 2021) The same research shows that around 50 percent of potential employees have a higher probability to even accept a lower salary if they see the company as sustainable regarding the environment.

A more local angle is *Svanen* that presents data in their *"The Nordic Swan Ecometer 2019".* (Svanen, n.d.) According to them, it is mostly the younger employees that have a higher demand on the sustainability focus of companies. Further it is said that a negative perception of the sustainability work of a company could be because of poor communication, and that communication is key in the area.

To summarise, the information from IBM and Svanen lifts the importance of good communication made by a company. What a company does and what the view of a potential employee are two separate things. These are examples of the importance of being transparent with the sustainability

work that the company does through, for example, a sustainability report or a sustainability page on a company's website.

In addition to the potential employees, the interest of NGOs is also important to consider. NGOs usually emphasise the importance of complying with laws and regulations regarding environmental sustainability. There are however examples when they wish to push companies even further.

For example, the World Wide Fund for Nature, *WWF*, presents several reasons why companies should do more in the area of biodiversity, such as financial aspects and company reputation (Church, 2022). Another example is the World Resource Institute, *WRI*, that encourages companies to speed up the process of carbon pollution removal (Baltz, 2023). They state that the world is still far behind and needs to increase the focus of removing or capturing carbon pollution from the air.

4.3 Grading and Evaluation of Benchmarking Data

This section will treat the grading and evaluation of the actors in regard to sustainability reporting, emission and circularity goals, the scopes, SDGs and environmental KPIs.

4.3.1 How Actors Report Sustainability Aspects

To be able to compare the included actors one must acknowledge that they use different systems for reporting their sustainability data. A great majority of the actors provide annual or bi-annual sustainability reports while some solely refer to a webpage. In one case, Walraven Nordic AB, environmental sustainability information was not found.

In total, nine of eighteen actors use the GRI framework, one of which describes how they recently have started to use the framework, but not reported according to it yet (table 5). GRI is by far both the most common way among the included actors to report sustainability data, but also the most extensive reporting system used. Other ways of reporting are the NASDAQ's ESG Reporting Guide 2.0 and the International EPD System. A few included actors exclusively report their GHG emissions according to the methodology of the GHG Protocol. The GRI framework and the NASDAQ's ESG Reporting Guide 2.0 are the most extensive reporting systems occurring in this project followed by the International EPD System. If an actor has more extensive reporting, they provide a great number of KPIs, declare their change over time and present clear goals.

Table 5: Compilation of how the actors report environmental sustainability aspects

How do actors report sustainability aspects?							
Primary Swedish sustainability reports have been used. Where such has not been found, a global or group SR has been used.	**More extensive reporting**						**Less extensive reporting**
	SR including reporting according to GRI index	*SR including reporting according to NASDAQ's ESG Reporting Guide 2.0.*	*SR including reporting according to International EPD System*	*SR including reporting according to methodology of GHG Protocol*	*SR with own framework for reporting*	*No public SR found. Information retrieved from webpage.*	*No information regarding environmental sustainability found*
Hilti Group	X						
Hilti Svenska AB	X						
Milwaukee Tool (TTI group)	X						
Würth Svenska AB	X*						
Fischer Group				X**	X**		
Walraven Nordic AB							X
Husqvarna Group	X						
Firesafe Sverige AB						X	
Ahlsell	X						
Beijer Bygg (STARK Group)		X					
Dahl (Saint Gobain Sweden AB)			X				
Skanska AB	X						
Ramirent (Loxam Group)					X		
Bravida Holding AB				X			
Best in class							
Specsavers Sweden AB						X	
Schnitzer Steel Industries Inc	X						
Essity AB	X						
Patagonia Inc.					X		

* Has recently (2021) started to collect data according to GRI but not begun reporting it yet

** Reports the scopes according to GHG Protocol but an own reporting framework for other aspects

4.3.2 Emission and Circularity Goals

Information regarding the actors' emission and circularity goals were compiled and graded after two scales developed from Baumgardner and Ebners' (2010) four-level maturity grid. Table 6 and 7 shows the different levels for the two aspects. The information collected was the overarching goals for

emissions of CO_2 and GHG and circularity within the organisations communicated to the public. If actors have internal goals or ambitions, these are not represented in the evaluation.

Table 6: Grading scale for emission goals

	Beginning	**Elementary**	**Satisfying**	**Sophisticated**
Communicated Overarching Emission goals	No communicated CO_2/GHG emissions goal	Communicated CO_2/GHG emissions goal with defined year for achievement	Communicated long term CO_2/GHG emissions goal >10 years in the future and near-term CO_2/GHG emissions goal <10 years in the future	Communicated Net Zero emissions/Climate Neutral goal with defined year and near-term emissions goal <10 years in the future

Table 7: Grading scale for circularity goals

	Beginning	**Elementary**	**Satisfying**	**Sophisticated**
Communicated Overarching Circularity goals	No communicated circularity goal/ambition	Communicated goal/ambition in circularity for some area of the organisation	Communicated circularity goal for the entire organisation with a defined year for achievement.	Communicated long term goal >10 years in the future and near-term circularity goal <10 years in the future

The result is presented in Table 8 and shows that regarding emissions goals, the actors vary from Beginning to Sophisticated with Husqvarna, Beijer Bygg (STARK Group), Essity AB and Skanska AB is graded highest because they have both a near- and a long-term goal of when they will reach net zero emissions. On the other side, Würth Svenska AB, Fischer Group, Walraven Nordic AB and Firesafe Sverige AB do not communicate any emissions goals and are thus graded with Beginning.

In contrast, the compiling of the actors' circularity goals shows less variety between the actors. 13 of the actors reach the grade of Elementary, which shows they have ambitions or goals to transit towards a more circular economy, but no actor defines a deadline for when they will achieve this. Consequently, no actors reach the two higher grades.

Table 8: Grade of goals. B - Beginning, E - Elementary, S - Satisfying, SO - Sophisticated

Goals		
	Communicated Overarching Emission goals	**Communicated Overarching Circularity goals**
Hilti Group	S	E
Hilti Svenska AB	S	E
Milwaukee Tool (TTI group)	E	E
Würth Svenska AB	B	E
Fischer Group	B	B
Walraven Nordic AB	B	B
Husqvarna Group	SO	E
Firesafe Sverige AB	B	B
Ahlsell	E	E
Beijer Bygg (STARK Group)	SO	E
Dahl (Saint Gobain Sweden AB)	S	E
Skanska AB	SO	E
Ramirent (Loxam Group)	E	B
Bravida Holding AB	S	E
Best in class		
Specsavers Sweden AB	S	B
Schnitzer Steel Industries Inc	E	E
Essity AB	SO	E
Patagonia Inc.	E	E

4.3.3 Scope 1, 2 and 3

Since scope 1, 2 and 3 includes both direct emissions, emissions from purchased electricity and emissions from the up- and downstream value chain, if and how well the actors track and report these was studied (Table 9). This all to get an understanding of how aware the actors are of one of their biggest climate impacts. The actors can collect the data for scope 1 and 2 internally, but for scope 3 more collaboration with external actors as suppliers and customers is needed. This results in a variation of how and what the actors report in scope 3. Therefore, the actors' scope 3 reporting has been further graded with a maturity scale (Table 9). The data for scope 3 can both be measured, calculated, or approximated. To reward extensive reporting, declaration of the process of data collection consisted in the maturity scale (Table 10). Also, because data for scope 1 and 2 is more accessible, there is no instance where an actor reports scope 3 and not scope 1 and 2, meaning if an actor reports scope 3, it is implied that they report scope 1 and 2 as well.

Table 9: Grading on how the actors report scope 1, 2, 3

Scope 1, 2 and 3 reporting	
Scope 3	
Sophisticated	Hilti Group Skanska AB
Satisfying	Husqvarna Group
Elementary	Hilti Svenska AB Ahlsell Beijer Bygg (STARK Group) Dahl (Saint Gobain Sweden AB) Schnitzer Steel Industries Inc. Essity AB Ramirent (Loxam Group) Bravida Holding AB
Beginning	Patagonia Inc. Milwaukee Tool (TTI group) Fischer Group
Scope 1 and 2	Würth Svenska AB
Does not report the scopes	Walraven Nordic AB Firesafe Sverige AB Specsavers Sweden AB

Table 10: Grading on how the actors report scope 3

	Beginning	**Elementary**	**Satisfying**	**Sophisticated**
Scope 3 reporting	Has started to map scope 3 but does not report it yet.	The actor has started to report categories of scope 3.	Reports scope 3 in actual or calculated data for all of scope 3 except for negligible categories adding up to <1%	Reports scope 3 in actual and calculated data for all of scope 3 except for negligible categories adding up to <1%. Data collection for the different scopes are declared for.

The result showed that a great majority of the actors report all three scopes. Many of these still only report some categories of scope 3 while three actors, Hilti Group, Skanska AB and Husqvarna Group report their scope 3 emissions to >99%. Eight actors report all scopes and get the grade Elementary as they report some categories of scope 3. These, together with the three actors that have recently begun to map their scope 3, shows an increasing ambition from the actors to understand their emissions.

4.3.4 Science Based Targets

At the request of the client of this project, a small benchmarking was carried out of how and whether the included actors work with the Science Based Target initiative (SBTi). In the process of applying SBTi to an organisation, there are different states to achieve, with Committed being the first step and setting a long-term target for when to reach net-zero emission being the last step. The SBTi complements other emission goals an organisation has by showing the actor takes their goals seriously enough to commit to a third-party organisation with their goals. Table 11 shows that eight actors have committed or made targets according to the SBTi. Only the global group of Dahl, Saint Gobain Group has yet set a long-term target.

Table 11: Grading on how the actors report SBTi

Science based targets	
Status	**Actors**
Long term target	Dahl (Saint Gobain Group)
Short term target	Husqvarna Group Beijer Bygg (STARK Group) Essity AB Skanska AB
Committed	Hilti Group Patagonia Inc. Ramirent (Loxam Group)
Not signed	Milwaukee Tool (TTI group) Würth Svenska AB Fischer Group Walraven Nordic AB Firesafe Sverige AB Ahlsell Specsavers Sweden AB Schnitzer Steel Industries Inc Bravida Holding AB

Hilti Svenska AB and Dahl (Saint Gobain Sweden AB) is represented by their global group which has committed to the SBTi.

4.3.5 Sustainable Development Goals

In addition to goals and the scopes, the actors also report which sustainable development goals (SGDs) that they consider important to work with. In an article from 2022, Perello-Marin et al. investigate different actors in the manufacturing industry to identify which six SDGs that most strongly relate to social, economic, or environmental sustainability for this sector. The SDGs they identify as most important regarding environmental sustainability for the industry are SDG 6 Clean water and sanitation, 7 Affordable and clean energy, 9 Industry, innovation, and infrastructure, 11 Sustainable cities and communities, 12 Responsible consumption and production and 13 Climate action. Table 12 shows if the actors included in this sustainability benchmark describe that they consider these SDGs.

