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An Evaluation of the Applicability of Social Life Cycle Assessment in the Aerospace Industry

Master's Thesis - Quality and Operations Management

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INSTITUTION OF Industrials and Materials Science

CHALMERS UNIVERSITY OF TECHNOLOGY
Gothenburg 2026
www.chalmers.se

Master's Thesis 2026

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"There's no problem so bad that you can't make it worse"

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Master's Thesis 2026
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Written in LaTeX
Gothenburg 2026

An Evaluation of the Applicability Social Life Cycle Assessment in the Aerospace Industry

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Abstract

This master's thesis evaluates the applicability and effectiveness of Social Life Assessment (S-LCA) as a method for assessing social sustainability within the aerospace industry. Given the increasing emphasis in recent years on corporate sustainability, the study investigates whether S-LCA can provide meaningful insights into the complex social impacts associated with aerospace products and their global value chains. The research combines a methodological review of S-LCA and its applicability with a case study on a selected aerospace product. The study assesses how S-LCA can be implemented across different life cycle stages, from raw material extraction to usage, a so-called "cradle-to-gate" approach, and identifies social hotspots on organizational as well as on industry level. The findings indicate that S-LCA is, in theory, a valuable tool for identifying social hotspots and, by extension, feasible to use for addressing social sustainability challenges. However, the methodology presents limitations, including data availability and quality challenges, the inherent subjectivity of the assessment, and sensitivity to selected system boundaries. The case study demonstrates that results vary to a great degree depending on made assumptions and what data sources are used, which highlights the need for careful methodological choices. To summarize, the thesis concludes that while S-LCA is a promising approach, its use and effectiveness in the aerospace industry is dependent on methodological development and increased data transparency.

Key words: Aerospace, S-LCA, cradle-to-gate, sustainability, Social Life Cycle Assessment, UNEP, hotspots

Preface

Throughout the duration of the thesis, several individuals have been of great help to us. We would therefore like to express our sincere thanks to our supervisor Johanna Nylander, for her invaluable guidance and expertise lended during the project regarding sustainability and the conducting of the thesis overall.

We would also like to thank our manager Anne-Sophie Thomsen who always took time out of her day to help us irregardless of the queries we had or how small or big the issue at hand was.

A special thanks as well to the entire Sustainability, Strategy and Communications teams at Innovatum, the kindness and interest you showed in us made us feel welcome right from the start.

Finally, we would like to thank our examiner Peter Hammersberg, who always made us feel like the situation was under control during our meetings in Café Bulten.

Johannes Angel & Oscar Bisseberg, Göteborg, June 2026

Acronyms

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

E-LCA	Environmental Life Cycle Assessment
GKNA	GKN Aerospace
JRC	Joint Research Centre (European Commision)
OECD	Organization for Economic Co-operation and Development
S-LCA	Social Life Cycle Assessment
UNEP	United Nations Environmental Programme

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Introduction

1.1 Background

In the aerospace industry, social sustainability is increasingly recognized as an important aspect as a part of the long term planning (Boeing, 2025; Melrose Industries, 2026). Although discourse within the industry sustainability-wise has been dominated by environmental performance throughout recent years (Yawar & Seuring, 2017), the social impacts of companies' entire value chain on society must be taken into account to ensure the sector's ability to operate responsibly and positively towards society (Younus et al. 2016).

This presents a great challenge, as aerospace supply chains span a wide range of countries and a large number of suppliers, complicating the access to data. Furthermore, laws and regulations regarding issues such as ethical labour practices, human rights protections, and freedom of association vary greatly between different countries and regions of the world (OECD, 2025). In addition, customers, regulators, and investors expect greater transparency and responsibility throughout the value chain of companies to ensure that companies have a net positive effect on society (Truant et al., 2024).

Through social sustainability assessments, such as a social life cycle assessment (S-LCA), companies can gain knowledge and increase transparency on how their products, parts & organizations trickle down and what impacts they might have on the entire value chain from the cradle to the gate.

1.2 Case Company

The thesis was conducted in Trollhättan at the Engines division at GKN Aerospace (GKNA), a global, multi-technology aerospace manufacturer and supplier. GKNA has limited experience with social sustainability assessments and has no established frameworks or processes for conducting these assessments. This created both a challenge and an opportunity to explore the applicability of S-LCA within the context of the aerospace industry.

1.3 Purpose

The purpose of this thesis is to evaluate the applicability of Social Life Cycle Assessment (S-LCA) as a method for assessing social sustainability in the aerospace industry. The study further aims to explore current industry challenges related to social sustainability and to assess the feasibility, credibility, and usefulness of applying S-LCA to a selected product within GKN Aerospace's product portfolio.

1.4 Research Questions

How applicable and effective is Social Life Cycle Assessment as a method to evaluate social sustainability within the aerospace industry?

How can Social Life Cycle Assessment be used for a selected product to assess social impacts throughout its life cycle, and what variations appear when using the method?

1.5 Limitations

There are numerous limitations that need to be taken into consideration before conducting this thesis. The main limitation was data availability throughout the life cycle of the product. Typically, social data are rather hard to quantify and access, since the social values are more soft and fragmented in nature. The further upstream the value chain the information is, the harder it will be to collect and assess any type of data.

While Environmental Life Cycle Assessments (E-LCA) are established methods in the industry, S-LCA is a relatively new method that is not as embedded as a methodology in the industry. That means, when studying previously made S-LCAs, both made by GKNA and other actors, a high degree of variation was found. The lack of standardization also makes data collection a big challenge, since there are so many different sources and databases where project can collect their data from. Due to this lack of standardized data collection, there are risks of subjectivity in the results, since the result from the interviews and the interpretations of social impacts depends on the researcher and the sources and databases that can be accessed.

Environmental LCAs (E-LCAs) done at GKNA currently do not have an established command structure. The decision to conduct one can be made by the conducting research engineer, a product owner, material specialist or a customer, which means that the level of understanding of where and how the information is used varies. Furthermore, there exists no established feedback mechanism where the research engineer can see whether, and to what extent, recommendations derived from the E-LCA have been implemented. Since this thesis and S-LCA was conducted at the same department as the E-LCAs, it is not improbable to suggest that S-LCAs can have similar problems with where and how the insights gained from S-LCAs is reflected in future operations.

2

Theory

2.1 Life cycle thinking in the Aerospace industry

Sustainability has become a great factor within the aerospace industry regarding needs for new solutions regarding the environmental impacts that the industry and sector apply on the environment. Aircraft production and aircraft operation involve complex manufacturing processes and has often a demand for high need of industrial supply chain cooperation as the industry, and primarly, the technology evolves. This puts the demand on GKN Aerospace to be up to date with new sustainability perspectives, and it requires a holistic perspective that considers impacts occurring throughout the entire life cycle of aircraft systems and components.

The aerospace industry operates through highly interconnected global supply chains, often involving numerous of suppliers, materials, and components for the final assembly. These materials and components are typically from multiple regions around the world, meaning that sustainability impacts occur at more than one stage throughout the supply chain.

Traditionally, sustainability assessments in aviation have primarily focused on operational impacts from the industry, such as fuel consumption or greenhouse gas emissions (Janic, 2007). However, Shila & Johnson, (2025) showed that sustainability impacts should be studied across the entire life cycle of aircraft technologies and not only during the operational impacts from the industry. The authors stated that stages such as raw material extraction, manufacturing of components, aircraft assembly, aircraft operation, and the end of life stage must be taken into consideration when reviewing the sustainability in the aircraft industry.

The aerospace sector relies on global supply chains that involve many suppliers producing different materials and components (Umar et al, 2026). GKNA provides a crucial role in this supply chain by manufacturing systems and products that will later be integrated into aircraft, built by manufacturers such as Boeing or Airbus.

Applying life-cycle thinking in the aerospace industry is particularly important because of the long lifetimes of the aircrafts and complex systems. Aircraft components typically require energy-intensive manufacturing and extensive materials that can be found upstreams in the value chain, which makes it essential to assess their social and environmental implications from the earliest stages of production onward.

To consider all stages of a products lifecycle, the use of E-LCAs has grown a lot in industry recent decades. E-LCAs help identify the environmental impacts that occur throughout the entire lifecycle of a product, process, or service. The method is described in international ISO standards, which provide the main principles and guidelines for how an E-LCA should be carried out.

While LCAs have traditionally focused on environmental impacts, the International Civil Aviation Organization (ICAO, 2019) highlighted the broader role of sustainability. ICAO states that sustainable aviation development is achieved when environmental, economic, and social objectives are balanced. Therefore, focusing only on environmental aspects is not sufficient when addressing sustainability in the aerospace sector.

2.2 Social Life Cycle assessments

Focusing only on environmental aspects is not enough to achieve full sustainability. It is important to also weigh in economic and social factors to stay sustainable. Although E-LCAs and Life Cycle Costing (LCC) are well-established approaches, Social Life Cycle Assessment (S-LCA) remains the youngest and least developed of the three (Pollok et al., 2021), resulting in non-negligible variation in the methodological approaches applied across S-LCA studies.

The concept of a S-LCA is quite similar to an E-LCA. S-LCA follows a life cycle perspective, meaning that all the steps, within the set boundary, are taken into consideration. But instead of considering environmental impacts, it is measuring the social and socio-economic impacts that may occur throughout the life cycle. S-LCA is a relatively new method (Pollok et al., 2021) and as such, the applicability and the methods have varied a lot depending on which area and sector that have been investigated. The guidelines chosen for this conduct S-LCA were taken from the United Nations Environment Programme, which, together with the ISO standard that was released in 2024, provided a framework with four standard phases: Goal & Scope definition, Inventory Analysis, Impact Assessment, and Interpretation (UNEP, 2020). Continuing, they also provide possible outcomes of an S-LCA, including the identification of social risks and social hotspots.

S-LCA is a method for evaluating how people and society is affected by a specific product or service. S-LCA focuses on social conditions, examining issues related to workers, local communities, consumers, value chain actors and the entire society. In order to evaluate this, the method uses a set of social indicators. There are recommended social indicators to use for S-LCA, provided by UNEP (2020). But you can also provide your own, if literature or other reasoning argues for these social matters being relevant. Typical indicators involve issues such as health and safety, working conditions, and non-discrimination. Indicators can be quantitative, qualitative or semi quantitative, which all come with different advantages and disadvantages.

