Bachelor's Thesis

Industrial Management Engineering

2024

Elviira Nyrhilä

A system responsible's possibilities to affect the size of a system's carbon footprint

TURKU AMK
TURKU UNIVERSITY OF APPLIED SCIENCES

Bachelor’s Thesis | Abstract

Turku University of Applied Sciences

Industrial Management Engineering

2024 | 45 pages

Elviira Nyrhilä

A system responsible’s possibilities to affect the size of a system’s carbon footprint

The purpose of this thesis was to discover ways with which a system responsible could affect the size of the carbon footprint the system produces. The thesis was done to detect areas in the Hotel Design Department in which sustainability could be improved in, focusing on the role of a system responsible. Parts of the thesis are not included in the public version.

The theoretical part of the thesis focuses on sustainability, standards, permits and carbon footprint assessment methods. The intention of the theoretical part is to give background to the topics that are discussed during the research part.

As a result of the thesis, suggestions of development are given out and areas that need further consideration are presented. In addition, suggestions for additions to the work instructions of a system responsible are given. Based on the results it can be stated that there are still areas in which sustainability factors have not been fully considered and where there is still a need for improvement.

Keywords:

Sustainability, Life Cycle Assessment, Carbon footprint, Environmental Product Declaration, Job description, Development

Opinnäytetyö AMK | Tiivistelmä

Turun ammattikorkeakoulu

Tuotantotalous

2024 | 45 sivua

Elviira Nyrhilä

Systeemivastaavan mahdollisuudet vaikuttaa systeemin hiilijalanjäljen kokoon

Opinnäytetyön tarkoituksena oli löytää keinoja, joilla systeemivastaava voi vaikuttaa systeeminsä tuottaman hiilijalanjäljen kokoon. Opinnäytetyö tehtiin, jotta voitaisiin löytää alueita hotellisuunnitteluosastolla, jossa kestävyyttä voitaisiin parantaa, keskittyen systeemivastaavan rooliin. Jotkin opinnäytetyön osat eivät sisälly julkiseen versioon.

Opinnäytetyön teoreettinen osuus keskittyy kestävään kehitykseen, standardeihin ja lupiin, sekä hiilijalanjäljen arviointimenetelmiin. Teoreettisen osuuden tarkoituksena on antaa taustatietoa aihealueille, joita käsitellään tutkimusosuuden aikana.

Opinnäytetyön tuloksena syntyi kehitysehdotuksia ja lisätutkimusta vaativat aihealueet esiteltiin. Lisäksi annettiin ehdotuksia lisäyksille systeemivastaavan työnkuvaukseen. Tulosten perusteella voidaan sanoa, että on yhä osa-alueita joissa vastuullisuustekijöitä ei olla täysin huomioitu ja joissa on yhä tarvetta kehitykselle.

Avainsanat:

Vastuullisuus, Elinkaariarviointi, Hiilijalanjälki, Ympäristöseloste, Työnkuvaus, Kehitys

Table of contents

List of abbreviations and glossary used **6**

1 Introduction **8**

2 Sustainability **9**

2.1 Sustainability in businesses 9

2.1.1 How to implement sustainability as a goal 10

2.1.2 Benefits 12

2.1.3 Challenges 12

2.2 Goals within different organizations 14

2.2.1 The SDGs 14

2.2.2 EU goals 16

2.2.3 International maritime organization 16

2.2.4 Cruise lines international association 17

3 Standards and permits **18**

3.1 ISO 14001 18

3.2 ISO 14040 and 14044 19

3.3 EMAS 19

3.4 Environmental permits 19

3.5 EU Ecolabel 20

3.6 EPD 20

3.7 PEF 21

4 Carbon footprint assessment methods **22**

4.1 GHG protocol 22

4.1.1 Identifying sources of GHG emissions 22

4.1.2 Selecting an approach for calculation, collecting data and applying tools 24

4.2 LCA 25

4.2.1 Stages 25

4.2.2 Methodology 26

4.2.3 Models 26

5 Possibilities of a system responsible 28
5.1 Background 28
5.2 Design process at Meyer Turku 28
5.2.2 Hotel Design Department 29
5.2.2 Role of a system responsible 30
5.3 What sustainability things will be considered 31
5.4 Present state 31
5.5 Possibilities in the chosen systems 32
5.5.1 Possibilities in supplier choices 32
5.5.2 Possibilities in communication between stakeholders 33

6 Recommendations 35
6.1 How to include the results into a system responsible's daily work 35
6.1.1 Possible obstacles and benefits 36
6.2 Job description content 36

7 Conclusion 38
7.1 For further research 38

Sources 40

Appendices

Appendix 1. Interview questions for system responsibles

Figures

Figure 1. Stages of sustainability (Adapted from Silvius etc. 2012, 13) 10
Figure 2. UN goals 12, 13 and 14 (United Nations, 2024a) 15
Figure 3. GHG Scopes (Adapted from Greenhouse Gas Protocol. n.d.).....23

List of abbreviations and glossary used

Bottleneck	A point within a project or process that slows it down (Orderful n.d.)
CLIA	Cruise lines international association (Cruise lines international association, 2024)
DAP	Delivered-at-place (The Investopedia team, 2024a)
EMAS	Eco-Management and Audit Scheme tool (European Commission 2024b)
EPD	Environmental product declaration (The international EPD system n.d.)
ESG	Environmental, social and governance (Spiliakos, 2018)
GHG	Greenhouse gas (Greenhouse gas protocol n.d.)
HFC	Hydrofluorocarbon (Rogers n.d.)
IMO	International Maritime Organization (International maritime organization, 2024a)
ISO	The International Organization for Standardization (International organization for standardization, 2024a)
ISO 14040	A globally recognized standard that describes the framework for an LCA (International organization for standardization, 2024b)
ISO 14001	A globally recognized standard that describes the requirements for an environmental management system. (International organization for standardization 2015, 2)
ISO 14044	A globally recognized standard that describes the requirements and produces guidelines for an LCA (International organization for standardization, 2024c)
LCA	Life cycle assessment (Shaked etc. 2015,1)

MARPOL	The International Convention for the Prevention of Pollution from Ships (International maritime organization, 2024c)
Necoleap	A green transition project (Meyer Turku, 2024b)
Owner	The cruise line company that has ordered the ship. (Internal documents)
PEF	Product environmental footprint (Ecochain, 2024a)
SDG	Sustainable development goal (United Nations, 2024a)
SETAC	The Society of Environmental Toxicology and Chemistry (Setac, 2024)
Ship contract	The contract between the shipyard and the owner. (Internal documents)
SOLAS	The international convention for the safety of life at sea (International maritime organization, 2024d)
System	An entity of a specified material/product in the ship (Internal documents)
System responsible	The responsible of a material system (Internal documents)
Technical team leader	The responsible for the technical specification of his/her area (Internal documents)

1 Introduction

The concept of sustainability is said to state as far back as the late 18th century when Thomas Malthues put forth the idea that earth would eventually not be able to sustain the increasing growth rate of its population, which would then lead to the collapse of both human and natural systems. To him, the only solution was to control population growth, an idea that was later surpassed with technological advancements. (Portney, 2015, 5).