Table 12: Compilation of which SDGs, relevant for the manufacturing industry, the actors treat.

Which SDGs do the actors work with?						
The environmental SDGs relevant for the manufacturing industry that the actors explicitly state they work with.						
Hilti Group	x	x	x	x	x	x
Hilti Svenska AB				x	x	x
Milwaukee Tool (TTI group)	x	x	x	x	x	x
Würth Svenska AB	x	x	x	x	x	x
Fischer Group		x	x		x	x
Walraven Nordic AB						
Husqvarna Group	x			x	x	x
Firesafe Sverige AB						
Ahlsell	x	x	x	x	x	x
Beijer Bygg (STARK Group)		x		x	x	x
Dahl (Saint Gobain Sweden AB)			x	x	x	x
Skanska AB			x	x	x	x
Ramirent (Loxam Group)	x	x	x		x	x
Bravida Holding AB		x			x	x
Best in class						
Specsavers Sweden AB						
Schnitzer Steel Industries Inc	x	x	x	x	x	
Essity AB	x				x	x
Patagonia Inc.						

As one can see, five of the actors agree with Perello-Marin et al. (2022) and state all the six SDGs as important to their activities. In some cases, as with for example Essity AB, Specsavers Sweden AB and Skanska AB, one or more SDGs might not be applicable to some of the actors since they operate in industries other than manufacturing.

In addition, this compilation shows those SDGs the actor explicitly describes themselves, meaning there is a possibility that the actors treat more SDGs unintentionally or the opposite, describe more SDGs than what their actions reflect.

4.3.6 KPIs for Environmental Sustainability and Circular Economy

To understand how the actors perform within the other environmental aspects highlighted in the literature study, Energy, Material use and Waste, and the actors work towards CE, four KPIs were

compared. Included in the comparison were the actors which reported with the most extensive framework (GRI) due to access to data. The activities of the actors vary and thus, the KPIs compared are independent of the size of the actor, revenue, or type of activities. Lack of reporting of these KPIs does not correspond to an actor's actual effort to become more sustainable. The KPIs is a selection made to get a comparable perspective on circular matters. Hilti Svenska AB is included in the tables even though their group reports on their behalf. A more detailed disclosure on how the data for table 13, 14 and 15 was conducted can be found in appendix 1.

Table 13: Comparison of the actors' rate of renewable electricity and waste diverted from disposal

	Renewable electricity/ Total energy use	**Waste diverted from disposal/Total waste**
Hilti Group	30%	N/A
Hilti Svenska AB	N/A	N/A
Milwaukee Tool (TTI group)	15%	78%
Würth Svenska AB	N/A	N/A
Husqvarna Group	54%	79%
Ahlsell	7%	70%
Skanska	29%	N/A
Best in class		
Schnitzer Steel Industries Inc	22%	88%
Essity AB	N/A	64%

Table 13 shows how much renewable electricity the actors use compared to their total use of energy. The total use of energy can include energy sources as electricity from non-renewable sources, combustibles and fuels and natural gas. When actors report their use of renewable electricity, they show that they are aware of the origin of their energy and that may indicate that they work with a transition to more sustainable energy use. Six of the nine included actors reported how much renewable electricity they use and their total energy use. These six actors describe how they increase their use of renewable electricity by purchasing electricity from renewable energy production. In addition, Hilti Group, Milwaukee Tool (TTI group) and Husqvarna group describe how they are building their own photovoltaic systems with solar panels to supply their facilities. Also, Hilti Group, Hilti Svenska AB, Milwaukee Tool (TTI group) and Ahlsell are in the process of converting their fleets of vehicles to electrical vehicles while Husqvarna tries to electrify motorised equipment as much as possible.

Table 13 also shows how much of an actor's waste has been diverted away from landfill and into a system of either reuse or recycling. By reducing their waste to landfill, actors contribute to more circular systems. Five of the included actors declare data for their waste diverted from landfill and their total waste. There are different initiatives to put the waste in circular systems among those five actors. Several of the actors, such as Milwaukee Tool (TTI group), Husqvarna and Schnitzer Steel Industries Inc collaborate with different contractors to have a good waste management and programs for recycling. These three actors also describe how they educate their employees in correct handling

of waste. In addition, Milwaukee Tool (TTI group) and Essity AB describe how they work with choosing input materials that will have second hand value and ease recycling.

Table 14: Comparison of the actors' rate of recycled input materials used

	Recycled input materials used	Notes/Initiatives
Hilti Group	27%	Only for all their tools.
Hilti Svenska AB	N/A	
Milwaukee Tool (TTI group)	N/A	
Würth Svenska AB	N/A	
Husqvarna Group	N/A	The components of the Gardena Division EcoLineTM, a range of watering products and handheld tools, consist of at least 65% recycled material.
Ahlsell	N/A	
Skanska	N/A	
Best in class		
Schnitzer Steel Industries Inc	95%	The manufacturer of steel using recycled ferrous metal where virtually all material inputs are recycled materials.
Essity AB	56%	3.2 million tonnes of wood-based fresh fibre compared to 1.8 million tonnes of recycled fibre (2021).

Since the circular economy is based on reuse, recycling or recovery of resources, the focus was not only on what is happening with the resources after a process, but also their origin. Table 14 shows how the actors work with replacing raw materials with recycled materials in their products. In addition, table 15 shows how the actors work with recycled material in their packaging. This gives further insights in how the actors work with recycled material because these two aspects are often separated.

Table 15: Comparison of the actors' rate of recycled materials for packaging

	Recycled materials for packaging/Total packaging used	Notes/Initiatives
Hilti Group	N/A	Recycled content of cardboard boxes = 60 % (2021) - 1/3 of toolboxes produced in Europe are made with 100 % recycled plastic. - Tool bags are produced with 100 % recycled fabric and a total average recycled content of 70 %.
Hilti Svenska AB	N/A	
Milwaukee Tool (TTI group)	88%	
Würth Svenska AB	N/A	100 % non-renewable plastic has been replaced with 52 % recycled plastic, which is 100 % recyclable. The filling material consists of 99% air and 1% material.
Husqvarna Group	N/A	All packaging for Gardena Division EcoLineTM is made from 100% recycled and recyclable material.
Ahlsell	N/A	In 2021, the average value was 90 % of waste in their central warehouses and 52 % in their stores was sent into professionals to be sorted.
Skanska	N/A	
Best in class		
Schnitzer Steel Industries Inc	N/A	Their products are predominantly shipped without packaging materials.
Essity AB	78%	

As shown in section 4.2.1 Emission and Circularity Goals, CE is an aspect that is not being covered in the same extent as other sustainability aspects yet. This can also be seen in table 14 and 15. However, lack of reporting does not necessarily correspond to activities which makes CE hard to compare in an objective manner. However, the initiatives of the actors indicate some progress.

4.4 Comparison of Data from Sustainability Benchmarking

In this section, the data from the SRs, which has been graded, will be compared. This to see how the different actors position themselves in relation to each other. The comparisons include reporting standards, scope 3 reporting, emission goals and circularity goals.

4.4.1 Scope 3 Reporting vs. Reporting Standard

Figure 5 shows a comparison between the scope 3 reporting of the actors and what reporting system they use. The actors are divided into groups according to their standard of reporting and then ranked internally in the groups, with the most advanced scope 3 reporting to the right in the chart. Using a more advanced reporting system seems to be somewhat correlated to having a more extensive scope 3 reporting. The actors with no framework are all at the grading below beginning, meaning that they are not making any effort in scope 3, this can be explained by lacking reporting overall. It is, however, interesting to see that both Wurth and Milwaukee are ranked as beginning or not even beginning in scope 3, even though they report according to the GRI standard, which makes them stand out to the other actors on the right half of the chart. Noteworthy is also that it is possible to achieve the grading

elementary even with an own framework, like Ramirent. Finally, the 3 actors above the grading elementary are all reporting to GRI. It might be a coincidence, but GRI is however considered to be the most prominent reporting system.

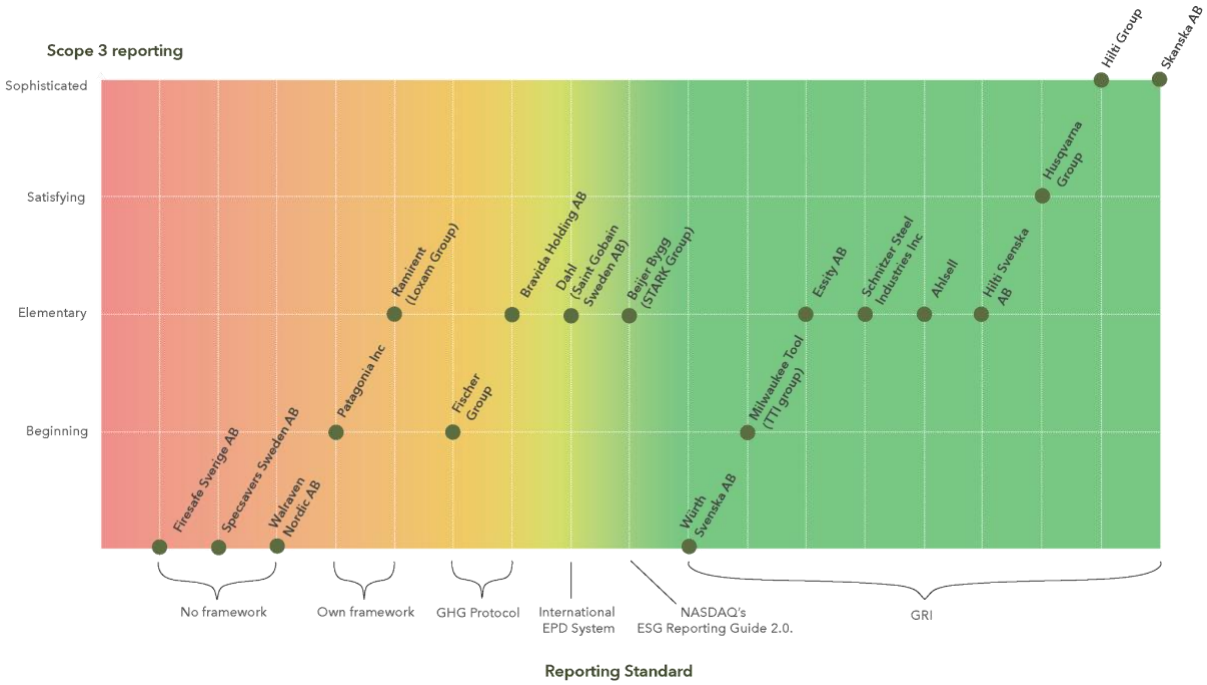

Figure 5: Actors' reporting standard and scope 3 reporting

4.4.2 Scope 3 Reporting vs. Emission Goals

Several of the actors are communicating ambitious emission goals but do not report scope 3 higher than elementary, or do not report scope 3 at all (Figure 6). This means that for several of the benchmarked actors an ambitious goal is not correlated to detailed reporting of scope 3. This makes it hard to follow an organisation's total emissions on the journey towards the goal, and it is not possible to understand how far the actor is from the set goal. Skanska stands out as a leader in both scope 3 reporting and Emission goals. With the transparency of their scope 3 reporting, it is also possible to follow their progress towards the set goal.