Depending on data availability, there are two approaches that can be used. If you have a lot of primary, site specific data, the best approach is to use a *Social Performance assessment*, meaning it evaluates the actual social conditions of the particular context. This assessment can be used for decision-making as it provides an image of the "current state" of the product, service, or organization. However, when primary, on-site data are not available, a so-called *Social Risk Assessment* can be used alternatively. Instead of using real performance data, this method evaluates potential social risks, typically based on global datasets or literature. These data are based on country-, region-, or sector-averages, and shows potential social risks down to the chosen level, but crucially does not paint the full picture to a product or organizational level. These two approaches provide a coherent picture of the social dimension of a product system. This dual structure allows S-LCA to focus on the entire life cycle of a product, identifying potential risks without site specific data, and evaluating the social risks where data is available.

A significant milestone for the field was the publication of the first international S-LCA standard (ISO 14075:2024), which formally established principles and a unified framework for conducting S-LCA. The standard provides guidance for goal and scope definition, inventory analysis, impact assessment, interpretation, and reporting, and aims to align S-LCA more closely with global sustainability frameworks such as the Sustainable Development Goals (SDGs) (Traverso, 2025). Despite this development, the method remains comparatively not as well-established, and its practical implementation continues to face challenges related to data availability and methodological consistency

Another challenge with S-LCA is the lack of complete data and the issue of subjectivity. Bhatnagar et al. (2024) stated that many studies struggle to collect complete and comprehensive data across the whole life cycle. Another reason for the low data availability can be that some companies are afraid of receiving low social-responsibility score, so they avoid being transparent with data (Barrio et al, 2021). Because of this, many S-LCA studies rely on secondary databases. These databases give general information, which can help find possible hotspots, but the data is often too broad. This can hide important local differences and sometimes provoke a false alarm making a situation look worse than it is. The United Nations Environment Programme (2020) states that this strong reliance on secondary data is a major weakness of S-LCA. It is very hard to collect first hand data as it is difficult to access and very time consuming, and the secondary data can sometimes not be correct.

Subjectivity is also a challenge for this method. Social issues can be understood differently by different people, and authors may think some social topics are more important than other, which means that researchers may make different choices even when using the same data. Because their own personal opinion on what is most important takes over, S-LCAs have a tendency to become inconsistent and produce different results for similar case studies (Bhatnagar et al, 2024).

2.3 Stakeholders & Social Indicators

Since S-LCA aims to evaluate social impacts across the entire life cycle of a product system, it is essential to identify which groups may be affected by these impacts. In a Social Life Cycle Assessment, *stakeholders* represent the groups, individuals and institutions who may experience social impacts by the product system, whether it is positive or negative, throughout a product's life cycle (UNEP, 2020). Identifying stakeholders is crucial, as it determines whose interests are to be considered, which social issues are prioritized, and what the boundaries for the assessment are (UNEP, 2020).

Social indicators act as a gateway between stakeholders and the assessment, as they translate stakeholder concerns into measurable or assessable criteria (UNEP, 2020). S-LCA combines quantitative, qualitative, and semi-quantitative indicators in order to capture the complex spectrum of social hotspots and issues. The reason of using social indicators is to consistently and systematically assess social performance of a product system across its life cycle and to identify potential social hotspots (UNEP, 2020).

Workers are typically one of the most central stakeholders, as they are directly involved in the entire process that transforms raw materials into the final products. Workers' rights, well-being and working conditions represent immediate social risks within global value chains, particularly as laws and regulations vary across the world (UNEP, 2020). Indicators such as occupational health and safety, fair salary, working hours, job security and protection against discrimination are among those that was analysed, as regulatory frameworks for these issues differ significantly between industries, regions and countries (UNEP, 2020).

Local communities represent another stakeholder group, as they may be affected by various impacts resulting from activities within the value chain (UNEP, 2020). These impacts include, but are not limited to, changes in access to natural resources, exposure to environmental health risks, or changes in infrastructure and economic structures. While a construction of a production facility generate employment opportunities and foster infrastructure development, it could have the added side effect of land use conflicts, pollution, or water access disputes (UNEP, 2020).

Another relevant stakeholder category includes *consumers*, as they are the ones interacting with the product primarily during its use phase. The concerns include whether the product is safe to use, protects the users privacy and how transparent selling entities can be with their customers (UNEP, 2020).

Value chain actors include parties such as suppliers, distributors, and other organisations involved within the product's life cycle (UNEP, 2020). These actors have an influence and are influenced by the governance of the supply chain, contractual relationships and the degree of transparency within business to business practices (UNEP, 2020). The interactions between GKNA and their associates help shape

the stability of partnerships, fairness of competition and implementation of socially responsible sourcing strategies.

Finally, *society* at large represents a stakeholder group that captures social impacts beyond local level or direct interactions (UNEP, 2020). This could be public commitment to sustainability issues, contributions to national economic development and the prescence of corruption within the sector. Taking society as a stakeholder into account helps highlight how corporate activities influence long-term societal development and well-being (UNEP, 2020).

2.4 Social Sustainability in the Aerospace industry

Social sustainability is gaining increasing importance within the aerospace industry. Major manufacturers such as Boeing, highlight several social sustainability topics in their 2024 Global Sustainability Report (Boeing, 2025), including employee well being, human rights, and workplace safety. Similarly, GKN Aerospace and its parent company Melrose Industries emphasizes social sustainability in its own reporting, highlighting the importance of providing a safe working environment, respecting employee rights, promoting diversity and inclusion, and fostering a culture where employees feel safe to speak up (Melrose Industries, 2026). However, social conditions, such as worker health and supply chain ethics, are less studied in the aerospace industry, specifically among smaller companies (Umar et al, 2026).

So, even though social sustainability is starting to gain attention, the application of structured S-LCA remains very limited in aerospace research. As a result of this, there is still limited knowledge on how S-LCA can be implemented in aerospace companies.

A review of the current literature studies related to aerospace manufacturing or aerospace production have been conducted with the help of proven academic sources such as Sciencedirect, Scopus and Chalmerslibrary. The most comprehensive publicly available S-LCA is the study made by Loth (2021), which examines the social impact of the Airbus A380 program using the guidelines from the United Nations Environment Program. The study highlights significant challenges related to data availability and relies heavily on interviews, with no access to big databases such as SHDB or PSILCA.

Other studies have attempted to incorporate social indicators into broader life cycle assessments, however, these cannot be considered full S-LCA applications. As mentioned, the literature reveals a lack of standardized approached and limited empirical applications of S-LCA in the aerospace sector. Therefore, further research is needed to explore the applicability and usefulness of S-LCA in this context.

3
Method

3.1 Literature study

A literature study was was conducted to build and increase the understanding of Social Life Cycle Assessements and social sustainability. Both generally and in the aerospace industry.

The literature was mainly collected through scientific data sources, originating from Chalmers Library, ResearchGate, and ScienceDirect. The main search terms were "S-LCA", "Social Life Cycle Assessment", "S-LCA Aerospace", "S-LCA Airplane", "Life Cycle Assessment Aerospace".

Additionally, a snowballing approach was also used, where references from relevant articles and reports were reviewed to find additional sources. This was used due to the limited research on S-LCA within the aerospace industry, and as such, references listed were investigated further.

The literature mainly focused on newer publications, since the research and published literature on S-LCA is evolving rapidly. Two specific years were identified as important within the development and research of S-LCA. In 2009, UNEP published the first guidelines for S-LCA, which later was updated in 2020. Another shift was in 2024, when ISO 14075 was introduced, which is the first ISO standards for how to conduct a S-LCA.

Additionally, internal company documents were also reviewed to increase the understanding of the case company and its current sustainability work. These included internal assessments, Codes of Conduct, internal LCA documents, and material-related information. Due to the case study nature of this thesis, these documents helped provide context and contributed to a better understanding of existing practices and processes within the organisation.

3.2 Interview study

An interview study was conducted in order to gain in-depth insights of the current state of how employees view social sustainability, their experiences with it and how it is worked with. This allowed for more rich, detailed data to be analysed that provided a deeper understanding of the research problem. The interview study also

aimed to capture role specific insights that could help us understand how S-LCA can be developed and if it is suitable as a method for GKNA right now. The interviews therefore explored how different parts of the organisation tackle social issues, and if they know or can think of any specific social hotspots or risks in the value chain. By including employees from with diverse responsibilities, enabled broader knowledge on the importance of social sustainability, and gave insights to which areas may require more focus.

3.2.1 Sampling

This thesis made use of a purposive sampling strategy in order to capture a broad range of perspectives on social sustainability within the organisation. Participants were selected from various functions, seniority levels and degrees of involvement in sustainability-related work. Additionally, after every interview, the participants were asked if they had any recommendations on anyone they thought would be helpful to this thesis, a so-called snowball approach (Bell et al, 2022). This approach served three purposes. First, it helped reduce the risk of any sampling bias by ensuring that selected participants were not limited to the authors' initial assumptions and knowledge. Secondly, when names aligned with those already identified, it gave confirmation that the individuals selected were appropriate candidates. Thirdly, this process also found additional participants who might have been overlooked, which further broadened the range of perspectives that were included in the study. It also helped unearth any potential hidden gems that the authors didn't think of originally (Bell et al, 2022).

3.2.2 Data collection

The data was collected via a series of semi-structured interviews, where a question template was used as a guideline. However, depending on the situation or previous answers of the participant, follow-up questions were asked to collect unique insights from the participant's own experiences. The participants were told in advance that their participation was voluntary, that their answers would be treated confidentially, and would solely be used for this thesis.

3.2.3 Data Analysis

The data collected in the interviews will be evaluated with the use of a thematic analysis (Bell et al, 2022). A thematic analysis is where the data, in this case the answers from the interviews, are categorized into different themes. The data within a particular theme for one interviewee is then compared against the data for the other interviewees under that same theme. This is done to more easily spot patterns, similarities and also the differences in the participants' responses. The insights from the interviews then allowed the thesis to further define the scope. Furthermore, the interviews findings helped clarify which social issues that were relevant, and which life cycle stages that were out of interest to investigate. The interviews contributed to shaping the focus of the S-LCA and ensured that the assessment was grounded from the current state at GKN, and not only based from what the literature stated.