This thesis was commissioned by Meyer Turku. The company's Necoleap program's goal is to develop a carbon neutral cruise ship concept by the year 2025 as well as to ensure the carbon neutrality of the shipyard's own operations by 2030. (Meyer Turku 2024b) The topic of the thesis is ideal as in the 21st century companies have gained important competitive advantage by considering the quickly growing sustainability needs of the planet, not to mention the need of following different internationally binding laws that have been set to delay the effects of global warming.

The thesis will aim to answer the following question: Are there ways that a system responsible can actively affect the size of the system's carbon footprint? Based on the results the work instructions of a system responsible will be updated to give sustainability factors more value. The study will be conducted in a way that its findings can be further utilized for other systems in the future. The study will conclude literary familiarization towards topics like sustainability and different standards as well as carbon footprint assessment methods. Qualitative methods such as interviews will be performed to collect data and personal research will be conducted to further review the data provided in the company's material systems.

2 Sustainability

First defined as" meeting the needs of the present without compromising the ability of future generations to meet their own needs" by the United Nations Brundtland Commission in 1987, sustainability by definition has varied throughout the years. (Browne 2022.)

To describe what sustainable development is the "Three Pillars of Sustainability" was created. It splits the concept of sustainability into three pillars: Environmental Sustainability, Social Sustainability and Economic Sustainability. (Browne 2022.) Environmental Sustainability is the environment's capability of supporting a certain degree of environmental quality and the extraction of natural resources endlessly. The consequences of not achieving environmental sustainability will be catastrophic, yet due to the outcome of it being delayed it remains too unimportant to solve. The ability of a social system to maintain a certain level of social well-being is called social sustainability. Indicators such as war, poverty, different types of unfairness and low level of education are evidence of a system's social unsustainability. Economic Sustainability is an economy's capability of supporting a certain level of economic production endlessly. Due to the recession of 2008 this remains widely as the main focus which then endangers the achievement of Environmental Sustainability. (Thwink.org, 2014.) Due to the thesis' topic, the focus will be on Environmental Sustainability.

2.1 Sustainability in businesses

Throughout the years more and more companies have accepted and implemented at least some level of sustainability into their core functions. This has of course been widely influenced by regulations set by governments and multinational organizations, as well as other forms of outside pressure and set of morals and values. The level of sustainability a company chooses is, however, prone to a lot of variation. (Silvius etc. 2012, 13.)

These levels a company chooses to act on can be divided into five stages: Pre-compliance, compliance, beyond compliance, integrated strategy, purpose and passion. The stages are represented in Figure 1.

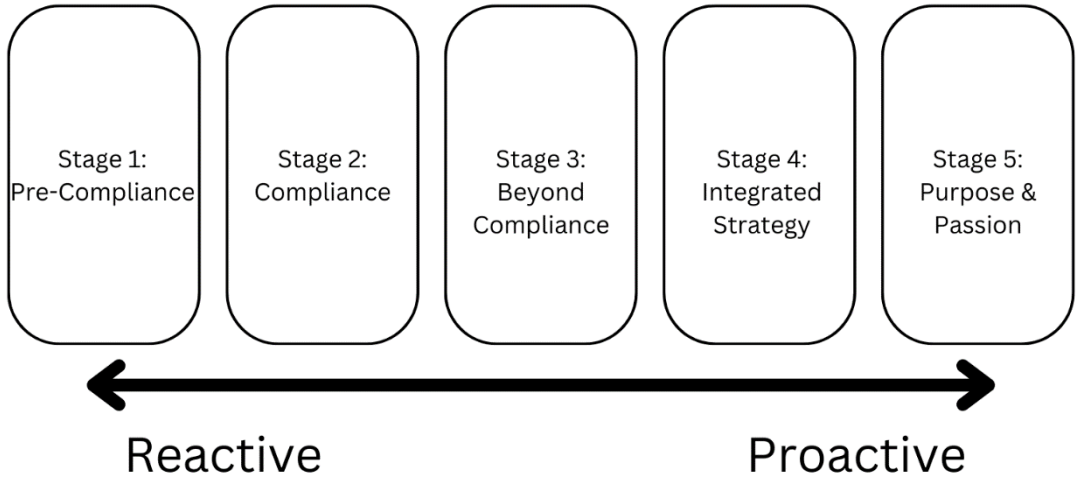

Figure 1. Stages of sustainability (Adapted from Silvius etc. 2012, 13)

As a company moves from stages 1-5 it starts from not following environmental regulations to, complying with them, introducing sustainable actions within the organization, integrating sustainability in its strategy to finally transforming from a profit seeking organization to one that wants to improve our environment through a sense of responsibility. (Silvius etc. 2012, 13-14.)

2.1.1 How to implement sustainability as a goal

In addition to an organization's core values, a company might be claiming sustainability as one of its goals since most investors are using so called ESG metrics to determine an organization's ethical influence and level of sustainability (Spiliakos, 2018.)

When a company creates sustainability goals, it needs to guarantee that those goals are aligned with its business processes. This can mean major changes,

for example in used materials or sources of energy. Direction can be found from frameworks set by different organizations such as the UN or WWF. (Steele, 2021.) More detail will be put on these frameworks later in this chapter.

Creating a sustainability goal for the company includes four steps (Spiliakos, 2018.):

1. Evaluate the problems and define goals

   The organization needs to determine what is the meaning of sustainability for the different stakeholders. The meaning might vary remarkably between the company, its workers, and the client. Therefore, the goals might vary as well.

2. Define the aim

   To start, concrete goals must be defined. To help with this a mission statement should be created to outline the values and the five W's: Who, what, when, where and why. It should also give room for growth.

3. Strategy

   Sustainability strategy should be created in a way that it does not cut down on the profit. Even minor changes can have a big effect especially when the company in question is sizable. The industry in question will have a considerable influence on what kind of strategy is created. It is important to consider whether the customers are prepared to pay more for sustainability or if it would be smarter to consider factors such as cutting down on waste.

4. Implementation

   Following up on the strategy and making sure results are achieved is perhaps the most important part to improve sustainability. A revisit to the created mission statement and goals will help to stay on track. To get things started, the areas where the effect will be the greatest is a good place to begin. (Spiliakos, 2018.)

2.1.2 Benefits

From an organization's point of view perhaps the most important aspect of the transition into sustainability are the benefits. At first the transition may only sound like something that is adding onto the costs, but in fact it can be quite the opposite. Being more ecofriendly also means being more efficient, meaning that the aim is to move processes towards the point where less materials, energy and water are used as well as cutting down on the producing of waste. Value is also added when the lifespan of products increases by using more durable products and processes. (Silvius etc. 2012, 14.)