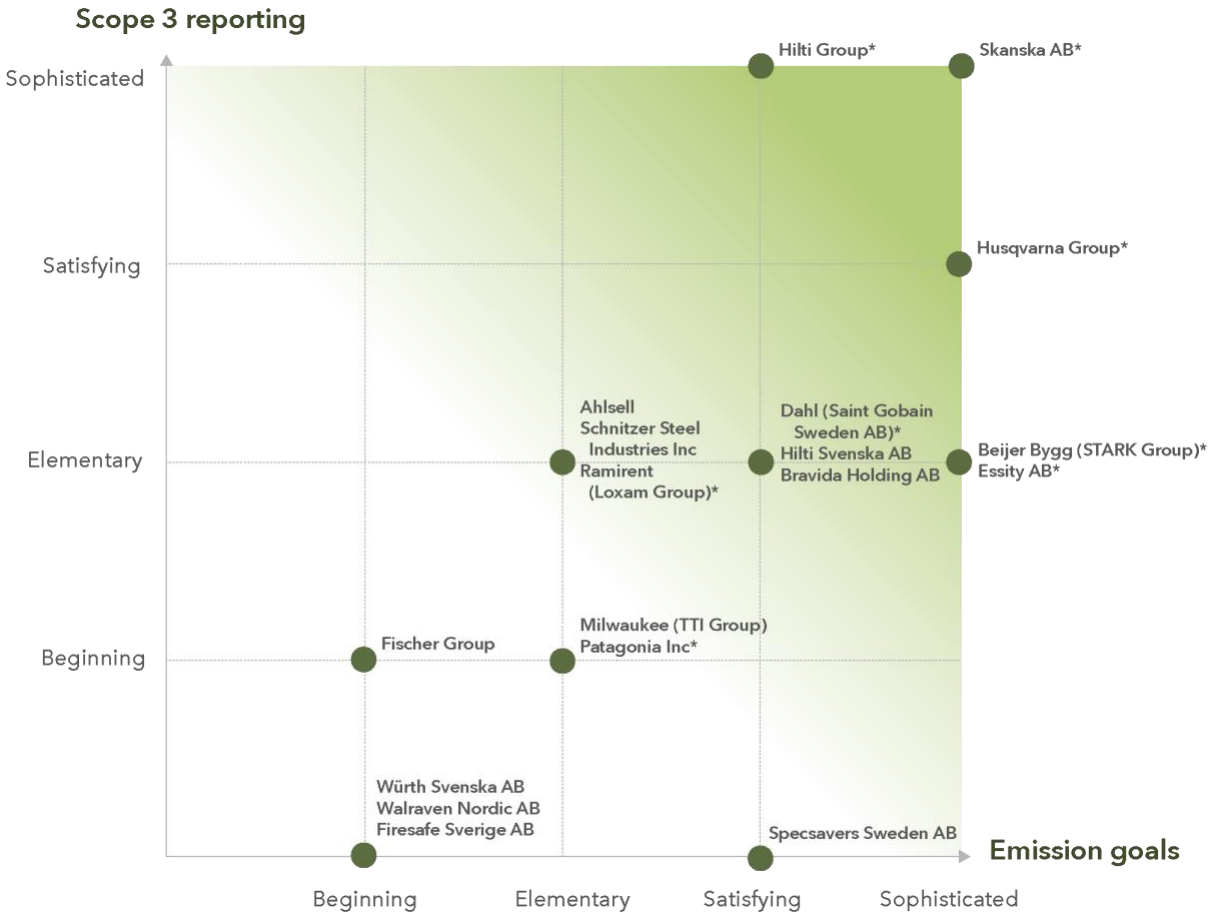

Figure 6: Actors scope 3 reporting and Emission goals

Actors marked with a ”*” have committed to Science Based Targets initiative, which usually makes their overarching Emission goal on the same level as the one they have committed to in Science based targets.

4.4.3 Circularity Goals vs. Emission Goals

When it comes to circularity goals, none of the benchmarked actors are graded above elementary. This due to the lack of a defined goal for the entire organisation with a year for achievement. Many actors express an ambition to become more circular, or the ambition to improve a specific segment or part of the organisation. However, the benchmarked actors are not in general defining as ambitious circularity goals as they do in emissions (Figure 7). Würth Svenska AB stands out as the only actor which has a circularity goal but no communicated emissions goal. All other actors have the same or higher grading for emission goals when compared to circularity goals. The four actors with the highest grading for emission goals do not reach above the grading elementary. It seems that companies do not prioritise circularity goals in the same way as they do with emission goals for now.

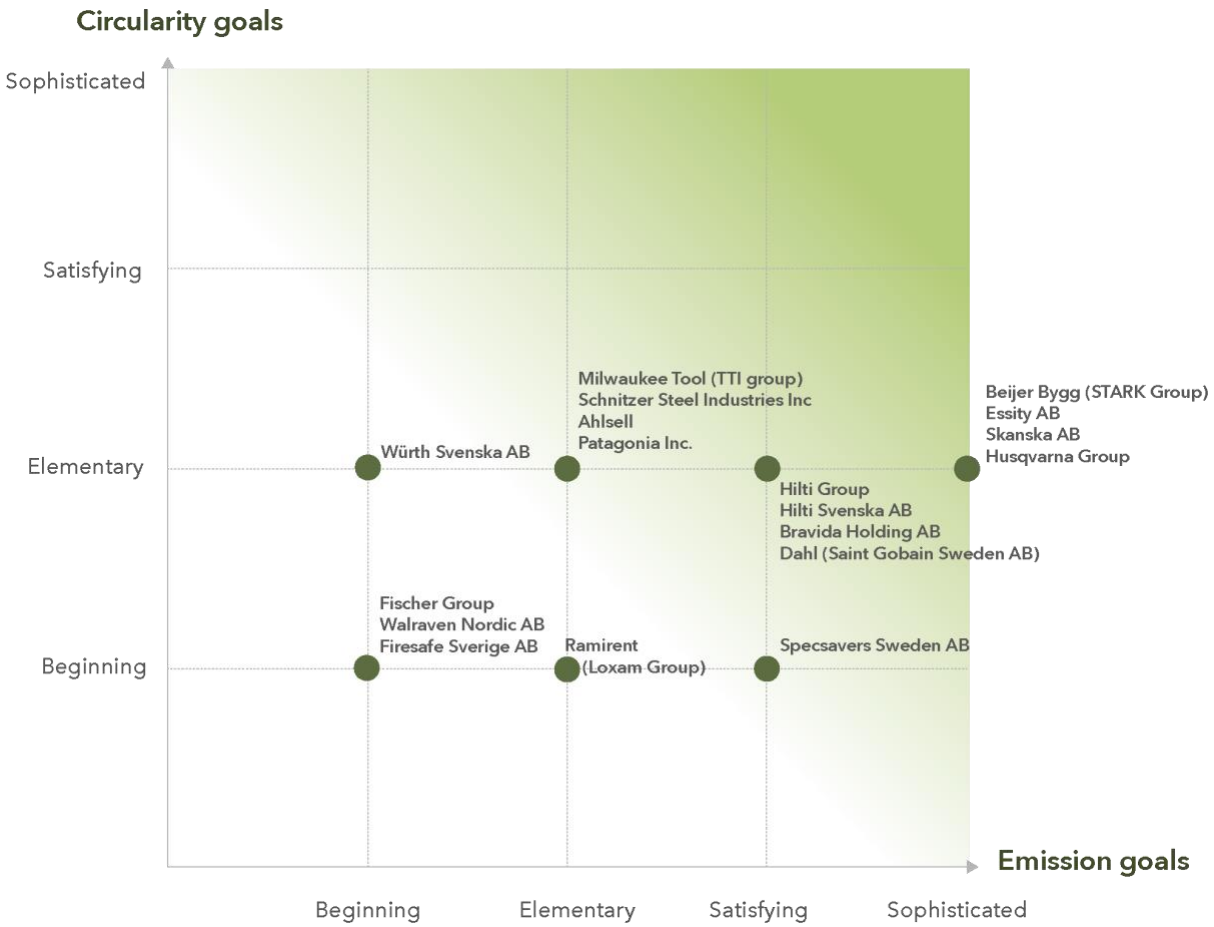

Figure 8: Actors' circularity and emission goals

4.5 Takeaways from the Sustainability Benchmarking

In this section, the key takeaways from the result of the sustainability benchmarking will be presented. These are from the perspective of Hilti Group and Hilti Svenska AB and will be used to identify possible areas for improvement in the upcoming concept development.

- Regarding emissions and circularity goals, Hilti Group and Hilti Svenska AB have similar goals. With emissions, they do as well or better than the competitors. However, there are other big actors in the sustainability benchmark Hilti can learn from, for example, to set a zero-emission goal.

- With circularity goals, all the actors lack explicit goals or ambitions, but some initiatives are starting to emerge. Since Hilti Svenska AB has no production, the control of the circularity of their products is on a group level. However, they have control of their use of consumables, energy and waste and small and seemingly insignificant actions in the stores or offices can lead to significant outcomes if scaled up.

- Compared to the other actors in the sustainability benchmarking, Hilti Group and Hilti Svenska AB have ambitious goals. And because they have reported some KPIs over years where their changes are declared, the change can be followed with transparency. Even though

Hilti Group and Hilti Svenska AB are performing well, Hilti Svenska AB can improve their scope 3 reporting and Hilti Group should benefit from a net zero emission goal.

- The sustainability benchmarking shows that those who have the most extensive reporting of scope 3 also do the most extensive reporting overall.

- Both Hilti Group and Hilti Svenska AB report their scope 1 and 2 and have started to map their scope 3, and both companies are in the lead on reporting of the scopes among the benchmarked actors. More detailed scope 3 reporting, the better, which is something Hilti Svenska AB can improve.

- In regard to the SBTi, Hilti Group performs on a more mature level than the majority of the other actors. However, the SBTi is an initiative from the industry which has not been recognised as a standard yet. Improved targets for the SBTi will be made on group level before it can be implemented by Hilti Svenska AB.

- Six SDGs are identified as the most crucial for the manufacturing industry. Common for reports in this study is that they discuss the importance of SDGs but lack to describe actions to address them. However, since Hilti Svenska AB has no production, there are some variations in what SDGs that are relevant for them. But still, actions on a local level can help the group achieve the goals of the. In addition, the Swedish government has signed the Agenda 30 on behalf of Sweden which makes the SDGs relevant for Hilti Svenska AB.