3.3 Social Life Cycle Assessment Framework

The framework for the case study was based on UNEP's (2020) *Guidelines for Social Life Cycle Assessment of Products and Organizations 2020*, which is the latest revised UN-authorized recommendations for a Social Life Cycle Assessment. It is used as a method to assess social and socio-economic risks and performance across the life cycle of products and organizations, integrating social considerations into organizations' sustainability evaluations alongside the economic and environmental aspects.

3.3.1 Goal & Scope

The goal and scope phase is the foundational framework for this Social Life Cycle Assessment, as this is where the objectives are established, the depth of the analysis is set and the boundaries of the system are evaluated. The goal definition must be clear in its intended application and what stakeholders who may benefit from the thesis' findings.

The scope definition converts the goal into technical requirements via the setting of system boundaries. Defining the system boundaries is important as it sets out what is going to be evaluated and perhaps as importantly what is not to be evaluated. Within the set boundaries, appropriate stakeholders can then be identified.

The findings of this thesis are intended to provide GKN Aerospace with valuable insights about the usage of an S-LCA and the potential social risks present throughout their value chain. By identifying social hotspots and testing the applicability of an S-LCA, this report supports GKN Aerospace's strategic long-term goals in social sustainability and will assist the effort to make GKN Aerospace's entire value chain in line with its mission: "To be the most trusted and sustainable partner in the sky".

In order to evaluate the S-LCA method practically, it was decided to conduct a case study on a selected product in GKNA's portfolio. Social impacts are inherently complex and are easier understood when examining the specific conditions under which a product is produced, used and managed (Joint Research Centre, 2016). By applying the methodology in a concrete case, the study will gain access to the actual, real-world nuances and dynamics that shape the social performance for the selected product's life cycle. The S-LCA assessed the product from raw material to a completed product in use, conventionally known as a "cradle-to-gate". This includes the following stages of the product's life cycle:

Life cycle stage	Description
Extraction & processing	Extraction, processing and refinement of raw materials and resources needed for components and parts entering the GKNA system boundary
Production (Suppliers)	Manufacturing, processing and overall production performed by suppliers, including all upstream production and any subcontracted operations within the supply chain
Production (GKNA)	Manufacturing, assembling, and processing performed directly by GKNA or outsourced processes under GKNA's control
Production (Company D)	Manufacturing, assembling and overall production performed by the organization GKNA delivers its product to
Usage (Company F)	The utilization of the part, component or product by the customer once it is fully operational

Figure 3.1: Description of life cycle stages

The S-LCA was conducted on Product X, which plays a central role in GKN Aerospace's operations. Product X is composed of a wide range of components, all made from either Ti64 or Ti6242. The main parts are produced through casting, forging and sheet metal forming. The mapping and identified processes was provided by an internal LCA conducted on Product X. The origin of the organization that extracts the raw material for Product X varies which meant that assumptions had to be made of what country the raw material originated. The direct suppliers were laid out in accessible internal documents, but due to time constraints not all the suppliers was evaluated. Instead, three suppliers were chosen, one delivering casting components, one delivering forging components, and one delivering metal sheet components.

GKNA's production site in Trollhättan produces Product X before it is sent out to another manufacturer where it is used as part of an aircraft engine. The entire aircraft engine is then delivered to another manufacturer which produces airplanes, which then represents the usage phase. All company names have been anonymized and replaced with fictitious names to protect intellectual property, business relationships, and confidentiality. The material flow is illustrated in the figure 3.2.

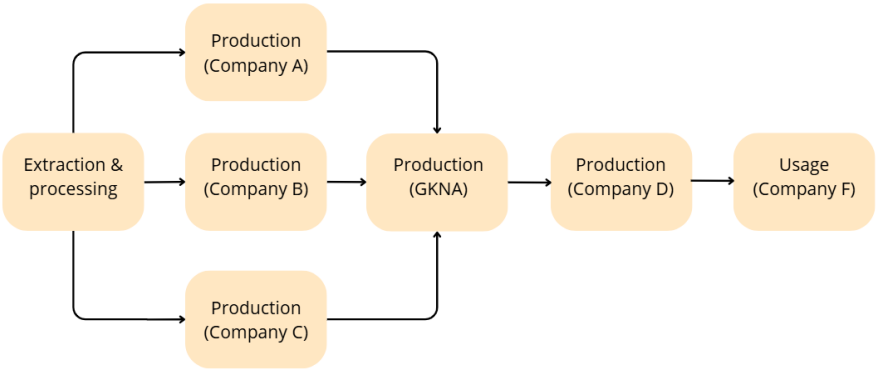

Figure 3.2: Simplified material flow

From the interviews that were conducted, it was apparent that there was a clear

line set by GKNA where their knowledge boundaries were. As mentioned in chapter 4.1, multiple participants spoke of the due diligence done on the directly upstream associated parties with GKNA, and that they do not do business with organizations that do not meet GKNA's demands. Therefore, it seems reasonable to establish a "knowledge boundary line", i.e the stages of a product's life cycle where GKNA are in charge of operations or have good, direct knowledge about the other party's operations. The two stages that this concerns are *Production (Suppliers)* and *Production (GKNA)*. This gives us the following picture of the product's life cycle, as shown in figure 3.3.

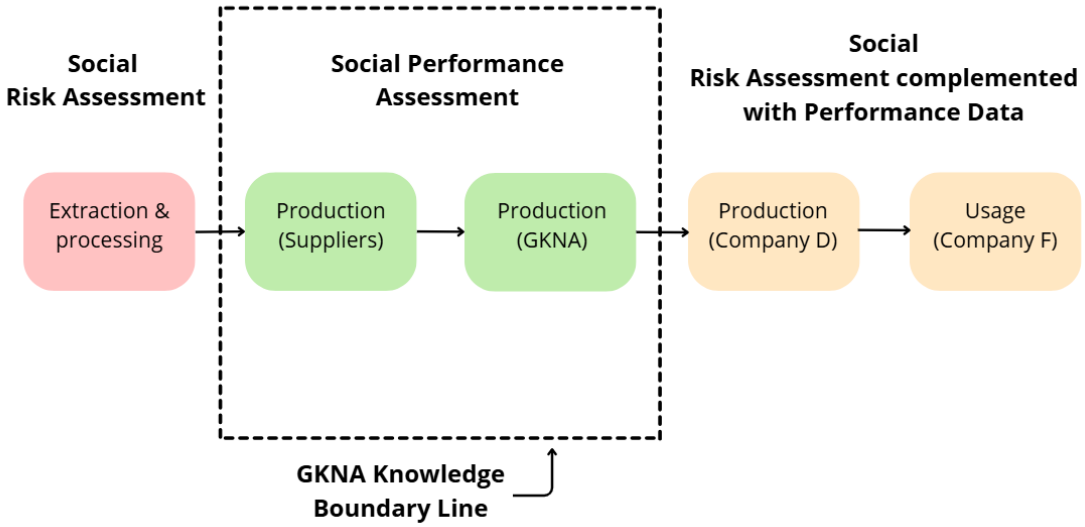

Figure 3.3: Established assessment types for every life cycle stage for a selected product

Furthermore, within this knowledge boundary line, it was appropriate to conduct a *Social Performance Assessment* for these two stages, the so-called *mainstream* part of the life cycle. Given that reliable and comprehensive data are expected to be available for these stages, the assessment done will reflect the "current state" of the organizations and will be performance-based. While certain indicators are directly applicable to the selected product, others have a broader organizational scope. Consequently, performance will be evaluated not only in terms of the selected product's performance but also in terms of the organization's wider social performance.

However, outside of these lines, it is anticipated data collection will be of varying degree of difficulty which is further strengthened by the interviews conducted in the interview study in chapter 4.1. Without robust and complete data, performance assessments risk being inaccurate in their reflection of the actual performance and instead risk being speculative rather than evidence-based. Additionally, poor or incomplete data make it harder to reproduce results with consistency, which weakens the credibility of the assessment and limits its actual value for any possible decision-making.

As a result of this, for the stage *Extraction & Processing*, the study will be focused on potential risks that may arise during these stages, a so-called *Social Risk Assessment*. After discussions and interviews with people at GKNA with good knowledge of the upstream value chain, it was decided to use secondary, generic data instead of primary, on-site data, as it was deemed to be, in most cases, hard to find or of poor quality.

Common databases used for this type of assessment are SHDB & PSILCA, both of which are recommended to use by UNEP (2020). However, due to budget constraints, they were not accessible for purposes of this study. This thesis got access to the Social Impact Audit Tool (SIAT), developed by Ansys, which is a tool developed to highlight potential social risks, in line with this S-LCA's description of a *Social Risk Assessment*.

SIAT was developed in-line with the same UNEP guidelines this study followed and uses data from the Nations of the World database in the Ansys Granta Edupack software. The tool has a database for various social indicators for numerous countries that it uses to assign scores (1-100, where 1 indicates least good practice and 100 best practice) that are used to highlight potential social risks. The threshold chosen by the authors that indicate a potential social risk was 25, in order to ensure consistency with the inter quartile range approach described in chapter 3.3.3.1. This tool was the primary source of data for this stage of the life cycle, which was complemented by correspondence with specialists in raw material sourcing, supply chain management, and social sustainability in the company for certain indicators. Additionally, for this particular phase, it was decided to focus only on the hotspots raised in SIAT, as this avoids over-interpretation of non-significant results.

For the phases *Production (Company D)* and *Usage (Company F)* however, some secondary data had to be used for some indicators, as no primary data was found for those particular indicators. Consequently, the assessment for these two stages will still be considered a *Social Performance Assessment* but with a lower degree of certainty due to the increased amount of secondary data. Consequently, this assessment does not provide a perfect "current state" reflection of the organization, but instead highlights potential hotspots with greater certainty that can be used when evaluating potential future organizational risks and priorities.

Although this study aimed to conduct a performance assessment of the *mainstream* part of the life cycle, when judged that the data collected is not complete, the aspects of the assessment that are deemed incomplete will then be evaluated as a risk assessment. Likewise, data that was considered to be of poor quality was not used as empirical evidence in the performance assessment, as doing so could lead to misleading interpretations or speculative conclusions.