Another important aspect is a company’s ability to increase revenue by producing products that are more sustainable than the ones competitors offer. A real-life example of this is General Electric’s program launched in 2010 that doubled the company’s past investment in producing products that have considerable environmental and economic performance. The company was eventually able to double that investment in revenue. The success of the company demonstrates the constantly growing demand for more sustainable products. (Silvius etc. 2012, 14-15.)

Not adhering to sustainable carefulness may also have its risks. Making considerable sustainable damage deliberately or not and thereby breaking international laws can have considerable financial consequences both in legal fees and in the damage done to the brand. (Silvius etc. 2012, 15.)

2.1.3 Challenges

Different studies prove that companies struggle with inserting sustainability into their operations. Beforehand this has been due to the major transformation needed that would affect several different aspects within the organization. (Milanese etc. 2022.)

Six main challenges to create an effective sustainability plan in businesses have been determined. They include not understanding the sustainability strategy,

failing to change the business model, no balance between short- and long-term sustainability plans, overlooking the value added by sustainability partners across expanded ecosystems, governance complicating control and being unable to track performance with the correct tools. (Milanese etc. 2022.)

The sustainability strategy not being understood is a frequent problem among the employees. This is usually caused by factors such as insufficient communication, lack of incentives and lack of understanding internal sustainability standards. Improvement is needed in informing the employees of the strategy and in explaining to employees what is measured and what the KPIs are. Incentives must be created to create an environment where all employees are enthusiastic in executing sustainability plans. (Milanese etc. 2022.)

Sustainability will need to be a central goal in all the organization's business models and depending on the sector in question minor modifications will most likely not take the company there. To gain the full advantages of sustainability and meeting the set targets, a change in models and ways of operating are needed. (Milanese etc. 2022.)

For the strategy to fully function, there will need to be a mix of long- and short-term plans. Once a long-term goal is set, short-term goals to achieve it will need to be set. To set those short-term goals, the current situation will need to be estimated. To elevate these goals, an organization should be introduced to sustainability partners across wider ecosystems. This will add new ideas and ways of thinking. (Milanese etc. 2022.)

The changes made will need to be met with strong governance. This is to ensure that the entire organization understands the goals and can move in the same direction. The governance will have to make sure that standards are explained and measured at every level. The built governance can be organized in a lot of different ways, keeping in mind that to function well it will need to be ingrained into the existing corporate organization and must have at least some corporate control over it. (Milanese etc. 2022.)

Being unable to track performance is a serious challenge the organization might face. An organization must be efficient in tracking progress towards meeting sustainability targets and demonstrating it to different stakeholders such as investors, authorities, and customers. However, many organizations lack correct tools to measure and follow the performance made towards the set targets. This creates a problem with different stakeholders that demand a higher level of transparency and a lack of data resulting in a lower level of sustainability. (Milanese etc. 2022.)

2.2 Goals within different organizations

2.2.1 The SDGs

The cornerstone and possibly the most widely known sustainability goal is the SDGs by the United Nations. Included in “The 2030 Agenda for Sustainable development”, the SDGs were adopted by every member state in 2015 with the goal of peace and prosperity for all now and in the future. (United Nations, 2024a)

The seventeen goals are (United Nations, 2024a)

“

1. No poverty
2. Zero hunger
3. Good health and well-being
4. Quality education
5. Gender equality
6. Clean water and sanitation
7. Affordable and clean energy
8. Decent work and economic growth
9. Industry, innovation and infrastructure

10. Reduced inequalities
11. Sustainable cities and communities
12. Responsible consumption and production
13. Climate action
14. Life below water
15. Life on land
16. Peace, justice and strong institutions
17. Partnership for the goals”

Due to the content of the thesis, we will be focusing on three of these that are represented in Figure 2.: Responsible consumption and production, Life below water and Life on land.

Figure 2. UN goals 12, 13 and 14 (United Nations, 2024a)

The goal twelve, Responsible consumption and production, focuses on ensuring patterns for sustainable consumption and production. It was detected as one of the three necessities for sustainable development in 2002 at the World Summit on Sustainable Development along with the removal of poverty and natural resource management. At that point it was acknowledged that fundamental changes to the ways societies consume and produce are crucial in achieving global sustainable development. (United Nations. 2024b)

Climate action, as goal thirteen, aims to tackle climate change and its impacts. To do that, countries united in the first legally binding agreement, the Paris

agreement. The importance of this specific goal can be demonstrated by stating the fact that the process made towards this goal will have a significant effect on other SDG goals as well. (United Nations, 2024c)

Goal fourteen, Life below water, seeks to preserve the oceans, seas and marine resources. In total they cover more than two-thirds of the earth's area and are therefore a vital part of its ecosystem. Not only are they important due to the water and oxygen they provide, but also for the livelihood they create for over three billion people. (United Nations, 2024d)

2.2.2 EU goals

The European Union has aligned its goals within the United Nations' SDG's. The president of the European Commission, Ursula von der Leyen has acted ambitiously towards delivering the SDGs in EU and beyond its borders. In fact, her program integrates all seventeen of them in the commissions' core strategies and proposals. The member states have the initial responsibility for ensuring that these goals are met on all levels, including national policies, and they are obligated to report regularly on progress made towards meeting them. (European Commission 2024a)

2.2.3 International maritime organization

The United Nation's organization known as the International Maritime Organization (IMO) specializes in shipping security and safety as well as preventing marine pollution caused by ships. (International maritime organization 2024a)

All though shipping compared to other methods of transportation is environmentally speaking the best option, IMOs way of following the SDGs is still crucial in keeping the oceans safe. IMO's work is directly linked to the 14th SDG "Life below water" as it seeks to implement its regulations and through it

address the issue of marine pollution. (International maritime organization 2024b, 3-5.)