- When Hilti Svenska AB reports KPIs within energy, the data they present is recalculated to their scope 2 instead of presenting energy related KPIs. However, they express an awareness of sustainable energy sources. Regarding material and waste, Hilti Group reports recycled material input and waste diverted from landfill for some parts of their tools and other activities. However, full overview is not presented.

- Stakeholder analysis revealed NGOs and potential employees share interest in Hilti Group and Hilti Svenska ABs' sustainability. The latter has an increased interest in sustainable workplaces. Local improvement satisfies them, but group-level change is key.

- The NGOs are primarily concerned with legal frameworks and regulations. In contrast, Hilti Group and Hilti Svenska AB are proactively taking initiatives that surpass the minimum legal requirements currently in place. Notably, both companies have commenced reporting on their scope 3. It is worth emphasising that initiatives driven at the group-level or by management are keys in driving improvements in this area.

- With the overall sustainability reporting, Hilti Group and Hilti Svenska AB are among the actors who report most extensively and mature which is positive. Some of their data is calculated while others are measured, and they make some effort to declare their data origin.

- Lastly, the literature highlights areas of sustainability which are less frequently discussed in sustainability reports. These areas are primarily biodiversity and land use.

4.5.1 Focus Areas for Improvement in Stores

It differs how big the impact, or how feasible a change within the takeaways, would be. The ways of reporting sustainability are controlled on a high level by both the Swedish and the global parts of Hilti Group and Hilti Svenska AB and the emission goals and CE targets are set on group level. Therefore, these are hard to affect on a local level.

The sustainability aspects of Hilti Svenska AB's energy consumption is also hard to impact in the stores since Hilti Svenska AB has no production, which is among the most energy-intensive activities in the group, and the stores are not in control of what electricity is purchased for the facilities, nor its origin. Aside from any activities with high energy consumption in the stores or at the offices, the most impact is from the source of purchased energy and choice of facilities to utilise.

Moreover, Hilti Svenska AB reports their scope 3 in a limited manner. To be able to give more than estimations on the scope 3, they need to track all levels of activities in the company. Therefore, to study material use and waste management in the stores can give a more detailed reporting or contribute to changed behaviour in regard to environmental sustainability. All these takeaways also match the takeaway that even small activities need to be aligned with the SDGs.

To conclude, material handling (reuse, recycling, waste management etc) in the Swedish Hilti stores has been identified as the most relevant activity to study to be able to target an area where both impact and feasibility is high. By studying the material handling in stores, areas of which the stores handle what material and what amount, can be identified and thereby benefiting scope 3 at a detailed level. This can help Hilti Group and Hilti Svenska AB reach their overarching goals and identify how Hilti Group and Hilti Svenska AB can work more towards the SDGs. The change made on a local level could possibly be scaled to make a positive change in 13 stores in Sweden, and potentially further influence locations outside of Sweden.

4.6 Concept Development

From the chosen focus areas from the benchmarking, the following results are part of the design process leading up to the final concept.

4.6.1 Context for Development

Reflecting on the final objective of the thesis:

"Use the design process to develop a concept for one of Hilti Svenska AB's areas of operation that facilitates employee's ability to behave sustainably."

The objective together with the problem formulation was further developed into targets for the design process which affect the activities in the study and what should be achieved. Also, because of the objective, there are some limitations presented.

Targets for design process:

- Achieve understanding of the material handling in a local store context through interviews and observations.
- Develop a concept that improves material handling from an environmental sustainability point of view that is implementable in all 15 Hilti stores in Sweden
- Develop a concept that, in the long run, can contribute to Hilti Group's environmental and circularity targets, with the starting point in a local context.

Limitations for design process, meaning the process will not include:

- Design or manufacture of a finished design concept due to time restrictions.
- Testing the developed concept
- Suggestions for changes in Hilti Svenska AB's organisational structure.
- Suggestions for changes of Hilti Svenska AB's current material and recycling partners.
- Interference with customer interaction.
- Not suggestions for changes in Hilti Svenska AB's business model

The context of this study was two Hilti stores in Sweden, studied during two days respectively. The target of the study was to investigate how to improve sustainability in the area of material handling. The users in the system are the employees in the stores. In total, five employees were interviewed.

4.6.2 Observation Result

To get an overview of the findings from the observations, an affinity diagram was created. This to structure the insights of how the different stores work and what activities they do that relates to environmental sustainability. Eventually these insights led to a foundation for the following problem identification. From the affinity diagram, the following eight groups of themes were identified and are presented below along with the major takeaways of the group.

- Service
    - When customers make a purchase or pick up an order, they usually leave the store without the original box, which is then thrown away. The customer has several ways of bringing the products from the stores. Either they take a product as it is, or they can bring it in a variety of different bags of their choice. This makes it easier for the customer.
- Attitudes
    - Many employees highlight the overarching ambitions of the global company group, and they describe how their view of Hilti Group and Hilti Svenska AB is positively affected by the ambitions of the company.
    - Some employees put a lot of effort into correct recycling at home, but not at the office, while others do not care on a personal level but do at work due to habits.
    - The employees are positive towards the possibility of adding small additional tasks to their daily work but are sceptical regarding more time consuming tasks.
    - There is a will in the organisation to implement positive changes from one store to all stores in Sweden.
- Deliveries
    - The deliveries to the stores vary in size but include mostly finished repairs or customer orders.

- Shipments
    - The shipments made from stores are either tools for repair which are sent daily, or collected, leased tools for recycling or reparation which are sent when a pallet is filled.
    - The shipments are packed in reused cardboard boxes from deliveries which are then packed on pallets.
- Facilities
    - The stores consist of a front store where the products are shown and the meeting with customers take place, and a back store with recycling bins and storage.
    - The stores are all similar, even if the layout can differ.
- Recycling
    - The recycling bins are provided and owned by a third-party company. Cardboard and combustible waste are the largest and most used bins.
    - In general, a significant amount of material is sorted incorrectly. Material ends up in the wrong recycling bin, as well as materials not being recycled at all and going to combustible waste.
    - The most handled material is cardboard. When recycled, cardboard boxes are not always folded which leads to the recycling bins being filled fast.
    - Waste is often thrown in the recycling bins while passing by employees operating in the store. The effort to recycle correctly differs a lot from person to person.
    - Also, both store employees and other employees such as office workers or account managers throw waste in the bins. They do this when they happen to pass by and do not have the store as their workplace in the same way as the store employees.
    - In some cases, a “temporary station” is used for recycling. For example, a store can have a bin to put office paper at the front desk that is then emptied when needed.
- Consumables
    - The stores consume items continuously such as tape, office paper, paper cups, and tools such as knives. However, no new cardboard boxes are used. Instead, boxes coming from deliveries are reused.
- Instruction manuals
    - Each product comes with an instruction manual. When sold to a customer the product is usually removed from the original packaging. The instruction manuals are then thrown away, wasting material.

The groups were analysed in terms of how if there were any problems observed or expressed by the employees. The cases of Service and Attitudes, covers observations of how the employees work is either motivated by a will to be as service minded towards customers as possible or depends on the employees’ internal drives, for example an interest in correct recycling. Deliveries and Shipment are strongly related to the bigger organisational systems of Hilti Svenska AB and are of low influence of the stores. How the store manages material, both consumables as printer paper and coffee cups, and product packaging and instruction manuals, is related to the facilities in the stores and recycling.

4.6.3 Problem Identification and Definition

From the affinity diagram, different problems were identified. These were then analysed and structured in a problem chart based on how they are related to each other. From the identified problems and their relations, core problems were emphasised. Figure 9 shows the problem chart.

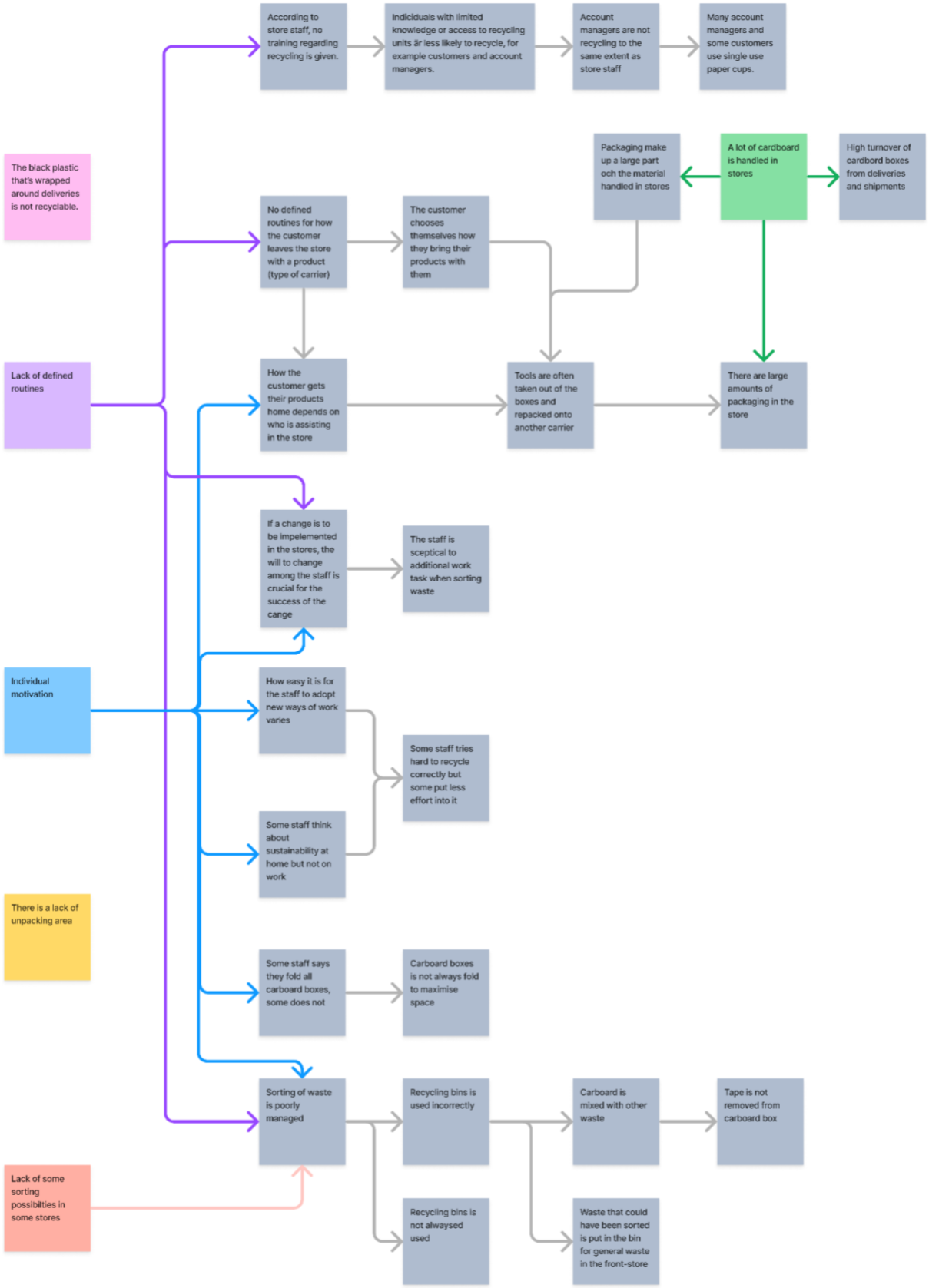

Figure 9: The chart shows the core problems in colour and the related problems in grey.