3.3.2 Inventory Analysis

3.3.2.1 Stakeholders

In an S-LCA stakeholders represent the groups that are being affected by the social impacts across a product's life cycle (UNEP, 2020). Identifying the relevant stakeholders are necessary as it ensures that the social life cycle assessment considers all parties that may be affected throughout each phase of the products life cycle. This S-LCA uses workers, local communities, consumers, actors in the value chain and society as stakeholders, which corresponds to the UNEP's S-LCA guidelines. These stakeholders ensure that the assessment captures impacts both within and beyond the organizations' operations.

3.3.2.2 Subcategories

A subcategory, as defined by UNEP (2020), is a specific social issue used to assess how a stakeholder group is affected in different phases in the life cycle. The chosen subcategories were based on the standard examples created by UNEP (2021). This decision was supported by review of scientific literature, social databases, and correspondence with researchers with subject-matter expertise, all of which promoted the use of the examples provided. By following these standards, the S-LCA aligns better with UNEP's methodology. This approach makes it easier to validate and compare this assessment, as the selected subcategories come from established stakeholder issues and acknowledged social risk areas within S-LCA practices.

Fair salary (Workers) means that wages for workers are reasonably and appropriately aligned with the value of the work performed (UNEP, 2021). Codes of conduct that address wages and benefits typically evaluate wage levels with the use of three main benchmarks:

- The legally mandated minimum wage in the country
- The prevailing wage within the industry in the country
- The "living wage", in other words, the minimum wage needed to sustain a worker's basic needs to live

Working hours (Workers) is defined as the hours worked by a worker that is compliant with applicable laws and industry standards (UNEP, 2021). This includes all time spent on tasks required by the employer and excludes non-working periods such as leave or off-duty time. Additionally, UNEP specifies that workers should not work "on a regular basis" for more than 48 hours per week with at one day off at the least for every 7-day period.

Health and safety (Workers) concerns the protection of workers from from occupational hazards and the promotion of safe working environments by the employer. this includes the physical, chemical, biological and ergonomic risks that the worker may encounter during the work process. According to UNEP (2021), this subcategory also includes the employer's responsibility to provide workers with appropriate safety measures, such as safety training, safety equipment and incident reporting

mechanisms.

Freedom of association (Workers) refers to workers' rights to form or join organizations of their choice such as trade unions, and to participate in collective bargaining without fear of repercussions (UNEP, 2021). This also include workers' right to strike, their right to elect representatives to trade unions without interference, and not be influenced by their employer of what interests they want to promote and defend.

Equal opportunities (Workers) is defined as the fair and equal treatment of workers, regardless of ethnicity, religion, gender, disability, political beliefs or any other characteristic that is unrelated to the worker's performance at the workplace (UNEP, 2021). Non-discrimination in areas such as wages, promotion opportunities, training, working conditions and recruitment regardless of characteristics in the worker is considered essential.

Social benefits/social security (Workers) refers to workers' access to mechanisms designed to reduce social vulnerability, such as healthcare, insurance, pensions, benefits, and parental leave. UNEP (2021) stresses the importance of the employer providing this for the worker, and making it easy to access to ensure stability and security for their worker if issues such as illness or employment interruptions.

Child labour (Workers) addresses the presence or risk of children being involved, directly or indirectly, in the work process in conditions that are in violation of international standards. These include, but are not limited to (UNEP, 2021):

- Mentally, physically, socially, or morally dangerous work for children
- Depriving them of the opportunity to attend school
- Obligating them to leave school prematurely
- Requiring them to attempt to combine school attendance with excessively long and heavy work

Child labour is defined as child labour if the child is either: (1) below 15 years of age; or (2) below the national minimum employment age if it is higher than 15; or (3) below the age of completion of compulsory education if it is higher.

Respect for locals (Local community) addresses how organizational activities interact with community norms and social structures. UNEP (2021) underlines the importance of addressing the local community in their own language, that company activities do not infringe on the community's right to lands, resources, and cultural heritage without explicit approval of locally elected governments.

Safe and healthy living conditions (Local community) evaluates whether company operations affect environmental factors that influence the wider community health, such as air quality, water quality, noise, and exposure to waste and pollutants. UNEP (2021) notes the importance that the local community's access to essential services and infrastructure such as sanitation, clean drinking water and waste management is respected by the organization and that its operations have no negative

impact on that.

Community engagement (Local community) refers to which degree an organization is involved within its local community, whether that is via dialogue, decision-making processes or community initiatives that the organization sponsors, organizes, or initiates (UNEP, 2021). This includes mechanisms such as information sharing, collaboration with local governments, educational, and sports organizations, as well as the organization's responsiveness to eventual community concerns in order to foster mutual understanding and trust.

Secure living conditions (Local community) concerns to which degree of protection the organization provides the local community when it comes to issues such as social unrest, human rights or other forms of insecurities that may be influenced by organizational activities. This includes activities such as daily operations, infrastructure development, or resource extraction that may have an effect on the local community's social stability, safety, and their fundamental human rights (UNEP, 2021).

Promotion of social responsibility (Value chain actors) refers to which extent an organization assumes good ethical conduct and integrates sustainable development-thinking into their governance and relationships with actors in their value chain (UNEP, 2021). This subcategory places emphasis on encouraging responsible practices throughout the value chain, pushing beyond legal social compliance, and to create positive social value, not just for the organization but for all assoiciated parties in the value chain.

Supplier relationships (Value chain actors) concerns all the associations and interactions the organization has with other parties that supply said organization with goods and services. This include activities such as collaborations, trade agreements, supply contracts, and upholding of good, decent relationships between organizations in order to create positive value for both suppliers and the buying organization (UNEP, 2021).

Health and safety (Consumers) addresses whether consumers' rights to be protected, from hazardous or other potential health risks that may occur through the use of a product or service, is respected and well-managed. This includes the expectation from customers that the product or service functions satisfactorily and that they are well-informed about any potential consequences if the product or service is mishandled or mismanaged in a way that can have an effect on their health or safety (UNEP, 2021).

Feedback mechanism (Consumers) refer to processes or paths that stakeholders can use to submit issues such as complaints, suggestions, warranties or concerns for matters regarding products, services or organizational activities in general (UNEP, 2021). Feedback mechanisms can help ensure that the voice of the consumer is heard, which helps organizations tailor their product, service or activity to better

meet customer needs and requirements.

Transparency (Consumers) refers to the extent to which an organization provides clear, accurate, and timely information about its products, services and other organizational activities so that the consumer can make informed decisions without the risk of being misled (UNEP, 2021). This helps assess how well organizational practices and communication build trust and foster positive relationships with consumers.

Public commitment to sustainability issues (Society) are promises or agreements that organizations make to its customers, employees, stakeholders, local community, or society in general that declare their responsibility towards social, environmental and economic sustainability. The progress of the set sustainability goals and targets and their eventual fulfillment should be shared publicly and transparently along with their timelines and potential changes (UNEP, 2021). This is done to demonstrate organizations' commitment to sustainable development.

Prevention and/or mitigation of armed conflicts evaluates how organizational practices avoids contributing to violence, instability or other potential conflict situations. This subcategory considers responsible sourcing, respect for human rights, and due diligence measures that aims to ensure that organizational activities, directly and indirectly, do not support armed conflicts or worsen existing tensions (UNEP, 2021).

Corruption (Society) refers to the abuse of power or other types of influence for private or organizational gain, which includes practices such as fraud, embezzlement, bribery, extortion, and other unethical or illegal practices (UNEP, 2021). This subcategory assess the extent to which an organization implements policies, monitoring tools and governance mechanisms to prevent, detect and implement corrective actions that address corruption, both within its own operations but also across its value chain.

3.3.2.3 Indicators

Indicators in an S-LCA are specific measurable variables that are used to assess potential social risks or social performance for different phases of a product's life cycle (UNEP, 2021). Whereas subcategories depict an overarching issue, indicators specify a particular data point within that issue that can be used for comparison and assessment of performance or potential risks.

Indicators were chosen based on a combination of literature reviews, correspondence with university researchers, specialists, and UNEP (2021) suggestions. While consistent indicators were applied across the stages of the life cycle that underwent a *Social Performance Assessment*, the *Extraction & Processing* phase relied heavily on a generic database that the thesis had access to that had a predefined set of indicators. Consequently, only a subset of indicators could be aligned with those used in other stages. This approach is consistent with UNEP (2020) guidelines, which emphasizes flexibility in indicator selection based on data availability and method-

ological approach. Therefore, the use of partially overlapped indicators should be seen as a compromise between the desire for consistency and the constraints of available secondary data.

3.3.2.4 Data collection

The data collection strategy varied across the different stages of the value chain, depending on data availability and the characteristics of each life cycle phase.

For the extraction and processing stage, data were collected using Ansys' Social Impact Audit Tool (SIAT) together with generic databases. Since primary data from actors involved in raw material extraction were not accessible, the assessment relied on country-specific risk data generated through the SIAT tool.

For the supplier stage, data were gathered through Supplier Environmental Management questionnaires (SEMs), interviews, discussions, mail correspondence, supplier Codes of Conduct, organisational policies, third-party audit information, and generic databases where necessary.

Data related to GKN Aerospace's own production activities were collected through semi-structured interviews, discussions and mail correspondence with employees from relevant organisational functions. In addition, gemba walks, available risk assessments, Health, Safety and Environment (HSE) data, and internal policies and documents were reviewed.

For the production stage represented by Company D and the use stage represented by Company F, the assessment relied primarily on discussions and mail correspondence with company representatives, publicly available policies, HSE-related information, and generic databases due to limited access to primary internal data.

Overall, a combination of primary and secondary data sources was used throughout the study. Primary data were utilised when accessible, while secondary and generic sources were used to address data gaps and enable the assessment of life cycle stages where direct access to stakeholders was limited.

3.3.3 Impact Analysis

3.3.3.1 Reference scale approach

In order to quantify and compare the collected data in the inventory phase, a reference scale with three levels of social performance was defined, with the levels being -1, 0, and +1. When indicator levels were quantitative, the inter quartile ranges of relevant databases from ILO and UN were used to define the different reference levels, where the top 25% of the dataset were used to define **+1**, the middle 50% were used to define **0** and the bottom 25% were used to define **-1**. This approach is inherently relative, as the assigned levels should be seen as the distribution of the dataset rather than absolute performance. As a result, values classified as **+1** or **-1**

should be interpreted in relation to the dataset rather than as objective measures, due to the arbitrary choice of using the IQR.