IMO does not only focus on pollution of the sea, but it also addresses air pollution and emissions caused by ships, as well as ocean acidification. All these critical issues are covered in the MARPOL Annex, the international convention for the prevention of pollution from ships. (International maritime organization 2024b, 5; International maritime organization 2024c)

The international convention for the safety of life at sea, better known as SOLAS, is regarded as the most significant of the treaties regarding the safety of merchant ships. First adopted after Titanic, the convention has been updated repeatedly through the years to address current issues. Its main purpose is to create the framework of what is mandatory on a minimum level for construction, materials, and operations to ensure safety. (International maritime organization 2024d)

2.2.4 Cruise lines international association

To reduce emissions and through that slow down global warming, the cruise industry is continuing its path in developing new technologies that help in that reduction. This includes the use of LNG as fuel, developing special paints to improve fuel efficiency, wastewater treatment systems, modern recycling practices, utilizing shoreside power, exhaust gas cleaning systems and so much more. To add, CLIA cruise lines are obligated to meet all national and international laws and often even exceed them. As the target of IMO is zero emissions, the cruise line industry has invested billions into developing technology to achieve this goal. Nothing goes undetected, as cruise ships face continuous inspections by different organizations depending on location such as flag state authorities, U.S. coast guard and different classification societies. (Cruise lines international association 2024)

3 Standards and permits

3.1 ISO 14001

An international standard known as ISO 14001 specifies the conditions for an environmental management system. With it companies can gain competitive advantage by improving their environmental performance. All different kinds of organizations can gain from an ISO 14001 standard, whether small or large, private, or governmental. What is required is that the organization acknowledges all kinds of environmental issues related to its operations, as well as works towards continual improvement. (International organization for standardization 2015, 2-3)

As for the reasons why an organization should conform to the standard, there are many. ISO 14001 helps show that all applicable laws and regulations are being followed, increases employee engagement and involvement of the leadership, improves the reputation of the company as well as trust between stakeholders, provides competitive advantage through strategic business aims, improves efficiency and reduces costs and encourages suppliers towards better environmental performance. (International organization for standardization 2015, 4)

Companies that have implemented ISO 14001 into their business strategy have been able to succeed in several areas including reducing both energy and water consumption, finding a more systematic way to comply with legal requirements and improving their total environmental performance. (International organization for standardization 2015, 8)

To get a company certified with the standard the first step is to implement an environment management system that is based on ISO 14001, then having an audit of it by a certified body to make sure that the implemented system meets the requirements. To meet the standard’s requirements there are several processes that are mandatory to include and some that can be added if the

company finds them necessary. Before moving to the auditing phase, the newly implemented environment management system will have to be operated for a while to collect records. After a successful audit, the company will be certified. (Hammar, 2024)

3.2 ISO 14040 and 14044

Created by the international organization for standardization the two standards, ISO 14040 and ISO 14044, allow organizations to perform an LCA in a standardized way. The framework is defined in ISO 14040 and the requirements in ISO 14044. Together they define the LCA, its inventory and impact phases and give a guideline for reporting and reviewing its results. Protocol for LCA limitations, managing relationships between phases and conditions for value choices can also be found in them. (KPMG, n.d.)

An LCA that follows the guidelines has four phases: study scope definition, preparation of inventory, assessing impacts and final evaluation. Different sub standards can also be found for these two standards to help make sure products and services have not been subject to greenwashing (KPMG, n.d.)

3.3 EMAS

Eco-Management and Audit Scheme tool created by the European Union called EMAS helps organizations to strengthen their environmental performance. It works within the framework of the European Green Deal, and it allows organizations to assess, report and improve their entire environmental performance through continuous improvement. (European Commission 2024b)

3.4 Environmental permits

Environmental permits are needed if there is a risk that the activities performed will cause pollution to the environment. In Finland, an application of such permit

will need to be sent to either the municipal environmental protection authority or the regional state administrative agency. Activities cannot begin without such a permit. The list of activities needing a permit includes for example the metal industry, chemical industry, ports and airports and many others. (Regional State Administrative Agency, n.d.) As a shipyard, the Meyer Turku shipyard also holds such a permit.

3.5 EU Ecolabel

Products that attain a reduced impact on the environment during their life cycle and that provide factual data to consumers can qualify for the ecolabel. The goal of the Ecolabel is to reduce the negative impacts of consumption and production and therefore it aims to promote those products with the best environmental performance on the market. The criteria seeks to take into consideration new environmental developments in evaluation of scientific evidence. To encourage development of products with a higher environmental performance in sectors affected by consumer choice due to environmental performance, the possibility of attaining the label should be extended. (Regulation of the European Parliament and of the Council (EC) No 66/2010, 1-6)

3.6 EPD

An environmental product declaration gives out a detailed description of the environmental performance of a product or a service from a life cycle viewpoint. The data it provides has been verified by a third-party representative and is therefore both transparent and impartially produced. As it uses LCA as its groundwork it usually considers the entire life cycle of the product. It consists of an LCA report that is viewed by the third-party representative and a public document consisting of the results and other related contents. The latter can be viewed in an EPD library for all the public. (The international EPD system n.d.)

3.7 PEF

Initiated by the European Commission, the Product Environmental Footprint is a new and improved method to measure a product's environmental performance. Being based on LCA, the PEF provides an improved framework of the steps and regulations for a life cycle assessment that can be easily compared between different companies. (Ecochain, 2024a)

With this new easily comparable standard for an LCA consumers can avoid being victims of greenwashing. By having one standard method between all the EU countries the results will be more credible as they all share the same framework and can then be easily compared. (Ecochain, 2024a)

4 Carbon footprint assessment methods

4.1 GHG protocol

In collaboration with governments and different businesses and organizations, the GHG Protocol creates extensive, internationally standardized frameworks for measuring and controlling greenhouse gas emissions from value chains, mitigation efforts and activities in the public and private sectors. It was created based on a demand in the late nineties for an international standard for enterprise GHG accounting and reporting. (Greenhouse gas protocol, n.d., 4)

To identify and calculate sources of GHG emissions based on the protocol companies must follow the following steps:

1. Identify sources of GHG emissions
2. Choose a method for calculating greenhouse gas emissions.
3. Choosing emission factors and collecting activity-based data
4. Application of calculation tools
5. Increase the level of GHG emissions data to enterprise level

(Ranganathan etc. 2004, 40)

4.1.1 Identifying sources of GHG emissions

Every business produces GHG emissions from various categories either directly or indirectly through its operations, goods, or services. The categories include fugitive emissions, process emissions, mobile combustion, and stationary combustion. The calculation tool based on the GHG protocol is based on these categories and to help the enterprise detect emission sources the GHG provides three scopes they can be divided into. (Ranganathan etc. 2004, 41) The scopes are represented in Figure 3.