The selection of the problem to solve was based on both impact and feasibility. Some of the smaller problems are related to a bigger problem, which if solved, would solve the smaller ones as well. However, some of the problems were deemed unrealistic to solve within the given scope. After considering the feasibility in stores, the expected impact, and the relations to core problems, one problem was chosen for further problem solving: *Sorting of waste is poorly managed* (figure 10).

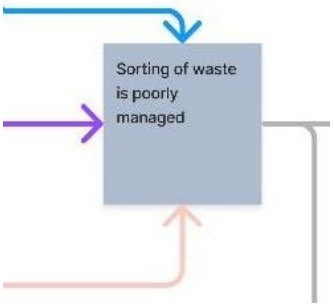

Figure 10: The chosen problem to solve is *Sorting of waste is poorly managed*

The following problem definition was established:

"The employees struggle with sorting waste correctly in the stores and materials end up in the wrong recycling bin. This is due to lack of either motivation, routines, or facilities. Mixed materials complicate efficient recycling. The design concept should make it easy for the employees to do the right thing throughout their workday."

This problem relates to the three core problems: Lack of some sorting possibilities in some stores, Individual motivation, and Lack of defined routines. This is because, when the store employees are to sort waste, how highly they value correct sorting will affect their behaviour. However, what the company provides in terms of facilities and routines also affects their actions. Among the feasible problems to solve, this was the problem which related to most core problems.

After the problem identification a requirement list based on the scope was conducted, see table 16.

Table 16: Requirements list

No.	Name	Class (Requirement/ Wish)	Weight (1-5)	Description
1	Positive impact on correct recycling	R	5	
2	Implementable in all stores	R	5	In Sweden
3	Not to modify recycling bins	R	5	Due to the bins being included in a third-party service
4	Accepted by users	W	5	The concept should be accepted by users and blend in well with their current
5	Not enable workarounds	W	4	The design concept should not for the employees to work around or ignore
6	Intuitive use	W	4	
7	Avoid additional time consumption	W	3	If the design concept adds extra time of a work task for the employees, it should be held to a minimum
8	Change employee attitudes	W	2	Regarding recycling
9	Educates regarding recycling	W	2	Educate employees in stores
10	Simple manufacturing	W	1	Estimate due to outside scope
11	Cheap manufacturing	W	1	Estimate due to outside scope

Positive impact on correct recycling, Implementable in all stores and Not to modify recycling bins are requirements which a design concept must comply with while the rest are more or less important wishes.

4.6.4 Ideation and Concept Development

To meet the specifications from the requirement list and address the problem definition an ideation process took place through several steps (figure 11). The initial brainwriting and brainstorming resulted in ideas with a broad solution space. The brainwriting and brainstorming was followed up with the Scamper method where the Scamper method resulted in additional ideas, originating mostly from the prompts: *Combine*, *Adapt*, and *Modify*. Combined, the brainwriting, brainstorming and SCAMPER methods resulted in 26 ideas.

A first elimination was made to exclude ideas not feasible for continued development. The criteria for elimination where:

1. *Idea not deemed realistic*
2. *Idea not deemed feasible for the time and size limitations of the scope*
3. *Ideas predicted to have a very low environmental impact.*

After this first elimination 11 ideas remained. These 11 ideas were then further detailed into concepts with sketches and explanations and can be found in appendix 2.

To achieve a final selection of concepts to develop further a Kesselring matrix was made. Here the concepts were compared on how well they met the requirements from the requirement list and one concept stood out and got the highest points. The Kesselring matrix can be found in appendix 3.

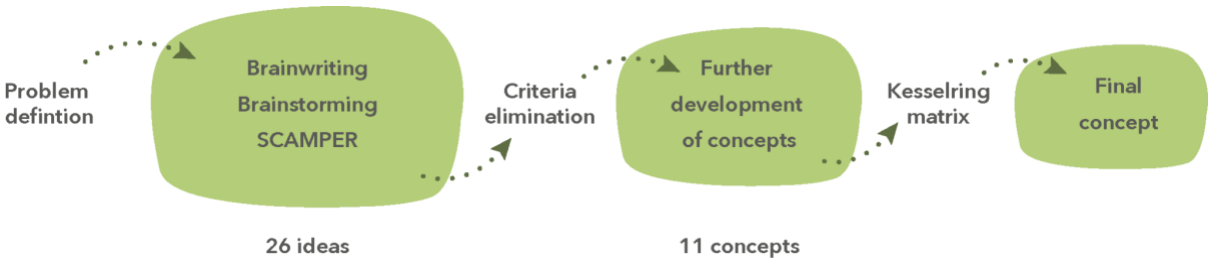

Figure 11: From many ideas, one final concept was taken to further development.

The selected idea consists of a handle, add-on, or other physical product connected to the recycling bins that shows the material that could be recycled. The material sample should indicate and nudge the employees not to throw the wrong material in each bin. The add-on is sketched in figure 12 where it hangs on the front edge of the recycling bin.

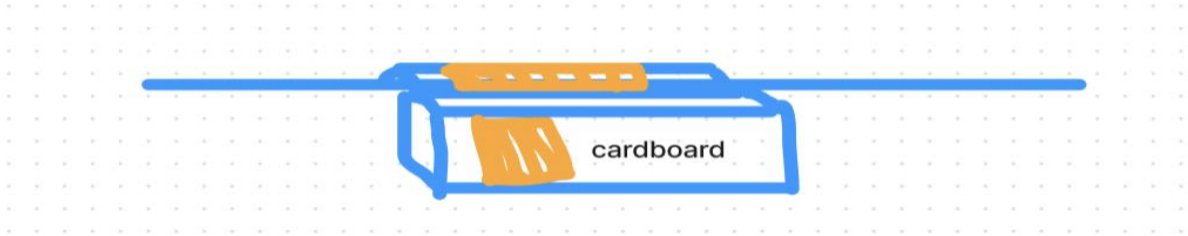

Figure 12: Early sketch of selected concept.

The chosen concept was further developed through additional sketching, brainstorming, and CAD-prototyping.

Throughout this process, several obstacles with the nudging and feasibility of the different design variants emerged, as well as positive aspects that could have a higher probability of solving the problem. Some potential strengths and weaknesses with the concept were identified.

1. Mobility of the concept

The mobility, or immobility of the concept was identified as a high priority aspect. A concept that is permanently attached to the recycling bins might create problems for the 3rd party company responsible for the bins. Definitive interference with the recycling bins is outside of the scope and the emptying and handling of the bins from the recycling company's perspective would then need to be analysed. On the other hand, a completely removable concept would risk the concept to be removed by the employees and not later reattached and thereby lose its function. The solution selected for the concept was a middle path as a standalone or semi-permanent concept that is not attached to the bin, but also hard to remove, thereby increasing the possibility of the concept functioning over time.

2. Physical obstacle in the concept

It was identified that, not to risk that the behaviour changes in regards to the concept can be forgotten or ignored, a physical obstacle will be of importance. Another interesting aspect of a physical obstacle is that it could lead to a new action in the act of recycling. This action could be triggered by the physical limitations of the concept.

3. Reflective behaviour change

Apart from the physical nature of the concept, more reflective and behaviour changes in the act of recycling was identified as a positive possibility to include. A physical obstacle could mean a moment of reflection, since it would interfere with how the recycling is done today.

Further, the concept should, from the chosen idea, involve material samples of what can be recycled in a specific bin. To raise awareness for the individual recycling an idea was to create relatively large symbols in connection to the samples to further increase the possibility of correct recycling by reflecting during the act of recycling.

4.6.5 Final Concept

The final concept is on a high level of abstraction, showcasing elements with functions that could solve the selected problem of incorrect recycling, rather than specific design choices. The elements in figure 12 and figure 13 below are focused on a recycling bin for cardboard, since cardboard was identified as the most handled material in the stores. However, the functions of the elements could be translated into recycling bins for any material. An important aspect of the concept is to reduce mindless activity and nudge the user to reflect on their choices when interacting with the concept.

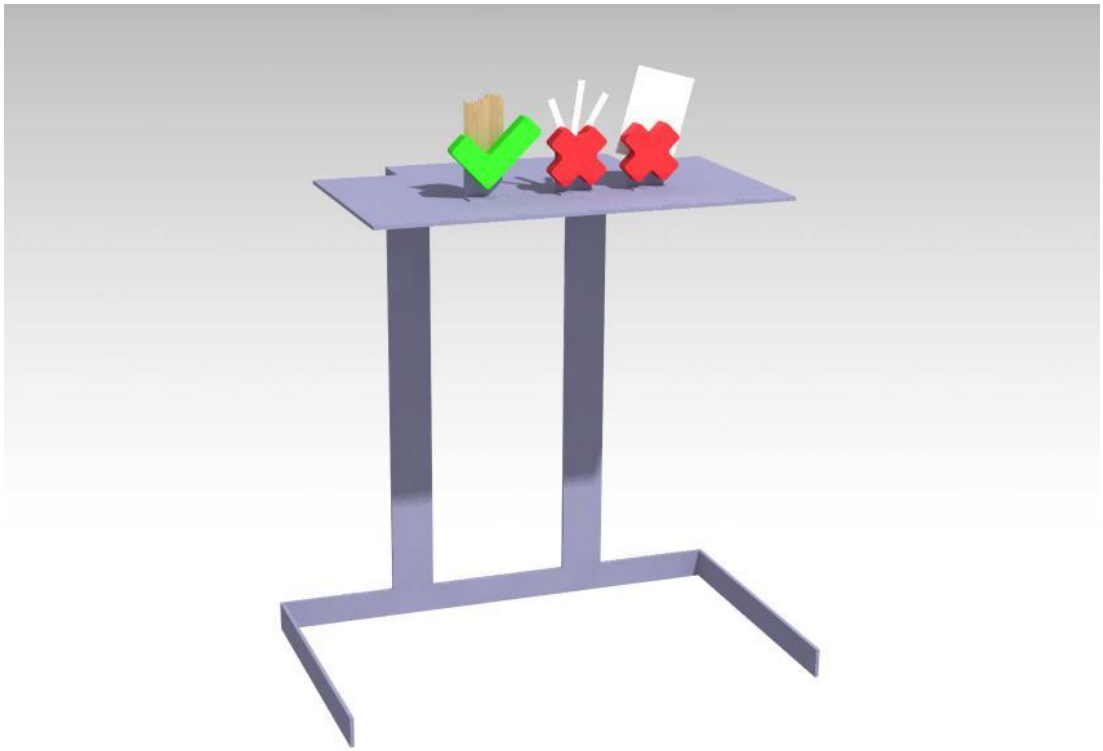

Figure 12: The base and standing structure without a recycling bin in under.