When indicator levels were qualitative, reference level descriptions were based on descriptions found in relevant literature such as ILO conventions, ISO standards, regulations, and UN declarations. All this helped ensure that the references used were legitimately, internationally recognized social benchmarks rather than subjective judgments by individual authors or organizations with potential conflicts of interest. As mentioned, the data availability and quality varied between phases and stakeholders, which led to the decision to apply equal weighting, as differentiation in weights could not be justified consistently. The complete reference scale and its applications on the different stages of the life cycle are included in the appendix, with its sources listed in the references.

-1 or low/non-compliance represents situations where social conditions are below internationally accepted minimum standards. As a consequence of this, cases scoring a **-1** signals an increased presence of social risks or negative social impacts. Characteristics in these situations include instances such as violations of ILO labour standards, non-transparency, or non-compliance with governmental laws and regulations. A score at this level indicates that corrective actions are likely to be necessary.

0 or medium/compliance describes cases where social conditions are at basic levels set by international standards and national laws and regulations. Circumstances are socially acceptable and in line with formal requirements but are not at a level considered excellent. This includes examples such as when organizations comply with ILO conventions, adhere to national sustainability laws, or have basic social protection policies without systematic monitoring or tools of correction. Indicators scoring at this level indicate that improvements can be made in area but without the same urgency as the **-1** level.

+1 or high/beyond compliance reflects situations where terms and conditions are at a level that exceeds requirements while also demonstrating proactive engagement in social sustainability. Characteristics in these instances include examples such as additional benefits to workers beyond legal requirements, the welcoming and integration of trade unions in the organizations, and implementation of voluntary suggestions and standards by governmental and non-governmental organizations. Scores at this level suggest a high level of positive social contribution to the associated stakeholder and alignment with best practices on social sustainability.

N/A or not available/applicable was given to cases where no data could be found, data was considered to be of bad quality or if the indicator was inapplicable to the particular stage.

Given this context, this is an example of the levels of reference for an indicator, in this case for the stakeholder *Workers* and the indicator *Prevention of discrimination based on gender, religion, age, ethnicity, disability or culture*:

+1: The organisation has a formal, written non-discrimination and equal opportunity policy, clear procedures and action to implement and monitor the policy, available mechanisms to report and get help if needed.
0: The organisation has a non-discrimination policy focused on legal compliance, lacking clear implementation measures, monitoring, with low worker awareness of the policy
-1: No formal non-discrimination policy, no guidance or training for workers to act accordingly, no or little actions or procedures implemented to prevent discrimination

Figure 3.4: Example of levels of reference for an indicator

The reference scale used the same performance level descriptions and the same underlying data benchmarks for each phase of the life cycle, which meant that every data point was compared against the same predefined conditions, ensuring consistency. When primary, on-site data was unavailable or of bad quality, secondary, generic data found in databases was used as a screening tool to identify potential risks. As such, results from the sections that used sector-level data should be viewed as potential areas of concern rather than as a basis for decision-making as the data does not reflect performance, due to it not being organization-specific.

3.3.4 Interpretation

The interpretation and discussion stage is the final step of a S-LCA and was conducted in accordance with the guidelines outlined by UNEP (2020) and ISO 14075. The main objective of this stage is to analyse the robustness of the results, pinpoint issues and hotspots, evaluate data quality and methodological limitations, and formulate conclusions and recommendations that are in line with the established goal and scope of the thesis.

A completeness check was performed in order to ensure that all processes within the defined system boundaries were accounted for and included in the inventory and impact assessment stages. In other words, checking whether all relevant data had been collected, processed and analysed to the relevant stakeholders, whether the gathered results have met the goals of the S-LCA and what insights and recommendations can be drawn from the assessment.

In order to assess the reliability of the final results, uncertainty and sensitivity checks were performed. The uncertainty check covered to what degree the results were affected by for example uncertainties or irregularities in the collected data, whereas the sensitivity check was used to explain to which degree assumptions made or generic data used influenced the final results.

A consistency check was also performed to ensure the methods used during the

inventory and impact assessment stages have been used in a consistent manner and in accordance with the goal and scope. Through a series of guiding questions, this part was done to ensure the robustness of the methods and choices during the study and to increase the transparency of the report.

There was also a need to evaluate the results and establish which social risks were of greater significance. This part is done in order to figure out which social issues, stakeholders and stages of the chosen product's life cycle are of the highest importance. This was mainly touched upon in a separate chapter in the thesis' discussion.

4
Results

4.1 Interview study results

The interview study was conducted on site with six people participating. One main learning concerned the extent of how much GKNA audits its value chain. Participants consistently described the audit boundary as extending from GKNA's immediate suppliers to the purchasing organization. This was independently confirmed by multiple people across several organizational functions. Consequently, participants generally perceived that the likelihood of social hotspots within these specific stages of GKNA's product value chain as comparitively low.

GKNA's *Supplier Code of Conduct* (2023) was mentioned several times as a guiding benchmark that all suppliers have to comply with in order to business with GKNA. However, participants noted a difficulty in quantifying social demands with the same level of consistency as the environmental demands. Several participants raised questions on how social risks could be defined, highlighting that their inherently subjective and complex nature often leads to binary assessment scales (e.g. "Yes/No") rather than quantifiable metrics comparable to environmental indicators such as measured CO_2 emissions. Multiple respondents highlighted that the sustainability and compliance requirements set by GKNA are often formulated in vague or easy-to-meet terms. This tendency was attributed to the relatively small amount of suppliers available within the industry, which constrains GKNA's bargaining power. Although GKNA aspires to implement more rigid standards, the limited amount of suppliers in the aerospace industry means that it has to do a balancing act with their demands in order to maintain their essential supplier relationships.

Several interviewees expressed persistent challenges when it comes to traceability within GKNA's value chain, in particular with the origin, movement, and transactional frequency of material. One director at the company described that "*certain materials almost seem to have a life of their own... it is quite messy*", underscoring the difficulty of establishing clear and verifiable traceability mechanisms.

One director at the company also highlighted a distinction between supplier audits and supplier assessments. According to the director, audits are generally more formal and focused on verifying compliance with requirements, while assessments are often used to identify improvement opportunities and facilitate dialogue with suppliers. Similar shortcomings may sometimes be identified through both meth-

ods, although the follow-up process can differ. The director emphasized that the two approaches serve different purposes within supplier management. This distinction may be relevant in the context of social sustainability, as the chosen evaluation method can influence how issues are identified, communicated, and addressed within supplier relationships.

When discussing the resources currently allocated to social issues, several interviewees mentioned that there is explicit extra internal pressure for initiatives in this area. At the same time, one employee noted that: "*If I had a plan and wanted to work more with social sustainability, I don't think my manager would stop me*". Within procurement, the work follows existing regulatory frameworks, which already includes certain requirements for social sustainability for suppliers. According to one interviewee, their department's efforts remain aligned with compliance obligations, and that no additional initiatives are actively pursued beyond what current laws and regulations require.

When discussing social hotspots or social risks that experts at GKN think may or may not exist. Does the same answer came up, with interviewees think that one big risk is from the material extraction upstream is one high social risk. GKN only has focus and demands on their own suppliers, and the further away from GKN that we go, the higher the risk of social issues are. The interviewees raised concerns downstreams in the value chain, stating "*We are very specific with defense, we are defending and protecting democracies. But we're not the one selling the final product, so how do we know what we say we are doing also is what is happening?*".

When discussing the social demands put on the suppliers, did one interviewee specifically state that *"financial and quality demands will always be prioritized"*. The interviewee explained that if one supplier fulfills a lot of the criteria, but a code of conduct is absent, it becomes very hard for GKN to know where to draw the line, as it gets very subjective.

4.2 Inventory Analysis & Impact Assessment results

This inventory analysis was the bedrock of the S-LCA, as it was where the comprehensive mapping of social data across the product flow took place. The inventory results showed considerable variability across the different life cycle stages. In particular, stages outside of GKNA's direct control had a higher degree of variation in the availability and quality of good data. The complete collection of data is presented in Appendix A. Building on the inventory analysis, the impact assessment was used to translate the collected data into, in the case of a *Social Risk Assessment*, potential social risks, or in the case of a *Social Performance Assessment*, the social performance for the associated organization.

The summarized scores for the indicators are presented and described further below

and highlight key areas, both in terms of bad and good performance, but also in areas with potential social risks. All in all, this provided a good understanding of the social performance and potential social risks of the life cycle.

4.2.1 Extraction & Processing

From correspondence with personnel in the sourcing department, the origins of raw materials were found to vary from batch to batch, with varying degrees of traceability. Therefore, assumptions regarding the countries of origin had to be made, as country-specific data were required for inclusion in SIAT. To inform these assumptions, the study identified the largest producer of each material according to the U.S. Geological Survey (2026). However, sourcing personnel also indicated that the United States is among the most common countries of origin for several of the assessed materials. Consequently, the United States was also included in the assessment to evaluate how different assumptions regarding material origin may influence the results. The materials included in the product are listed below together with their largest producing country and corresponding market share:

- Titanium – China (34%)
- Aluminium – China (60%)
- Vanadium – China (70%)
- Tin – China (23%)
- Zirconium – Australia (33%)
- Molybdenum – China (42%)

Due to these assumptions, China, USA and Australia were the countries that were analyzed in the tool. It could be observed by the lack of markers that Australia and USA showed no potential hotspots for the indicators available in SIAT. On the other hand, SIAT highlighted several indicators for China that indicate potential social risks, which can be seen marked with blue dots in figure 4.1.