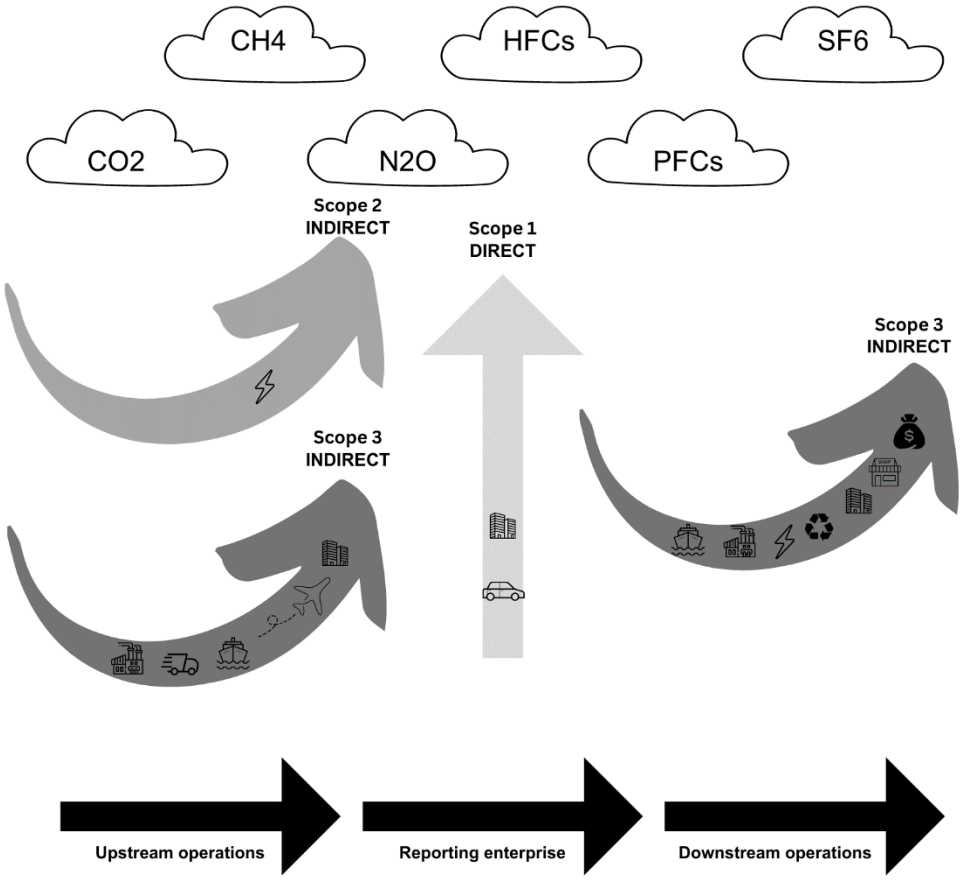

Figure 3. GHG Scopes (Adapted from Greenhouse Gas Protocol. n.d.)

Scope 1 focuses on direct emissions. Based on the type of industry they may or may not have emissions from all the categories. For example, a manufacturing company is likely to have direct emissions from all the four categories whereas an office company might not have any. (Ranganathan etc. 2004, 41)

Scope 2 focuses on indirect emissions caused by usage of purchased steam, heat, or electricity. Hardly any organization is self-sufficient in the way that they do not have consumption in this scope (Ranganathan etc. 2004, 41.)

Scope 3 ensures that all forms of emissions are considered. So, in addition to the latter, it includes other forms of indirect emissions caused by the organizations upstream and downstream operations. It also includes all the outsourced manufacturing, leases, and franchises. By choosing Scope 3, the

organization can detect GHG emissions in its entire value chain and be able to undergo major deductions. (Ranganathan etc. 2004, 41)

4.1.2 Selecting an approach for calculation, collecting data and applying tools

GHG emissions are hardly ever calculated by monitoring different rates during operation. Instead, companies usually choose to base their calculation on documented emission factors. Fuel usage data can also be used to accurately calculate emissions. The amount of fuel used, and its carbon content is something that most businesses are already aware of so calculations are not hard to produce based on that. (Ranganathan etc. 2004, 42)

Scope 1 emissions can be calculated based on the quantity of purchased fuels and scope two emissions by metered consumption. Scope 3 emissions may be calculated using activity information such as passenger miles or fuel consumption and third-party or published emission factors. Emission factors that are specific to a source should be preferred over general factors. (Ranganathan etc. 2004, 42)

A company may use its own ways of carrying out GHG calculations if they align with the approaches of the GHG protocol corporate standards or use tools created for the task. The calculation tools can be divided into two groups: Sector-specific and cross-sector tools. The cross-sector tools include the usage of HFC’s in air conditioning and refrigeration, mobile and stationary combustion and uncertainty measurement and estimation. Sector-specific tools were created to calculate emissions in sectors such as office companies or oil and gas or paper industries. To fully unveil an organization’s sources of GHG emissions more than one tool may have to be used. (Ranganathan etc. 2004, 42-43)

To fully report its GHG emission data, an organization must collect and combine the data from all its facilities, and it might therefore be a lengthy process with

the possibility of errors. To aid in this different tools such as databases, spreadsheet templates or forms of paper reporting may be used. (Ranganathan etc. 2004, 45)

4.2 LCA

Life cycle assessment (LCA) is a crucial tool made to aid in the decision making towards choosing the correct technological solutions. It is especially important from the environmental standpoint as it considers the entire life cycle and does not give room to move the problem elsewhere or to another time. Unlike other environmental tools, LCA considers other factors too in addition to environmental performance, such as functionality. As its name already says, LCA considers the impact of the product from design to disposal. (Shaked etc. 2015, 1)

4.2.1 Stages

Defined by the ISO and SETAC, an LCA contains four stages. (Shaked etc. 2015, 7-9)

1. *Goal and scope definition*, where the issue is described and then the objectives and scope defined. In this stage, a lot of the important components are determined such as the function of the system, the unit that the emissions will be based on, the boundaries of the system and a detailed description of the feasible options and the base scenario.
2. *Inventory analysis*, in which the quantification of polluting emissions to air, water and soil together with retrieval of both nonrenewable and renewable materials, is completed.
3. The *Impact assessment* assesses the impacts that the quantified emissions will have on the environment.

4. *Interpretation*, where the results achieved are interpreted and uncertain matters evaluated. The results can then be compared with economic or social impacts.

It remains vital to understand that some of the stages are yet to achieve the same level of maturity as, for example, there remains room for development in focusing emissions on the right products. (Shaked etc. 2015, 7-9)

4.2.2 Methodology

An LCA can be performed in two ways, iteratively or by calculation. In the iterative method, first a screening is carried out to preliminarily evaluate the magnitude of each life cycle stage. It gives an idea of what the key processes are so that less time will be spent on those processes that do not have a significant contribution to the cause. Secondly, an analysis of more detail is carried out. The data gathered in the first screening is used to determine emissions, processes and phases that require additional research and need further exploration. In the interpretation phase a sensitivity study and uncertainty analysis is carried out and the study is finally finished by comparing the environmental impacts to socioeconomic performance. (Shaked etc. 2015, 9)

Preliminary calculations that focus on energy consumption or CO2 emissions can be made either by hand or with the use of software. For a broader study it is recommended to use a software designed for LCA together with checking balances by hand. (Shaked etc. 2015, 9) The Conduct of an LCA can be done with software such as SimaPro and GaBi. There are also several free LCA software available such as Brightway2 or CMLCA. (Shaked etc. 2015, 178)

4.2.3 Models

There are four typical models an organization can choose from based on what parts they want to consider in their LCA. The cradle-to-grave model considers

everything from sourcing of the materials to their disposal, whereas cradle-to-cradle has the same idea with the exception that materials will be recycled at the end of their life cycle. The cradle-to-gate model will only consider the impacts of the product to the point it leaves the factory, leaving for example transportation emissions to be considered by the buyer. Gate-to-gate is a model that can be used to assess the value-adding processes in the middle of the product life cycle. They are usually assessed individually and later on combined to create a more in depth LCA. (Ecochain, 2024b)