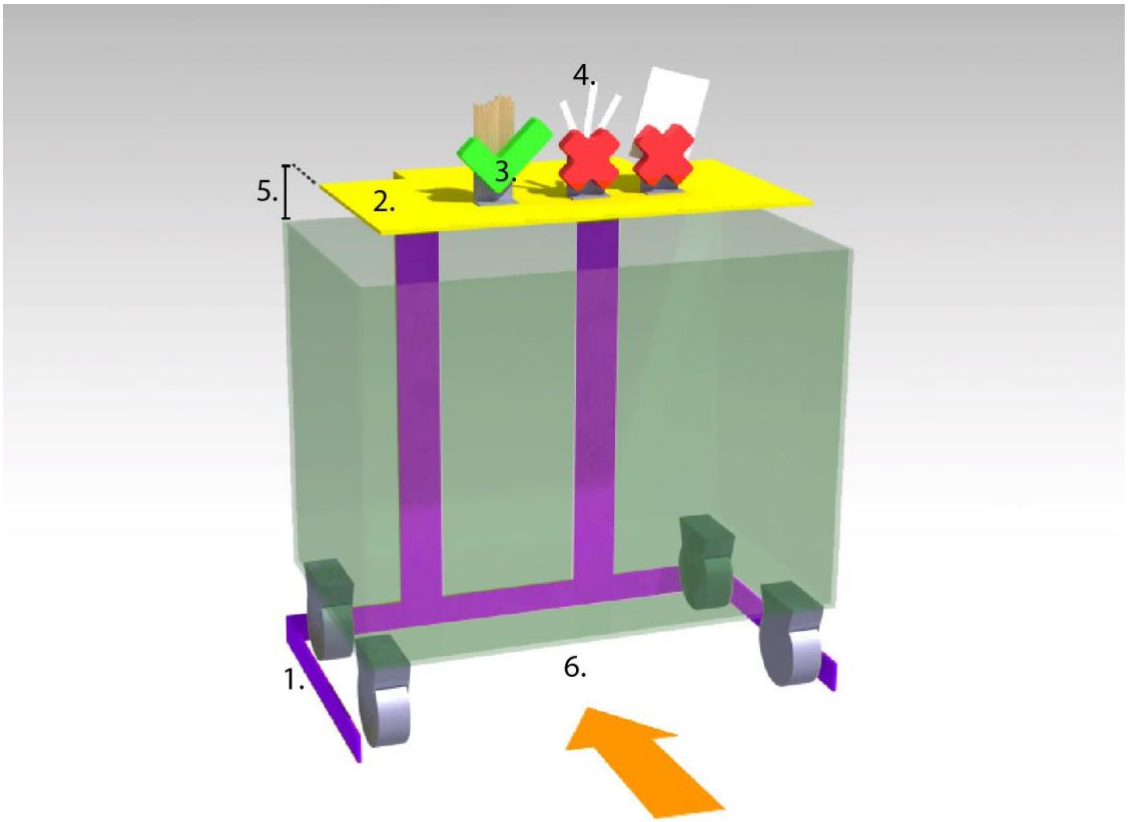

Figure 13: Developed concept with defined elements. Coloured parts defined for clarity. The position of the recycling bin is under the Protective obstacle element.

Explanation of elements and their functions:

1. Base and standing structure element of the concept
    a. The base and structure element would need to make the concept stable to stand on its own, but most importantly not be easily removable. The concept base and structure should define the placement of the recycling bins, rather than the other way around to avoid the possibility of not using the concept. The recycling bin is rolled in under the base structure.
2. Protective obstacle element
    a. The protective obstacle element's main function is to avoid material that does not fit being put in, as well as needing to perform an action close to the bin. As shown in a study, a physical obstacle could decrease the percentage of incorrectly sorted materials. The user has a harder time throwing anything in from a far and needs to get closer to fit and/or compress the waste to fit. This additional action could also break a current habit and make the user reflect on what is put in the bin.
3. Symbol elements with colours to indicate if something can be recycled in the bin
    a. The symbol element's function is to indicate, through coloured shapes, what can be thrown or not thrown in the bin. The "allowed" symbol should be easily recognized by the user as something positive and correct and the opposite for the "not allowed" symbol. The number of "allowed/not allowed" symbols should be customizable. The symbols should be clear enough to distinguish from each other, to not only rely on the colour coding. The symbols also need to be positioned in such a way that the human can easily identify them when carrying out the recycling due to cognitive ergonomics.

4. Material samples connected to the indicating symbols
    a. The material samples are connected to the symbol elements to indicate which precise materials can be recycled in the bin and examples of materials cannot be recycled (figure 14). Materials handled by employees in the stores could be attached for the specific context, and easily fastened to the symbol element.
5. Distance defining the space where material can enter the recycling bin
    a. The distance element defines the size or shape of what can be thrown in each specific recycling bin.
6. Recycling bin and the direction in which it is inserted in the concept
    a. The recycling bin is not an element of the concept itself but should have a specific and obvious direction and way of inserting it into the concept.

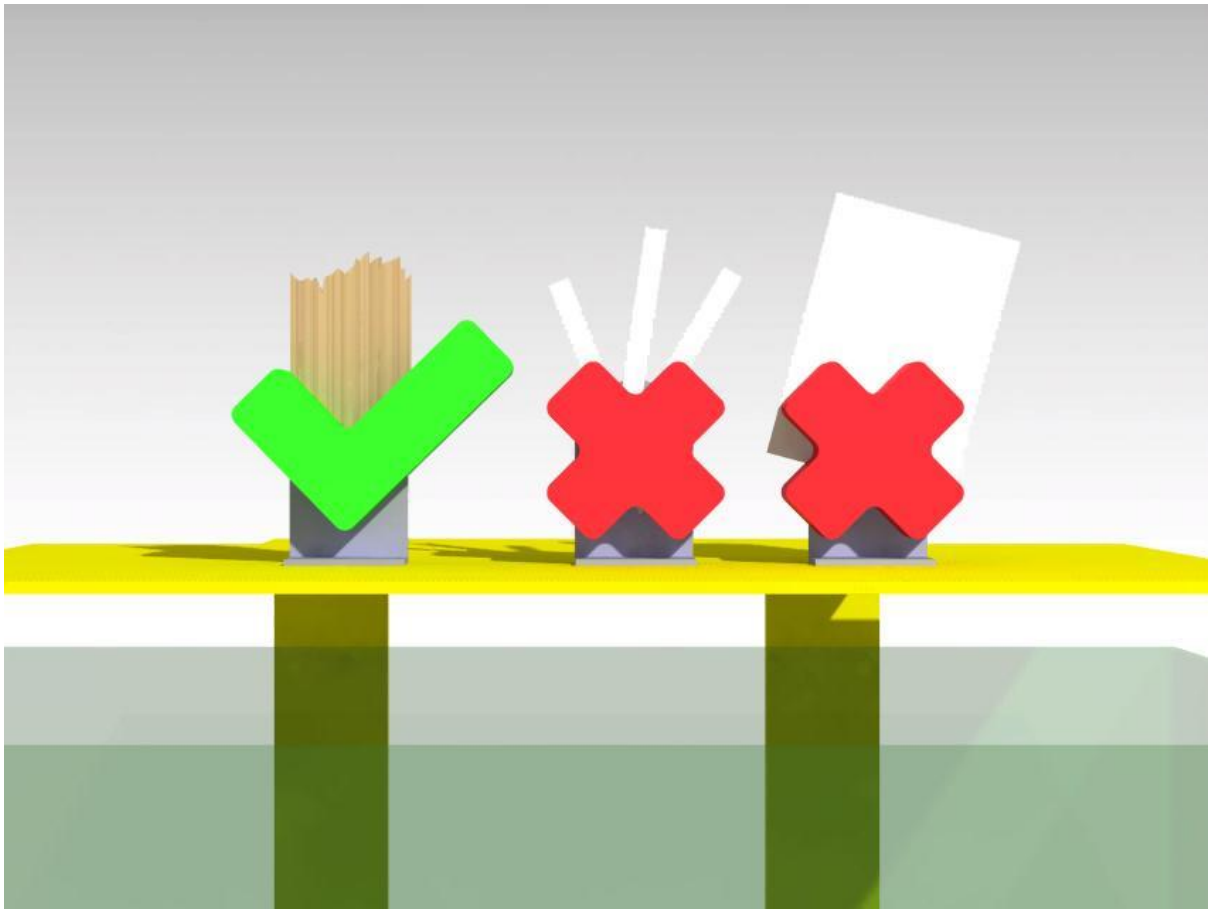

Figure 14: Close up view of symbol element examples with attached materials (In this case cardboard, plastic ribbons and office paper).

To conclude, the idea is firstly, that it should make recycling a slightly more time-consuming process, where materials are harder to throw in from afar, and larger objects that do not belong in each specific bin should not be physically possible to throw in. Secondly the concept should help the user to reflect on which material they throw in, through clearly visible indicators and material samples that they recognize.

4.6.6 Participant Validation

Since the presented concept is on a high abstraction level with suggestions of functions rather than a finalised design, no physical prototype was used in the user validation. The participants were instead

shown rendered images (figure 12 and 13) of the high-level concept and its functions were explained. The major takeaways from the interviews are presented below.

- The employees say they are positive towards the concept and that it is implementable in all stores in Sweden. The positive reaction comes from their situation today where they experience that the sorting of waste is not working well today.
- The physical obstacle will make people think. The employees like the thought of it being more difficult to throw in waste that does not belong in the bin, even if it adds an extra work task. However, there is a limit to how much time an additional task can consume. Further, they think that the physical obstacle is more important than symbols and informative text.
- The concept would lead to less waste sorted incorrectly, and the bins being filled in a more efficient way which might even lead to less frequent emptying of the bins.

"The solution would make more people do the correct thing. We would totally avoid someone taking a whole cardboard box and just throwing it in the bin."

- Store employee

- The employees think the coloured symbols are good as an object instead of just images of symbols. However, they would want the information on what should be recycled in a bin as obvious as possible, and adding information in the form of text should be done to have as many informative elements as possible. The employees further say that one should almost feel ashamed when sorting waste incorrectly when seeing several, very clear informative elements.
- The employees see a problem with implementation if the concept is too expensive to produce. They also say that the concept might not be enough to assure correct recycling in all cases, for example if a bin is filled, another might be used instead.