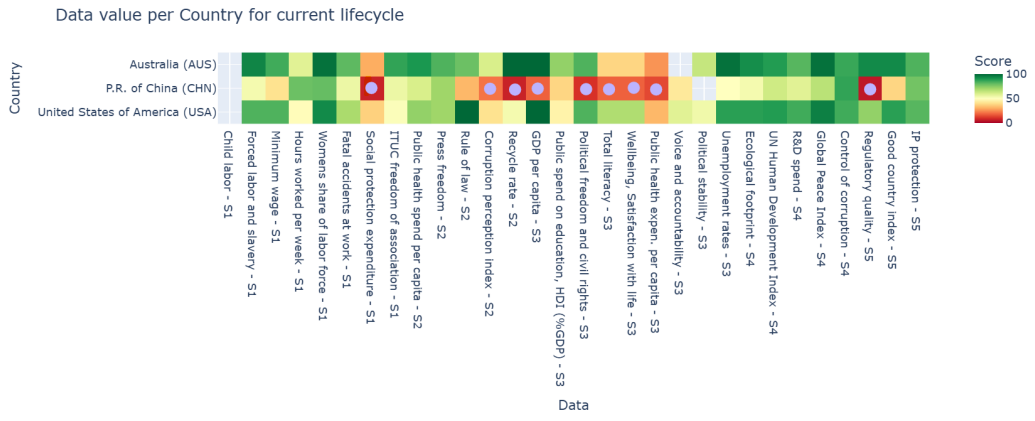

Figure 4.1: Graph generated by Ansys with potential hotspots (threshold = 25) marked with a blue circle

Nine different indicators scored as potential hotspots were identified in SIAT, with

one being for the stakeholder **Workers**, two for the stakeholder **Consumers**, five for the stakeholder **Local community**, and one for the stakeholder **Value chain actors**.

Social protection expenditure is described in SIAT as unemployment protections, sick leave, injury protection, parental leave, pensions, and other types of social benefits provided to an employee. It is based on the UNEP (2020) subcategory *Social benefits/social security*, which is one subcategory that the thesis also chose. China scored a value of **7** out of 100, highlighting a high potential social risk.

Corruption perception index is explained in SIAT as an index that "ranks countries and territories by their perceived levels of public sector corruption". It is based on the UNEP (2020) subcategory *Corruption*, overlapping with the indicator *Policies and commitment of the organization to prevent corruption* chosen for the other assessments in the study. China scored a value of **21**, which is indicative of increased potential risk of corruption.

Recycle rate is depicted in SIAT as the proportion of materials used that are recycled or recovered as waste. This particular subcategory was not adopted by the thesis and it is based on the UNEP (2020) subcategory of *End of life responsibility*, which refers to what degree of responsibility an organization takes in product disposal, reuse, or recycling from an environmental and social point of view. China scored a value of **7** out of 100, which is indicative of a potentially low recycle rate.

GDP per capita, or the market value of all goods and services produced within a country in a given time period divided by the total population, is described in SIAT as "an indicator of a country's standard of living". It is connected to the UNEP (2020) subcategory *Access to material resources*, where it is referred to "the extent to which organizations respect, work to protect, to provide, or to improve community access to local material resources and infrastructure". China scored a value of **18** out of 100, which indicates a heightened potential social risk.

Political freedom and civil rights is based on the UNEP (2020) subcategory *Respect of indigenous rights*, which is described in SIAT as "freedom from oppression or coercion, the absence of disabling conditions for an individual and the fulfillment of enabling conditions". China scored a value of **10** out of 100, indicating increased potential social risks of infringement of political freedom and civil rights.

Total literacy is defined in SIAT as the percentage of the total population that are above 15 years old that are literate. It is based on the UNEP (2020) subcategory *Access to immaterial resources*, which relates to a community's access to education and health care, access to information and knowledge, technology and freedom of expression. China scored a value of **18** out of 100, indicating increased potential for illiteracy.

Wellbeing and satisfaction with life is an indicator within SIAT that represents indi-

viduals' perceptions of their overall life conditions. It is based on the UNEP (2020) subcategory *Delocalisation and migration* which is the extent to which activities of an organization cause people to move in or out of a region, and how their stability and well-being is affected by this. China scored a value of **18** out of 100, indicating increased potential social risks for individuals' well-being and satisfaction with life.

Public health expenditure per capita is referred to in SIAT as "the percentage of gross domestic product of a state that is spent on health care". This is based on the UNEP (2020) subcategory *Safe and healthy living conditions* which refers to, among other things, how much organizations impact to the overall health and safety of the local community, their general safety conditions of operations, how they communicate potential health and safety impacts, and how they engage in compensation efforts if found culpable for negative health effects to the local community. China scored a value of **14** out of 100, which indicates an increased potential social risk on the local community's health and safety.

Regulatory quality is defined in SIAT as "perceptions of the ability of government to formulate and implement sound policies and regulations that permit and promote private sector development". It is related to the two UNEP (2020) subcategories *Supplier relationships* and *Fair competition*, which emphasize emphasize responsible and ethical business conduct that promotes transparency, fairness, and trust throughout the value chain. China scored a value of **5** out of 100, indicating an increased potential social risk for the quality of regulations.

4.2.2 Production (Suppliers)

For the suppliers, the initial idea was to measure and compare three different types of suppliers: one related to forging, one to casting, and one to sheet. The idea was also to conduct a performance evaluation of the suppliers. The reason behind this is that it was gathered from interviews that the supply chain department conducts a Supplier Evaluation Model (SEM), and these SEMs include data regarding social sustainability. This is relevant and valuable, as it directly addresses two issues. Firstly, social data is relevant for GKN and is taken into consideration when selecting a supplier. As discussed in theory, environmental sustainability is often prioritized. However, even if that is the case, it is still positive that GKN has already established social standards. Secondly, this should provide data that we can use to conduct a performance evaluation. Since we evaluate the suppliers' social score, we also gather data on their current status. However, we found that the issue with the SEMs is that they are only conducted once, before selecting the supplier. Meaning that the data conducted evaluating the supplier can be very old.

If it's a match, and GKN chooses to work with the evaluated supplier, business reviews are conducted once or twice each year. This constant contact and relationship, in order to meet and keep the standards that the suppliers agreed on, also builds a strong relationship with the suppliers, which gives GKN knowledge of the suppliers' strengths and weaknesses. So, instead of updating the data captured in

SEM, they work in trust and relationship building way. It was also found out that GKN yearly sends out surveys that each supplier should answer on. These surveys are later stored in GKN's supplier platform Assent.

Conducting the performance evaluation was initially hindered by the unmet expectation of having fresh and relevant data available. However, some variations occurred in the process. Only one SEM out of the three were found, which meant that the first hand data was very low, and the SEM that was found is from 2012.

The problem with this is not that the data is necessarily bad, but it remains unknown whether the social hotspots found in the SEM from 2012 are still relevant, and it has not been possible to find out what changes GKN has required them to make. However, there is confidence that what the suppliers responded "Yes" to in 2012, and what was seen as positive, still remains positive. This is due to GKN's relationship building and the continuous business reviews that they conduct with the relevant suppliers.

Another issue detected was that variations were found in the business reviews and surveys that the suppliers should respond to. The business reviews took place, but no notes or data have been submitted, leading to no available data. The same variation occurred for the surveys, where only one of the three suppliers had answered and submitted their responses.

For the supplier phase, both primary data and general data, such as databases and suppliers' websites, were used in order to find data for all the indicators.

4.2.2.1 Company A

Company A is an organization based in Mexico that specializes in manufacturing of forged parts and components, some of which are used in Product X. Company A is a key supplier for GKNA with a good, well-established relationship, with interviews indicating a high level of cooperation and healthy long-term partnership. Company A was evaluated in 2012, with the resulting data stored and available to the S-LCA. This data is considered to still be credible, due to GKNA's continuous and close relationship with Company A, although the risks identified in 2012 was double-checked by correspondence with people with subject-matter expertise. Furthermore, a third party audit was identified, conducted in 2023 as part of a due diligence process for a financing project involving Company A. This audit provided the S-LCA with additional first-hand, company-specific information, as it was based on site visits, interviews and a review of internal documents. This stage of the life cycle was conducted with the underlying data being largely primary data, with a small percentage being complemented with secondary data.

For the stakeholder **Workers**, there were a total of eleven indicators. The scoring indicators were all based on primary data with the exception of *Average number of hours worked by an employee in a year*, *Average holiday time worked by an employee in a year*, and *Occupational injury rate*, which used secondary data to get

a country-average as no primary data for those indicators were found. In total, Company A scored **+1** for 7 indicators, **0** for 2 indicator, and no data was found for *Social benefits provided by employer*. A summary is shown in figure 4.2.

Indicator	Absence of lowest paid workers compared to the minimum wage	Average number of hours worked by an employee in a year	Average holiday time available to an employee in a year	Occupational injury rate	Presence of perceived noise reduction measures
Score	+1	+1	0	0	N/A
Presence of health and safety requirements within workplace	Existence of legally recognised unions	Right of collective bargaining	Systems, policies and actions in place to prevent discrimination	Social benefits provided by employer	Presence of policy against child labour
+1	+1	+1	+1	N/A	+1

Figure 4.2: Summary of indicator scores for the stakeholder **Workers** for Company A

For the stakeholder **Local community**, there were a total of five indicators. Only two out of the five indicators were scored, both scoring **+1**, with the information for those indicators being based on primary data from a third-party audit and document review. No sources of secondary data deemed good enough by the authors were found which meant that three out of the five indicators were scored **N/A**. The absence of data for the majority of the indicators reduces the certainty of the assessment of Company A's social performance for the stakeholder **Local community**. Nevertheless, the two observed **+1** outcomes suggest the presence of some positive performance signals. A summary of the indicator scores are provided in figure 4.3.

Indicator	Presence of organizational information to community members in their spoken language	Organization efforts to minimize use of hazardous substances	Organization support for community initiatives	Disturbance due to noise	Casualties or injuries associated with the organization
Score	N/A	+1	+1	N/A	N/A

Figure 4.3: Summary of indicator scores for the stakeholder **Local community** for Company A

For the stakeholder **Value chain actors**, there were two indicators that were assessed. Company A has a supplier code of conduct that outlines terms and conditions organizations have to meet in order to do business with Company A. Company A,

in addition to regular, informal correspondence with GKNA, conducts formal "Business Reviews" annually or bi-annually. These are face-to-face meetings where they meet face to face annually or bi-annually with the supplier with the intent to share information, raise concerns, and evaluate performance. They look at past plans, how they turned out, what needs to be done in the future and check the overall alignment between the supplier and GKNA. The two indicators score **+1**, presented in figure 4.4, and indicate strong social performance.