5 Possibilities of a system responsible

5.1 Background

Meyer Turku together with Meyer Werftin and Neptun Werftin create the Meyer Group concern which is one of the leading cruise ship builder companies in the world. With a hold of 15% of the industry, Meyer Turku is dedicated to building cruise ships, ferries and other vessels that are both modern and environmentally friendly. Today Meyer Turku Oy includes three partner companies: Cabin module manufacturer Piikkio Works Oy, a turnkey supplier Shipbuilding Completion Oy and a design company ENG'nD Oy. (Meyer Turku, 2024a)

In 2008 the shipyard certified its quality, safety, and environmental systems, being the first shipyard company to do so. The company has also been the leader in incorporating LNG tanks into different vessels. The company is keen on participating in projects that help develop sustainability in the maritime and shipbuilding sectors and working with research and educational institutes. (Meyer Turku, 2024b)

In collaboration with different universities and research institutions, Meyer Turku Oy's Necoleap team strives to develop technology solutions that are both sustainable and innovative on a global scale. The goals of the Necoleap program include supporting and growing innovative research and development in its shipbuilding ecosystem, The use of smart technologies through a ship's lifecycle, a climate-neutral shipyard by 2030 and Creation of a cruise ship concept that is climate neutral by 2025. (Meyer Turku, 2024b) The work done in this thesis will be to aid the last.

5.2 Design process at Meyer Turku

Shipbuilding at Meyer shipyard consists of eight phases, sales, basic design, detailed design, work planning, manufacturing, assembly, test & approval and

guarantee. (Internal documents) In this thesis we will focus on the second phase, basic design.

Although the basic design is the second phase, it is already the responsibility of the department to support the sales phase as well as to continue support in other phases after the basic design phase. In the sales phase, the technical team leaders will participate in preparing specifications and related materials, material and hourly budgets and coordinating developments within the department. They will also manage communication between different groups such as authorities, production, and classification society. (Internal documents)

5.2.2 Hotel Design Department

As part of Basic Design, the Hotel Design Department consists of five groups: Architectural accommodation, technical accommodation, hotel electric, development and HVAC & routing. The group's technical team leaders together with the head of groups ensure each ship project's successful delivery in regard to their own work group. (Internal documents)

Based on the ship contract made in the sales phase, the basic design phase will begin. It is the department's responsibility to make sure that rules and regulations are being complied with while also following the requirements of the owner. The department will create documentation for area arrangements, technical systems, and architectural systems and design routing, locations, and layouts. Communication with the owner in case of a need for changes is also the responsibility of the employees in the department. (Internal documents)

As the shipbuilding process, from sale to delivery and guarantee, takes multiple months, so does the basic design process. When the official basic design phases are over, it is still the department's responsibility to continue keeping drawings up to date, support production, and manage modifications. (Internal documents)

5.2.2 Role of a system responsible

The responsibilities of the material systems in the ship have been distributed to system responsibles. The system responsible is responsible for the operation of the system, its conformity with the contract, budget compliance, scheduling, and overall development. (Internal documents)

Based on the ship contract and its specifications, the system responsible will start to look for suppliers. The process may vary between systems, as in some cases the owner will want to have a say in which kind of suppliers are used. Based on the offers from the suppliers, the system responsible might have to have negotiations with the owner, do warehouse visits, enquire for alternatives etc. to determine the most viable option for both the owner and the shipyard. After choosing the supplier, it is the system responsible's responsibility to ensure smooth delivery, installation, and function of the products. He or she will help coordinate the delivery of the products with the suppliers and work together with warehousing and production. (Internal documents)

The system responsible is also responsible for producing the necessary drawings, calculations, and material specifications of their system and ensuring that delivery documentation is done in time and in the right order. (Internal documents)

5.3 What sustainability things will be considered

To assess the emissions produced within the systems according to the GHG Scope 3, we will consider both direct and indirect emissions. To make the evaluation easier, we will share the lifetime of our materials into four stages.

1. Manufacturing
2. Transportation
3. Use
4. Disposal

All these stages will be separately considered to determine if something can be done to reach a better level of sustainability. These stages will be assessed by interviews which will then lead to personal research.

The interviews and research will be limited to two systems: deck coverings and loose furniture. The systems will be interviewed and processed separately trying to find key differences between them but also similarities that can be solved together. They are both part of the architectural accommodation work group and some similarities and solutions that could be applied to both systems are expected to be found.

Due to the study being limited to the possibilities of a system responsible and done only on two different systems the possibilities found may be limited and not be found in all life cycle stages. All life cycle stages will still be considered during the interviews to fully understand the capabilities of a system responsible.

5.4 Present state

The present state within the chosen systems was assessed by several interviews which were done with each system separately. The goal of the interviews was to collect information of the present state of sustainability factors

within the chosen systems and to estimate the possibilities of affecting the size of their carbon footprint. They were also conducted to understand different tasks of a system responsible better so that possible improvements could be detected. The interviews were conducted in Finnish and the English translation of the questions can be further reviewed in Appendix 1.

5.5 Possibilities in the chosen systems

After interviewing the system responsibles and getting a basic idea of daily work tasks, it is the aim to develop them to be more sustainable. As a result of the interviews, it can be said that the possibilities within the chosen systems are limited to supplier choices and communication, and that is where we will be focusing in this thesis. The hope is to determine ways a system responsible could give sustainability and carbon emissions more focus in their work.

5.5.1 Possibilities in supplier choices

Perhaps the most important and the biggest difference a system responsible can make is through selecting suppliers. Our system responsibles should choose suppliers based on geographical location and the level of sustainability. When choosing a supplier that is geographically close, we decrease the environmental impact caused by logistics due to a few different factors. Firstly, the transportation distance of our products is becoming smaller. Second, if replacements are needed, they can also be delivered without causing a greater environmental impact than necessary. Another viewpoint is that, when possible, we will try to repair materials instead of getting entirely new ones. So instead of having to send our materials to be repaired a long distance, we can more easily get replacement materials when the supplier is closer to the shipyard.

Assessing the level of sustainability of different suppliers is still a work in progress. Accessing sustainability data can be quite easy with some suppliers and then with some not at all. There are, however, certain factors that can be

considered to make this easier. Firstly, the system responsibles should start asking for EPDs as they provide the best solution for comparing products with the same functions. If the suppliers are not able to provide those, there are other environmental factors that could be compared to determine the most sustainable option. The system responsibles should look into different certifications and labels, as a supplier that holds those will have a good overall level of sustainability and can therefore be determined as a viable choice. If none of these exist, the choice of a supplier should be to the best of their ability be chosen based on their location, favoring the suppliers nearest to the shipyard.