"What might not make the concept work 100 percent will in the end come to systematic behaviour. Some have a harder time changing if there are no clearly defined rules internally."

- Store employee

5. Discussion

In this chapter, the results of the two deliveries will be discussed.

5.1 Sustainability Benchmarking

The sustainability benchmarking indicates that companies differ a lot in how well they carry out their sustainability reporting. The actors are increasingly using well known and acknowledged reporting systems. The scope 3 reporting is not thorough enough on a local level with data often being estimated. Actors such as Hilti Group that are doing well in scope 3 reporting still lack local level data. It is notable that Hilti Group do, on a global level, report a <99% scope 3, but Hilti Svenska AB does not. This seems contradictory since the activities of Hili Svenska's suppliers and customers is included in the scope 3 of both the local company and the group. Further, many actors set ambitious emission reduction goals. However, the whole industry struggles with setting circularity goals and clear subgoals for achieving their overarching emission goals.

The number of actors in the sustainability benchmarking is limited. The actors are only ranked between each other. This means that there is a possibility that there are actors that would be ranked higher or lower and thereby add new dimensions to the benchmarking. The actors were carefully selected together with Hilti Svenska AB, as well as through brainstorming, however there is no certainty that the actors selected creates the most nuanced picture. Further, the data in the benchmarking is only sourced from public reports and websites. To get a more thorough view on an actors' sustainability work, one would need to get a broader insight into each actor.

When selecting improvement areas for the concept development phase, feasibility for the scope was central. It is however possible that areas outside of the scope would have a higher impact and should not be neglected in the bigger picture. Even if the design process was carried out for a local context, other contexts, global or local could have been explored if the scope for the design process was wider. For example, in this project a design process was carried out, however, focusing on improving sustainability reporting, developing a process, or exploring organisational practices are examples of areas that could be further explored from the benchmarking results.

5.2 Final concept

Reflecting on the selected problem definition:

"The employees struggle with sorting waste correctly in the stores and materials end up in the wrong recycling bin. This is due to lack of either motivation, routines, or facilities. Mixed materials complicate efficient recycling. The design concept should make it easy for the employees to do the right thing throughout their workday."

The high-level concept could decrease the struggle that employees face when sorting waste correctly. The design concept does not address the possible lack of motivation or routines. It could however, through adding on to the facilities, make it harder to do the wrong thing when recycling. The store employees are in general positive towards the concept; however, it is important to take into account that the participant validation was made with a small group of employees in one single store. Therefore, their subjective opinions on whether the concept can have a positive impact cannot be seen as an absolute truth.

According to store employees, the design concept should be implementable in all stores in Sweden since they are similar. An international implementation would be dependent on how similar the stores are internationally compared to Sweden. Looking outside of the company, the design concept could possibly be implementable to all who use the same kind of recycling bins and experience similar problems, however that is a more speculative argument.

If the concept would have a positive impact, it would apart from better recycling help the company achieve their goals on a local scale. Further it would improve the scope 3 emissions from recycling on a local level since less material would be mixed and thus, possible to recycle. Also, the concept could possibly enable a more detailed scope 3 reporting, knowing more about the emissions regarding material handling in stores. Finally, it would improve the company's work with SDGs due to more efficient recycling and material handling. It should however be noted that the concept would in the large perspective have a very small impact. However, improvements like the concept could set a tone for how local areas of improvements could be explored and expanded sooner in the organisation.

6. Conclusion

In this concluding chapter, the research questions will be answered, followed by recommendations for potential further development.

6.1 Research Questions

"What environmental sustainability aspects are important in the manufacturing industry and how does Hilti Svenska AB perform in comparison to other actors regarding these aspects?"

The literature study highlights waste, material, energy, biodiversity, and emissions as key aspects of environmental sustainability. Also, to understand where the greatest impact can be made, measurable and relevant KPIs are crucial.

A big reason for why companies must increase the focus on sustainability is because of the influence of the UN and the SDGs. Hilti Group express how they work with the six goals identified as most relevant for the manufacturing industry. However, since Hilti Svenska AB is not a manufacturing company, it is understandable they have less focus on goals 6, 7 and 9.

Hilti Group and Hilti Svenska AB generally position themselves well compared to the other actors in the sustainability benchmarking. This primarily due to their use of an extensive reporting system and reporting of scope 3. Hilti Group reports their scope 3 emissions to >99% whereas most of the actors only reports a few categories of scope 3 or none.

Hilti Group and Hilti Svenska AB have equally mature emissions goals. However, there are companies who have managed to reach a higher level of maturity through a time-bound net zero emission target. If Hilti Group continues to work on their commitment to the SBTi, it will further strengthen the maturity of the emission goals.

Both Hilti Svenska AB and Hilti Group have, like most actors included in the benchmarking, less extensive goals and ambitions with regard to circularity compared to emission goals. It is also hard to find comparable KPIs within the aspects of waste, material use and energy use. More detailed reporting of KPIs that relate to circularity could assist the actors with improving their circularity goals.

"What can Hilti Svenska AB implement to improve environmental sustainability?"

While Hilti Svenska AB does not have direct control over the production of their products, they do have control over their facilities and local activities. It is important to recognise that sustainability needs to be embedded in all aspects of the company for it to become truly sustainable. Focusing on sustainability at the local level, such as waste management and material use in stores, can contribute to the overall sustainability efforts. The identified problem with highest feasibility and impact targets a change of behaviour among both store employees and their other colleagues.

The proposal is to implement an artefact that requires slightly increased effort to dispose of waste thoughtlessly. The design includes an obstacle to be placed above the recycling bin in combination

with visible symbols and material samples. The design encourages and nudges more mindful and responsible behaviour in the long run. By addressing sustainability at every level of the organisation, from production to in-store practices, Hilti Svenska AB can contribute to the larger goal of creating a sustainable future, recognizing that every small action plays a part in achieving overall sustainability.

6.2 Recommendations

Recommendations from the sustainability benchmarking from Hilti Svenska AB's perspective. Firstly, a recommendation is to continue expanding scope 3 reporting efforts. This involves capturing and reporting GHG emissions and other environmental impacts throughout the entire value chain, including suppliers, distribution, and product use. Increasing the scope of reporting will provide a comprehensive understanding of Hilti Svenska AB's environmental footprint and identify areas for improvement.

Furthermore, the creation of realistic and feasible goals for circularity is essential. Hilti Svenska AB should establish practical targets that focus on reducing waste generation, promoting reuse, and recycling, and implementing circular economy principles. These goals should be measurable and time-bound, enabling effective monitoring and progress assessment.

Additionally, Hilti Group and Hilti Svenska AB needs to achieve a higher maturity level regarding emission goals if they want to position themself among the other actors whose emission goals are more sophisticated. It is recommended to continue collaborating with the Science-Based Targets initiative (SBTi) to achieve this since tangible goals with stated deadlines are important. This commitment ensures that emission goals and sustainability strategies are based on credible scientific evidence and contribute significantly to addressing climate change.

Recommendations from the perspective of Hilti Svenska AB's local store context.
To begin, it is crucial to conduct further investigations into the extent of incorrect waste sorting in the stores and evaluate, together with the third party collecting the waste and providing the bins, the environmental benefits that improved waste sorting would bring. At the same time, there is also an opportunity to investigate the possibility of introducing more diverted waste management and introducing sorting of plastic and other materials to divert even less from incineration.

To encourage responsible waste sorting behaviour, it is recommended to make it more challenging for individuals to sort waste thoughtlessly or incorrectly. Implementing changes to waste disposal systems and providing clear instructions and reminders on proper waste sorting practices can contribute to this goal and ensure that all employees are well-informed about sustainable waste handling.

In addition, Hilti Svenska AB should develop a prototype of the design concept and evaluate if it would give the desired effect on the waste management. A prototype can be a practical tool to assess the feasibility and effectiveness of trying to change sorting method behaviours within the Hilti Svenska AB context. In addition, this could inform a more detailed design of the concept.

Lastly, several problems regarding material handling in the stores were identified through the observations and interviews. A recommendation is that these problems should be prioritised internally and further explored.

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Appendix 1

The following appendix disclose the data in table 13, 14 and 15 in section 4.3.6 KPIs for Environmental Sustainability and Circular Economy was conducted.

Data for Renewable electricity/Total energy use

	Renewable electricity (MWh), R	Total energy use (MWh), T	Year of data	R/T	%	Note
Hilti Group	148,112	491,926	2021	0,3011	30%	100% of Hilti Group's electricity is renewable.
Hilti Svenska AB	N/A	N/A	-	N/A		See Hilti Group
Competitors						
Milwaukee Tool (TTI group)	N/A	424,677	2021	15%	15%	p. 131: Information partially available — TTI's total consumption from renewable sources represents 15% of total energy consumption and will be more detailed in subsequent reports.
Würth Svenska AB	N/A	N/A		N/A		Has recently (2021) started to collect data according to GRI but not begun reporting it yet
Husqvarna Group	174,244	324,459	2021	0,5370	54%	Share of renewable electricity is 82% (2021)
Resellers						
Ahlsell	34,2	485	2022	0,0705	7%	(Renewable electricity = 45%)*(Total Electricity = 76 MWh)=(Renewable electricity = 34,2 MWh)
Best in class						
Schnitzer Steel Industries Inc		3,312,667 GJ	FY 2022		22%	p.71: Total energy consumed Gigajoules (GJ). 46% of total consumed energy was grid energy. 48% of grid energy was renewable => 22%
Essity AB	N/A	N/A	-	N/A	N/A	
Customers						
Skanska	N/A	1087000	2021	N/A	29%	Renewable electricity (excl. heating and cooling) % = 29

Data for Waste diverted from disposal/Total waste

	Waste diverted from disposal (t), R	Total waste (t), T	Year of data	R/T	%	Note
Hilti Group	N/A	25206	2021	N/A	N/A	70% of their tool mas can be recycled We have committed ourselves to disposing of zero waste to landfills. To achieve this goal, we carried out a screening process in all our production units in 2021.
Hilti Svenska AB	N/A	N/A		N/A		Body of tools: 73% material recycling, 27% to energy recovery
Competitors						
Milwaukee Tool (TTI group)	44979	57870	2021	0,777	78%	
Würth Svenska AB	215,6	1429	2021	0,151	15%	
Husqvarna Group	30 965	39319	2021	0,788	79%	Non-hazardous recycled waste 30 516 t + Hazardous recycled waste 449 = Total recycled waste 30 965
Resellers						
Ahlsell	N/A	N/A	2021	N/A	70%	Sorting rate in total measured by weight
Best in class						
Schnitzer Steel Industries Inc	691288	784205	2021	0,882	88%	(Business Waste + Process Waste) / (Beneficial Re-use/ Recycling)
Essity AB	N/A	N/A	2021	N/A	64%	Materal recycling and eneergy recovery for production waste
Customers						
Skanska	N/A	N/A	2021	N/A	N/A	Self-generated waste to landfill: 4,3 %