Indicator	Degree of presence of explicit supplier code of conduct	Level of interaction between organizations
Score	+1	+1

Figure 4.4: Summary of indicator scores for the stakeholder **Value chain actors** for Company A

For the stakeholder **Consumers**, there were three indicators that were assessed. All three assessed indicators used primary data and therefore gave a performance-based picture of the stakeholder's situation. Two scored **+1** and *Presence of mechanisms for customers to provide feedback* scored **0**. A summary of the indicator scores are presented in figure 4.5.

Indicator	Presence of mechanisms for customers to provide feedback	Publication of sustainability report	Consumer access to product information
Score	0	+1	+1

Figure 4.5: Summary of indicator scores for the stakeholder **Consumers** for Company A

For the stakeholder **Society**, there were four indicators that were assessed. All four indicators were based on primary data, which mean they give a good reflection of the "current state" of Company A's effect on the stakeholder **Society**. Two out of the four indicators scored **+1** and the other two scored **0**, which indicates good social performance. A summary of the indicator scores are presented in figure 4.6.

Indicator	Presence of promises or agreements on sustainability issues	Presence of policy concerning the handling and usage of conflict minerals	Degree of usage of conflict minerals	Policies and commitment of the organization to prevent corruption
Score	0	+1	0	+1

Figure 4.6: Summary of indicator scores for the stakeholder **Society** for Company A

4.2.2.2 Company B

Company B is located in the US and is a manufacturer of casting parts and components that are used in Product X. Company B is a key supplier to GKN Aerospace, with a long history of collaboration. The data found for this particular company was much more generic, as no SEMs or recorded audits were found or accessible for this S-LCA. Instead, publicly available data, such as documents and policies from their website was used and complemented with secondary data from databases.

For the stakeholder **Workers**, there were eleven indicators. Company B scored **+1** on one indicator, **0** on four indicators, **-1** on three indicators, and no data was found for the remaining three indicators. Country-average data was used for *Average number of hours worked by an employee in a year* and *Average holiday time available to an employee in a year*. Primary data, such as articles and publicly available documents, were used for the remainder of the scored indicators. A summary of the indicator scores are presented in figure 4.7.

Indicator	Absence of lowest paid workers compared to the minimum wage	Average number of hours worked by an employee in a year	Average holiday time available to an employee in a year	Occupational injury rate	Presence of perceived noise reduction measures
Score	0	0	-1	N/A	N/A
Presence of health and safety requirements within workplace	Existence of legally recognised unions	Right of collective bargaining	Systems, policies and actions in place to prevent discrimination	Social benefits provided by employer	Presence of policy against child labour
+1	-1	-1	0	N/A	0

Figure 4.7: Summary of indicator scores for the stakeholder **Workers** for Company B

For the stakeholder **Local community**, there were five indicators in total. One scored **0** and was based on a policy review on Company B's website. For the remaining four indicators, no primary or reliable secondary data was found, which led to all of them being assigned **N/A**. A summary of the indicator scores are presented in figure 4.8.

Indicator	Presence of organizational information to community members in their spoken language	Organization efforts to minimize use of hazardous substances	Organization support for community initiatives	Disturbance due to noise	Casualties or injuries associated with the organization
Score	N/A	0	N/A	N/A	N/A

Figure 4.8: Summary of indicator scores for the stakeholder **Local community** for Company B

For the stakeholder **Value chain actors**, two indicators were used. Both scored **+1** and was based on an assessment of Company B's "Supplier Integrity Guide" and the so-called "Business reviews" conducted by Company B together with GKNA. A summary of the indicator scores are presented in figure 4.9.

Indicator	Degree of presence of explicit supplier code of conduct	Level of interaction between organizations
Score	+1	+1

Figure 4.9: Summary of indicator scores for the stakeholder **Value chain actors** for Company B

For the stakeholder **Consumers**, three indicators were used. Two indicators were given the score **-1**, which was based on the authors' search for a sustainability report and publicly available product information. No such documents were found which led to the indicators being scored **-1**. A summary of the indicator scores are presented in figure 4.10.

Indicator	Presence of mechanisms for customers to provide feedback	Publication of sustainability report	Consumer access to product information
Score	0	-1	-1

Figure 4.10: Summary of indicator scores for the stakeholder **Consumers** for Company B

For the stakeholder **Society**, four indicators were assessed. Primary data was used for all four indicators, with a combination of reviews of Company B's available policies and documents. Two indicators scored **+1** and two indicators scored **0**, a summary of the indicator scores is presented in figure 4.11.

Indicator	Presence of promises or agreements on sustainability issues	Presence of policy concerning the handling and usage of conflict minerals	Degree of usage of conflict minerals	Policies and commitment of the organization to prevent corruption
Score	0	+1	0	+1

Figure 4.11: Summary of indicator scores for the stakeholder **Society** for Company B

4.2.2.3 Company C

Company C is a UK-based company that specializes in design and manufacturing of aerospace components and systems. They are a key supplier to GKNA for Product X, where their titanium alloy sheets are used. Primary data was used for the majority of the indicators, with review of policies and internal documents being the main foundation of the data. Additionally, a supplier survey sent out by GKNA answered by Company C was used for certain indicators. Secondary data was used for some indicators where no data could be found or accessed.

For the stakeholder **Workers**, there were eleven indicators that were assessed. Six indicators scored **+1**, four indicators scored **0**, and no data was found for one indicator. Country-average data was used for *Average number of hours worked by an employee in a year* and *Average holiday time available to an employee in a year*, as no company records were found regarding that data. Primary data, such as articles and publicly available documents, were used for the remainder of the scored indicators. A summary of the indicator scores are presented in figure 4.12.

Indicator	Absence of lowest paid workers compared to the minimum wage	Average number of hours worked by an employee in a year	Average holiday time available to an employee in a year	Occupational injury rate	Presence of perceived noise reduction measures
Score	0	+1	0	0	N/A
Presence of health and safety requirements within workplace	Existence of legally recognised unions	Right of collective bargaining	Systems, policies and actions in place to prevent discrimination	Social benefits provided by employer	Presence of policy against child labour
+1	+1	+1	+1	0	+1

Figure 4.12: Summary of indicator scores for the stakeholder **Workers** for Company C

For the stakeholder **Local community**, there were five indicators that were assessed. Primary data were found for *Organization efforts to minimize use of hazardous substances* and *Organization support for community initiatives*, which were used to score them **0** and **+1** respectively. No good data was found for the remaining indicators, which led to them being scored **N/A**. A summary of the indicator scores is presented in figure 4.13.

Indicator	Presence of organizational information to community members in their spoken language	Organization efforts to minimize use of hazardous substances	Organization support for community initiatives	Disturbance due to noise	Casualties or injuries associated with the organization
Score	N/A	0	+1	N/A	N/A

Figure 4.13: Summary of indicator scores for the stakeholder **Local community** for Company C

For the stakeholder **Value chain actors**, two indicators were assessed. Primary data was found for both of the indicators, by reviewing Company C's supplier code of conduct and discussions with personnel at GKNA responsible for the correspondence with Company C. One indicator scored **+1** and one scored **0**, a summary is presented in figure 4.14.

Indicator	Degree of presence of explicit supplier code of conduct	Level of interaction between organizations
Score	+1	0

Figure 4.14: Summary of indicator scores for the stakeholder **Value chain actors** for Company C

For the stakeholder **Consumers**, three indicators were assessed. Primary data was found for all three indicators, by reviewing publicly available documents and policies, in addition with correspondence with GKNA personnel involved in the relationship with Company C. Two indicators scored **+1** and one indicator scored **0**. A summary of the indicator scores are provided in figure 4.15.

Indicator	Presence of mechanisms for customers to provide feedback	Publication of sustainability report	Consumer access to product information
Score	0	+1	+1

Figure 4.15: Summary of indicator scores for the stakeholder **Consumers** for Company C

For the stakeholder **Society**, four indicators were assessed. Primary data such as correspondence with knowledgeable personnel, document review, and survey answers were used as the base for scoring the different indicators. Two of the four indicators scored **+1** and the remaining two indicators scored **0**, with a summary of the indicator scores shown in figure 4.16.

Indicator	Presence of promises or agreements on sustainability issues	Presence of policy concerning the handling and usage of conflict minerals	Degree of usage of conflict minerals	Policies and commitment of the organization to prevent corruption
Score	0	+1	0	+1

Figure 4.16: Summary of indicator scores for the stakeholder **Society** for Company C

4.2.3 Production (GKN Aerospace)

Product X is manufactured at GKN Aerospace's production facility in Trollhättan, where it is assembled into a larger product that is subsequently integrated into an aircraft engine further downstream. For the stakeholder **Workers**, eleven indicators were assessed. Primary data was found for all indicators, except for *Absence of lowest paid worker compared with statutory minimum wage*, which due to Sweden not having a statutory minimum wage meant it could not be applied, leading to a **N/A** score. Eight out of the remaining ten indicators scored **+1** and two scored **0**, a summary of the indicator scores is presented in figure 4.17.

Indicator	Absence of lowest paid worker compared with the minimum wage	Average number of hours worked by an employee in a year	Average holiday time available to an employee in a year	Occupational injury rate	Presence of perceived noise reduction measures
Score	N/A	+1	0	0	+1
Presence of health and safety requirements within workplace	Existence of legally recognised unions	Right of collective bargaining	Systems, policies and actions in place to prevent discrimination	Social benefits provided by employer	Presence of policy against child labour
+1	+1	+1	+1	+1	+1

Figure 4.17: Summary of indicator scores for the stakeholder **Workers** for GKN Aerospace Trollhättan

For the stakeholder **Local community**, five indicators were assessed. Primary data was collected for four out of the five indicators, where no data was found regarding *Disturbance due to noise* which led to it being scored **N/A**. All four indicators where data was collected scored **+1**, a summary of which is shown in figure 4.18.

Indicator	Presence of organisational information to the local community in their spoken language	Organization efforts to minimize hazardous substances	Organization support for community initiatives	Disturbance due to noise	Casualties or injuries associated with GKNA Trollhättan
Score	+1	+1	+1	N/A	+1

Figure 4.18: Summary of indicator scores for the stakeholder **Local community** for GKN Aerospace Trollhättan

For the stakeholder **Value chain actors**, two indicators were evaluated. Primary data was collected for both indicators, where a review of GKNA's supplier code

of conduct and correspondence with personnel in the sourcing, procurement, and supply chain departments was used as the basis for the indicator scoring. Both indicators scored **+1**, which is shown in figure 4.19.