Demanding better environmental performance from our suppliers can also result in shaping our market. Meyer Turku is a big company with as equally big demand for products, so it is beneficial to our suppliers to meet our demands. Although we might not yet be in a position where sustainability data is easily available, starting the process of demanding it from our suppliers will likely result in more and more of them working towards the direction of providing that in the future. It is therefore important to understand the effect of early action in the matter, so that we can easily meet the demands of the future where sustainability matters will no longer only be an option but a legal obligation.

5.5.2 Possibilities in communication between stakeholders

In the job description of a system responsible it is stated that a system responsible is the specialist of the given system and on top of other things it is his or her responsibility to follow the development of the system, including environmental development. However, there is no statement on how they are to follow up on these developments and who to contact about them. It also became clear during the conducted interviews that this process is not clear for everyone and therefore not fully utilized.

This is a clear bottleneck in the development of design and a process that should be more defined. Only through further communication of new

possibilities and better options can we make the changes required for a more sustainable outcome. Generally speaking, the communication part should happen as soon as possible since in some cases new findings could even be something that would already have to be included in the ship contract.

6 Recommendations

6.1 How to include the results into a system responsible's daily work

To assess the level of sustainability of different suppliers our system responsibles would need to begin by going through the existing suppliers and search for different sustainability indicators. An excel sheet could be a good starting point to collect data on certifications and labels that the different suppliers hold. Requesting EPD's from the suppliers should also start as soon as possible so that our suppliers would also be more aware of what will be needed from them in the future and have the time to prepare for it. Having the data from different suppliers collected would enable the system responsible to make fast decisions and form accurate comparisons.

A continuous search for new suppliers would ensure that we are using suppliers with the best possible environmental performance. New suppliers can be found from several separate places, for example by searching on the internet or by going to trade fairs. To serve the sustainability purpose, one great way to find suppliers that serve the cause is by going through different EDP libraries and registries.

For example, the international EPD system offers a library where you can search for items based on several attributes. You can filter by company name or EPD number, product category, product category rules, geographical scope and validity. As a result, you will receive products with an EPD that matches your search. Behind the provided pdf document for that product, you can find information about the product, how the LCA was conducted and other information but most importantly life cycle impacts. To support the carbon neutrality goal of the shipyard the most important attribute is the carbon emissions. However, for broader research other emissions can also be considered. The website also provides the option for machine readable EPD's, which will come in handy when a lot of data needs to be processed. (The international EPD system, n.d.)

Money cannot continue to be the key focus, as the shipyard aims to move towards a more sustainable outcome. At some point, each system will likely receive a carbon footprint budget, and the excess waste produced will not fit into it. Solutions can be explored in several areas, for example by recycling waste.

6.1.1 Possible obstacles and benefits

As the process of asking for EPD's from our suppliers is still in a very preliminary stage, it cannot be expected that we would have access to a lot of data. Having the needed data from only a few suppliers might lead the system responsible to make the wrong choices unknowingly, as some suppliers who as of now do not deliver the data might still have a better performance. Generally speaking the system responsibles should still be able to make good estimates, as for example a supplier that holds different labels and certifications should already be a good choice.

In addition, the EPD's that we would get from the suppliers may have been produced under very different circumstances. Assumptions the company has made during the LCA may vary and the software used could be different. Solutions for this problem may however be in the nearby future as for example the European Commission is introducing a standard for its member states in the upcoming year that would make their EPD's comparable. (Ecochain, 2024a)

By implementing these suggestions, we would get further towards our goal of carbon neutrality by starting to slowly move towards these practices and then hopefully in the future develop them further. All in all, we gain a starting point to our goal.

6.2 Job description content

Based on the findings in this thesis the company's job description of system responsible was updated. The goal was to give sustainability factors more

importance so the process towards more sustainable shipbuilding could be started within the Hotel Design department.

Due to the general nature of the instruction, system specific descriptions were not carried out. Each system has its own distinctive features that may or may not affect the ways things are done. For the description not to contradict those it had to be kept at a general level.

7 Conclusion

The goal of the thesis was to detect areas where sustainability factors had not been considered and development ideas could be suggested. To do so, several interviews were conducted, and personal research was done based on it. Before the interviews, the understanding of the tasks of a system responsible was much broader and therefore hopes of the number of possibilities for development greater.

The thesis process started with gathering a literature framework, which later supported the topics presented in the research part. The material for the study itself was gathered by first interviewing the system responsibles in the selected systems and then by doing personal research based on it and taking the ideas represented further. Recommendations for future actions were created based on the findings in the study. The recommendations included further review of suppliers and more thorough communication within the organization. For a system responsible to fully evaluate the sustainability of the suppliers chosen, they would need to seek for different sustainability indicators such as permits, labels and EPDs. Problems related to this were also presented. A need for a more defined process for communication and the reasoning behind it was also given.

Overall, the recommendations given in the thesis give a starting point in the department so that the design done by a system responsible can be more sustainable.

7.1 For further research

Although the thesis offers a good starting point for the department to move towards a more carbon neutral outcome there are a few factors outside of the work done in this thesis that will need more research in the future.

As the study was limited to two systems, looking into other systems and into their specific attributes might give new ideas or factors to consider. A way to determine the carbon footprint of the products where it cannot be obtained from the supplier, such as custom products, will need to be defined. Also, there is a need for templates for data collection with formulas already within them. The communication process between different stakeholders will also need to be more defined.

Sources

Browne, A. 2022. *Explainer: What Is Sustainability and Why Is It Important?* Referenced 19.01.2024. https://earth.org/what-is-sustainability/

Cruise lines international association. 2024. *Environmental sustainability.* Referenced 05.02.2024. https://cruising.org/-/media/Facts-and-Resources/CLIA_Environmental-Responsibility-Factsheet_9-June-2020_Global-US

Ecochain. 2024a. *Product environmental footprint (PEF) – A complete overview. Referenced* 28.03.2024. https://ecochain.com/blog/product-environmental-footprint/

Ecochain. 2024b. *Life Cycle Assessment (LCA) – Everything you need to know.* Referenced 28.03.2024. https://ecochain.com/blog/life-cycle-assessment-lca-guide/#product-life-cycle-lca

European Commission. 2024a. *EU 'whole-of-government' approach*. Referenced 04.02.2024. https://commission.europa.eu/strategy-and-policy/sustainable-development-goals/eu-whole-government-approach_en

European Commission. 2024b. *About EMAS*. Referenced 22.02.2024. https://green-business.ec.europa.eu/eco-management-and-audit-scheme-emas/about-emas_en

Greenhouse gas protocol. n.d. *Corporate Value Chain (Scope 3) Accounting and Reporting standard.* Referenced 07.03.2024. https://ghgprotocol.org/sites/default/files/standards/Corporate-Value-Chain-Accounting-Reporing-Standard_041613_2.pdf