Data Recycled input materials used

	Recycled input materials used	Notes
Hilti Group	27%	For all their tools.
Hilti Svenska AB		
Competitors		
Milwaukee Tool (TTI group)	N/A	
Würth Svenska AB	N/A	
Husqvarna Group	N/A	Gardena Division EcoLineTM, a range of watering products and handheld tools, components' consist of at least 65% recycled material.
Resellers		
Ahlsell	N/A	
Best in class		
Schnitzer Steel Industries Inc	95%	The manufacturer of steel using recycled ferrous metal where virtually all material inputs are recycled materials.
Essity AB	56%	3.2 million tonnes of wood-based fresh fibre compared to 1.8 million tonnes of recycled fibre (2021).
Customers		
Skanska	N/A	

Data Rate of recycled materials for packaging

	Recycled materials for packaging (tonnes), R	Total packaging used (Tonnes), T	R/T	%	**Notes/Initiatives**
Hilti Group	N/A	N/A		N/A	Recycled content of cardboard boxes = 60 % (2021) - 1/3 of toolboxes produced in Europe are made with 100 % recycled plastic. - Tool bags are produced with 100 % recycled fabric and a total average recycled content of 70 %.
Hilti Svenska AB	N/A	N/A		N/A	
Competitors					
Milwaukee Tool (TTI group)	64518	72913	0,885	88%	
Würth Svenska AB	209	N/A		N/A	100 % non-renewable plastic has been replaced with 52 % recycled plastic, which is 100 % recyclable. The filling material consists of 99% air and 1% material.
Husqvarna Group	N/A	N/A		N/A	All packaging for Gardena Division EcoLineTM is made from 100% recycled and recyclable material.
Resellers					
Ahlsell	N/A	N/A		N/A	In 2021, the average value was 90 percent of waste in their central warehouses and 52 percent in their stores was sent in to professionals to be sorted.
Best in class					
Schnitzer Steel Industries Inc	N/A	N/A		N/A	
Essity AB	N/A	N/A		78%	
Customers					
Skanska	N/A	N/A		N/A	

Appendix 2

The following appendix presents the 11 concepts which had been further developed from the initial idea stage.

Concept 1: Recycling routine with checklist

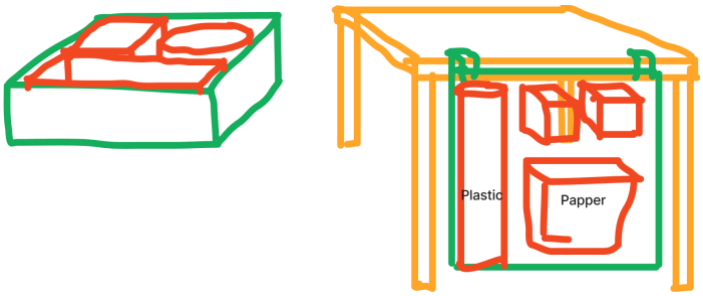
The concept is a routine for correct recycling that also includes a routine for re-sorting materials that ended up in the wrong bin. The routine is embodied as a checklist that is checked either daily, or every time recycling is made. The check list could be physical or digital and would need some sort of assurance, that the checklist was used.

Concept 2: Training in recycling

The concept is a training regarding recycling in the stores that all store staff needs to go through. The training will be standardised and led by a responsible person, for example the store manager. The training should both focus on how recycling should be done, but also the positive and negative consequences of recycling correct or incorrect.

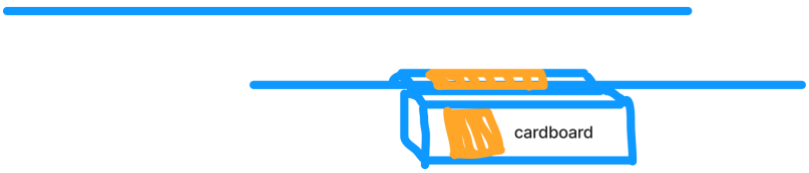
Concept 3: sub-station for recycling by the desk

The concept is a small recycling station by the store desk that can be used throughout the day and then emptied when time is available. The station should have compartments for every type of recycling the store has, this to avoid going back to the storage room or throw waste on the floor every time new waste comes up. The station could either be under the desk, or on one of the sides.



Concept 4: Handle/add-on for each recycling bin with the correct material

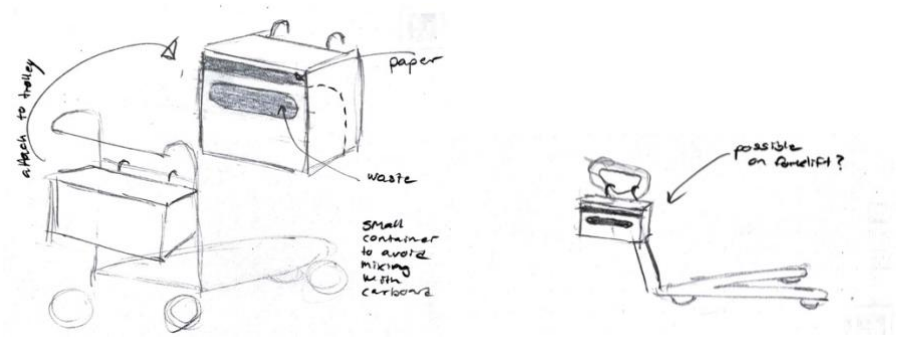
The concept is a handle, add-on, or other physical product connected to the recycling bins that shows the material that could be recycled. The material sample should indicate and nudge the staff to not throw the wrong material in each bin.



Concept 5: Waste management in front store

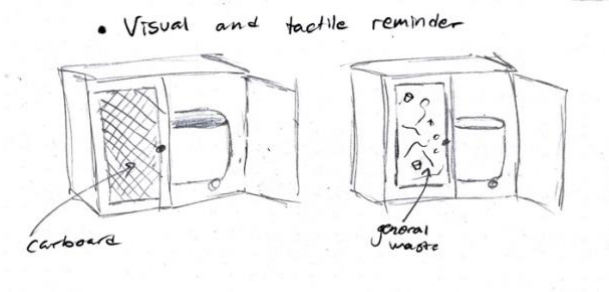
To prevent plastic and paper to be mixed with carboard when unpacking deliveries, a smaller waste management container is made to be attached on the trolley or forklift. In this way the worker can sort

the smaller pieces of waste directly which ensure the waste does not end up in the same bin later when the worker goes to the back-store to throw it away.



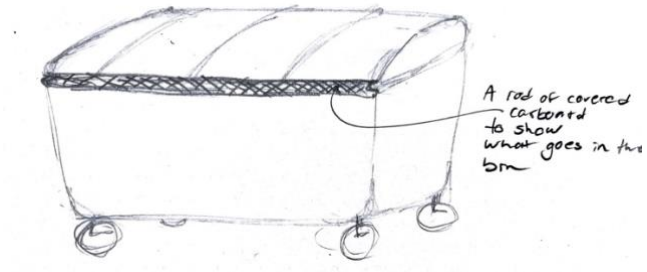
Concept 6: Visual and tactile reminder

To remind the staff of what waste that should go in what bin, the bins is put in lockers with outsides representing the correct material.



Concept 7: Click-on material sample on bin

A material sample is fastened on the recycle bin to give a visual reminder of what material that goes to what bin. The sample should not adjust the bin, only be “clicked” on. The click-on sample stays on the container when emptied.



Concept 8: In-house reuse

An open shelf where the staff can put material, they believe they can reuse in the store instead of throwing it out. This can make the staff more aware of possibilities with the waste.

Concept 9: Save wrong sorted materials

With a webpage where the staff can self-report if they move something away from the wrong bin and out it in the right bin. This can be a competition between different stores to see who the best at waste management (like step counting initiatives). Incorporate information on consequences of good circular economy. Reoccurring every quarter

Concept 10 Click-on lid extension

Fasten on the lids of the container, plastic screens which limits or indicates what size of the waste that belongs in what bin. A round hole for general waste to indicate that carboard boxes should not go in here. And a thinner gap for the carboard bin which encourage the staff to flatten the boxes. The screen is click-one'd on the bin and stays there when emptying the bins.

Concept 11 Go home-checklist

When the staff has closed the store and is about to wind up their day, they pull out the last task checklist. They work through the checklist (about 20 min). The list contains:
Lock the doors
Sweep the floors
Log out form the computer
Overlook the waste station and put material that are in the wrong bin correctly
Unpack packages that they did not have time to take care of during the day

Appendix 3

The following appendix contains the Kesselring matrix. This matrix was used to eliminate all concepts but one.

Chalmers		**Kesselring matrix**																							
Created: 2023-05-05																									
Criteria		**Alternative**																							
X = Requirement		**Ideal**		**1**		**2**		**3**		**4**		**5**		**6**		**7**		**8**		**9**		**10**		**11**	
Name	w	v	t	v	t	v	t	v	t	v	t	v	t	v	t	v	t	v	t	v	t	v	t	v	t
Positive impact on correct recycling	X	x		x		x		x		x		x		x		x		NO		x		x		x	
Implementable in all stores	X	x		x		x		x		x		x		NO		x				x		x		x	
Not changing recycling bins	X	x		x		x		x		x		x				x				x		x		x	
Accepted by users	5	5	25	4	20	4	20	4	20	5	25	3	15			4	20			2	10	4	20	3	15
Not enable workarounds	4	5	20	2	8	1	4	3	12	5	20	3	12			3	12			1	4	3	12	4	16
Intuitive use	4	5	20	3	12	2	8	5	20	3	12	5	20			5	20			5	20	5	20	5	20
Avoid additional time consumption	3	5	15	3	9	5	15	5	15	5	15	4	12			5	15			4	12	4	12	2	6
Change staff attitudes	2	5	10	3	6	5	10	3	6	3	6	2	4			3	6			5	10	3	6	3	6
Educates regarding recycling	2	5	10	1	2	5	10	3	6	3	6	3	6			3	6			3	6	3	6	1	2
Simple manufacturing	1	5	5	5	5	3	3	2	2	3	3	1	1			2	2			3	3	1	1	5	5
Cheap manufacturing	1	5	5	5	5	2	2	2	2	2	2	2	2			2	2			1	1	1	1	5	5
V=Sum v		40		26		27		27		29		23		0		27		0		24		24		28	
V/Vmax		1,0		0,65		0,68		0,68		0,73		0,58		0,00		0,68		0,00		0,60		0,60		0,70	
T=Sum t			110		67		72		83		89		72		0		83		0		66		78		75
T/Tmax			1,0		0,61		0,65		0,75		0,81		0,65		0,00		0,75		0,00		0,60		0,71		0,68
Rank					6		5		2		**1**		5				2				7		3		4
Decision		**Concept 4 is taken further to final development.**																							

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