Hammar, M. 2024. *What is ISO 14001?* Referenced 05.02.2024. ISO 14001: What is it, how does it work and why use it? (advisera.com)

International maritime organization. 2024a. *Introduction to IMO.* Referenced 05.02.2024. https://www.imo.org/en/About/Pages/Default.aspx

International maritime organization. 2024b. *IMO and Sustainable Development.* Referenced 05.02.2024. https://wwwcdn.imo.org/localresources/en/MediaCentre/HotTopics/Documents/IMO%20SDG%20Brochure.pdf

International maritime organization. 2024c. *Marpol*. Referenced 05.02.2024. https://www.imo.org/en/KnowledgeCentre/ConferencesMeetings/Pages/Marpol.aspx

International maritime organization. 2024d. *International Convention for the Safety of Life at Sea (SOLAS), 1974*. Referenced 05.02.2024. https://www.imo.org/en/About/Conventions/Pages/International-Convention-for-the-Safety-of-Life-at-Sea-(SOLAS),-1974.aspx

International Organization for standardization. 2015. *ISO 14001 Key benefits.* Referenced 04.02.2024. https://www.iso.org/files/live/sites/isoorg/files/store/en/PUB100372.pdf

International organization for standardization. 2024a. *About ISO*. Referenced 27.03.2024. https://www.iso.org/about-us.html

International organization for standardization. 2024b. *ISO 14040:2006.* Referenced 27.03.2024. https://www.iso.org/standard/37456.html

International organization for standardization. 2024c. *ISO 14044:2006.* Referenced 27.03.2024. https://www.iso.org/standard/38498.html

KPMG. n.d. *Life Cycle Assessment Guide.* Referenced 20.03.2024. https://kpmg.com/xx/en/home/insights/2023/10/life-cycle-assessment-guide.html

Meyer Turku. 2024a. *Company.* Referenced 19.02.2024. https://www.meyerturku.fi/en/company/index.jsp

Meyer Turku. 2024b. *Sustainability.* Referenced 19.02.2024. https://www.meyerturku.fi/en/sustainability/index.jsp

Milanese, S.; Eikelenboom, M & Stella, C. 2022. *Overcoming the challenges to sustainability.* Referenced 24.01.2024. https://www.adlittle.com/en/insights/report/overcoming-challenges-sustainability

Orderful. n.d. *What is a bottleneck in business? Definition and examples.* Referenced 05.04.2024. https://www.orderful.com/blog/what-is-a-bottleneck-in-business

Portney, K. 2015. *Sustainability*. England: The MIT Press. E-book. Referenced 19.01.2024. https://ebookcentral.proquest.com/lib/turkuamk-ebooks/reader.action?docID=4397950 Requires log in.

Ranganatha, J. Corbier, L. Bhatia, P. Schmitz S. Gage, P. Oren, K. 2004. *The Greenhouse Gas Protocol. A corporate Accounting and Reporting Standard.* Revised Edition. World Business Council for Sustainable Development and World Business Council. Referenced 07.03.2024. https://www.wbcsd.org/contentwbc/download/2670/33469/1

Regional State Administrative Agency. n.d. *Environmental permits*. Referenced 22.02.2024. https://avi.fi/en/services/businesses/licence-notices-and-applications/water-and-the-environment/environmental-permits

Regulation of the European Parliament and of the Council (EC) No 66/2010, 1-6. Referenced 08.03.2024. https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex%3A32010R0066

Rogers, K. N.d. *Hydrofluorocarbon*. Referenced 27.03.2024. https://www.britannica.com/science/hydrofluorocarbon

Setac. 2024. *Learn about SETAC.* Referenced 27.03.2024. https://www.setac.org/learn-about-setac.html

Shaked, S.; Crettaz, P.; Saade-Sbeih, M.; Jolliet, O. & Jolliet, A. 2015. *Environmental Life Cycle Assessment.* Boca Raton:CRC Press. E-book. Referenced 19.02.2024. https://directory.doabooks.org/handle/20.500.12854/29269 Requires log in.

Silvius, G.; Schipper, R.; Planko, J & Van den Brink, J. 2012. Sustainability in Project Management. London and New York:Taylor & Francis Group. E-book. Referenced 19.01.2024. https://ebookcentral.proquest.com/lib/turkuamk-ebooks/reader.action?docID=906949 Requires log in.

Spiliakos, A. 2018. *What does "sustainability" mean in business?* Referenced 24.01.2024 https://online.hbs.edu/blog/post/what-is-sustainability-in-business

Steele, G. 2021. *Setting the right sustainability goals*. Referenced 24.01.2024. https://www.forbes.com/sites/forbesbusinesscouncil/2021/05/27/setting-the-right-sustainability-goals/?sh=46904e6a5ed3

The international EPD system. n.d. *Environmental product declarations.* Referenced 26.03.2024. https://www.environdec.com/all-about-epds/the-epd

The International EPD system. n.d. *Search the EPD library*. Referenced 29.03.2024. https://www.environdec.com/library

The Investopedia team. 2024a. *Delivered-at-Place (DAP) Definition, How It Works, and Obligations.* Referenced 25.03.2024. https://www.investopedia.com/terms/d/delivered-place-dap.asp

Thwink.org. 2014. *The three pillars of sustainability*. Referenced 24.01.2024. https://www.thwink.org/sustain/glossary/ThreePillarsOfSustainability.htm

United Nations. 2024a. *Sustainable development goals*. Referenced 19.01.2024. https://sdgs.un.org/goals

United Nations. 2024b. *Sustainable consumption and production*. Referenced 19.01.2024. https://sdgs.un.org/topics/sustainable-consumption-and-production

United Nations. 2024c. *Climate Action and Synergies*. Referenced 19.01.2024. https://sdgs.un.org/topics/climate-action-synergies

United Nations. 2024d. *Oceans and Seas*. Referenced 24.01.2024. https://sdgs.un.org/topics/oceans-and-seas

Interviews for system responsibles

Interview questions 23.02.2024.

Do you think a system responsible has ways to affect the carbon footprint produced by it?

In your own work, do you already consider different sustainability factors?

Do you think more could be done to reduce the carbon footprint produced by the system?

Would considering sustainability factors increase the amount of your daily work?

Do you think you can fully estimate the environmental impact of different things within your system and make the best choices based on it?

As of right now is carbon footprint data accessible directly from the manufacturers?

Interview questions 05.03.2024.

How are the materials used chosen and what is the process behind it?

Do the materials have qualities that are adding to the carbon footprint but would perhaps not be necessary?

Who chooses the suppliers?

Who does the orders?

Can a system responsible have an effect on the way of delivery?

Are there ways that the system responsible could aid in prolonging the life cycle of the material?

Is there unnecessary waste being produced during the materials' lifecycle and if so, could a system responsible affect this?

Does a system responsible have a way of affecting how a material is disposed?

When you come across better options in your work do you know who to communicate about them and when?