Indicator	Degree of presence of explicit supplier code of conduct	Level of interaction between organizations
Score	+1	+1

Figure 4.19: Summary of indicator scores for the stakeholder **Value chain actors** for GKN Aerospace Trollhättan

For the stakeholder **Consumers**, three indicators were scored. Primary data was available for all three indicators, including correspondence with personnel with subject-matter knowledge and review of documents. Two out of the three indicators scored **+1**, with the remaining indicator scoring **0**. A summary of the indicator scores is shown in figure 4.20.

Indicator	Presence of mechanisms for customers to provide feedback	Publication of sustainability report	Access to product information
Score	+1	+1	0

Figure 4.20: Summary of indicator scores for the stakeholder **Consumers** for GKN Aerospace Trollhättan

For the stakeholder **Society**, four indicators were assessed. Primary data was accessible for all four indicators, which included material analysis, document reviews, policy reviews, and correspondence with personnel with subject-matter knowledge. Three out of four indicators scored **+1** and the remaining indicator scored **0**, which is shown in figure 4.21.

Indicator	Promises or agreements on sustainability issues	Degree of usage of conflict minerals	Presence of policy concerning the handling and usage of conflict minerals	Policies and commitment of the organization to prevent corruption
Score	+1	0	+1	+1

Figure 4.21: Summary of indicator scores for the stakeholder **Society** for GKN Aerospace Trollhättan

4.2.4 Production (Company D)

Company D is a UK-based, multinational engineering company known for designing and manufacturing aircraft engines and other advanced power systems. In this context, Company D receives Product X from GKNA which it uses as a subcomponent in an aircraft engine that is used in an aircraft made by Company F. Primary data was available for the majority of the indicators, with review of publicly available documents and correspondence with people with subject-level expertise being the main bulk of the data collection. Secondary data was used for some indicators in cases where no primary data was found or accessed.

For the stakeholder **Workers**, there were eleven indicators that were assessed. *Average number of hours worked by an employee in a year* used secondary data as no records from Company D showed their employees' annual working hours. Additionally, no data was found regarding *Presence of perceived noise reduction measures*. Primary data was found for nine indicators, where the bulk of the data used to score the indicators came from reviewing policies, commitments, and other publicly available documents. In total, six indicators scored **+1**, four indicators scored **0**, and one scored **N/A**, a summary of the indicators is presented in figure 4.22.

Indicator	Absence of lowest paid workers compared to the minimum wage	Average number of hours worked by an employee in a year	Average holiday time available to an employee in a year	Occupational injury rate	Presence of perceived noise reduction measures
Score	0	+1	0	0	N/A
Presence of health and safety requirements within workplace	Existence of legally recognised unions	Right of collective bargaining	Systems, policies and actions in place to prevent discrimination	Social benefits provided by employer	Presence of policy against child labour
+1	+1	+1	+1	+1	+1

Figure 4.22: Summary of indicator scores for the stakeholder **Workers** for Company D

For the stakeholder **Local community**, there were five indicators that were evaluated. Primary data was found for *Organization efforts to minimize use of hazardous substances* and *Organization support for community initiatives*, with no data being found for the remaining three indicators. In total, one indicator scored **0**, one indicator scored **-1**, and three indicators scored **N/A**. A summary of the indicator scores is presented in figure 4.23.

Indicator	Presence of organizational information to community members in their spoken language	Organization efforts to minimize use of hazardous substances	Organization support for community initiatives	Disturbance due to noise	Casualties or injuries associated with the organization
Score	N/A	-1	0	N/A	N/A

Figure 4.23: Summary of indicator scores for the stakeholder **Local community** for Company D

For the stakeholder **Value chain actors**, two indicators were assessed. Document review and discussions with GKNA personnel corresponding with Company D were sources for primary data, which provided that one indicator scored **+1** and that one indicator scored **0**. A summary is presented in figure 4.24.

Indicator	Degree of presence of explicit supplier code of conduct	Level of interaction between organizations
Score	+1	0

Figure 4.24: Summary of indicator scores for the stakeholder **Value chain actors** for Company D

For the stakeholder **Consumers**, three indicators were evaluated. Review of publicly available reports and policies on Company D's website as well as correspondence with personnel with subject-matter knowledge served as the basis for the assessment. All three indicators scored **+1**, as shown in figure 4.25.

Indicator	Presence of mechanisms for customers to provide feedback	Publication of sustainability report	Consumer access to product information
Score	+1	+1	+1

Figure 4.25: Summary of indicator scores for the stakeholder **Consumers** for Company D

For the stakeholder **Society**, four indicators were assessed. All four indicators were assessed using primary data sources such as internal and external policies. Three out of the four indicators scored **+1** and the remaining one scored **0**, which can be seen in figure 4.26.

Indicator	Promises or agreements on sustainability issues	Degree of usage of conflict minerals	Presence of policy concerning the handling and usage of conflict minerals	Policies and commitment of the organization to prevent corruption
Score	+1	0	+1	+1

Figure 4.26: Summary of indicator scores for the stakeholder **Society** for Company D

4.2.5 Usage (Company F)

Company F is a multinational aerospace corporation that specializes in the design and manufacturing of aircraft. Product X is delivered to Company F as part of an aircraft engine assembled by Company D, where it is integrated into the final aircraft. Primary data was available for a majority of the indicators, with review of publicly available documents and correspondence with GKNA personnel with subject-matter expertise used as the main foundation of the data collection. Some secondary data were used when no primary data was attained.

For the stakeholder **Workers**, eleven indicators were evaluated. Although Company F is multinational corporation with multiple production sites, Product X is used in a production facility in France. As no primary data was found for *Average number of hours worked by an employee in a year* and *Average holiday time available to an employee in a year*, country-average data for France were used. In total, four indicators scored **+1**, six indicators scored **0**, no data was found for one indicators. A summary of the indicator scores is shown in figure 4.12.

Indicator	Absence of lowest paid workers compared to the minimum wage	Average number of hours worked by an employee in a year	Average holiday time available to an employee in a year	Occupational injury rate	Presence of perceived noise reduction measures
Score	0	+1	0	0	+1
Presence of health and safety requirements within workplace	Existence of legally recognised unions	Right of collective bargaining	Systems, policies and actions in place to prevent discrimination	Social benefits provided by employer	Presence of policy against child labour
+1	+1	+1	+1	N/A	+1

Figure 4.27: Summary of indicator scores for the stakeholder **Workers** for Company F

For the stakeholder **Local community**, five indicators were assessed. Primary data was found for four out of the five indicators, with no good data found for *Presence of organizational information to community members in their spoken language*. Two indicators scored **+1**, one indicator scored **0**, one indicator scored **-1**, and no data was found for one indicator. A summary of the indicator scores is presented in figure 4.28.

Indicator	Presence of organizational information to community members in their spoken language	Organization efforts to minimize use of hazardous substances	Organization support for community initiatives	Disturbance due to noise	Casualties or injuries associated with the organization
Score	N/A	0	+1	-1	+1

Figure 4.28: Summary of indicator scores for the stakeholder **Local community** for Company F

For the stakeholder **Value chain actors**, two indicators were evaluated. One indicator scored **+1** and no data was found for the other indicator, giving it a **N/A**. The scores are shown in figure 4.29.

Indicator	Degree of presence of explicit supplier code of conduct	Level of interaction between organizations
Score	+1	N/A

Figure 4.29: Summary of indicator scores for the stakeholder **Value chain actors** for Company F

For the stakeholder **Consumers**, three indicators were assessed. Primary data was collected for all three indicators, which consisted of reviews of reports, policies, and other publicly available documents. All three indicators scored **+1**, as presented in figure 4.30.

Indicator	Presence of mechanisms for customers to provide feedback	Publication of sustainability report	Consumer access to product information
Score	+1	+1	+1

Figure 4.30: Summary of indicator scores for the stakeholder **Consumers** for Company F

For the stakeholder **Society**, four indicators were evaluated. Primary data was found for all four indicators, with the main bulk of the data being based on review

of internal and external policies. Three out of the four indicators scored **+1** and the remaining one scored **0**, which can be seen in figure 4.31.

Indicator	Promises or agreements on sustainability issues	Degree of usage of conflict minerals	Presence of policy concerning the handling and usage of conflict minerals	Policies and commitment of the organization to prevent corruption
Score	+1	0	+1	+1

Figure 4.31: Summary of indicator scores for the stakeholder **Society** for Company F

4.3 Interpretation

The purpose and objective of this thesis was to evaluate the applicability of a S-LCA as a method of assessing social sustainability in the aerospace industry. Additionally, it aimed to evaluate this by applying the methodology to a selected product within GKN Aerospace's product portfolio.

4.3.1 Completeness check

A completeness check was performed with the aim of reviewing whether all the issues that were outlined in the Goal & Scope have been covered in the inventory and impact assessment. The completeness check was conducted by the authors through a series of guiding questions that were used to check whether the information gathered was relevant and sufficient to fulfill the study's purpose. The questions used for this were based on standard example questions provided by UNEP (2020), as shown in figure 4.32. The questions were answered solely by the authors, which introduces a risk of confirmation bias, as the content is based on their own answers and interpretations and may lack objectivity.

Assessment phase	Guiding questions
GOAL AND SCOPE	• Are the Goal and Scope clearly defined? • Have all the relevant stakeholders been considered? If some stakeholders have been excluded, which criteria were used to justify it? • Have all the relevant life cycle phases and processes been taken into account? If cut-offs and omission have been applied, are they duly justified according to e.g. social significance, empirical motivations, identical elements, and decision relevancy?
INVENTORY	• Are the data collected sufficient for evaluating the identified relevant social aspects?
IMPACT ASSESSMENT	• Are the selected impact categories, subcategories, and indicators sufficient for addressing the performances/impacts of the study? • Are the social impact pathways sufficient for addressing the identified impacts (if applicable)?
INTERPRETATION	• Are the results answering the research/evaluation questions? Are there unsolved questions or information gaps? • Are value choices properly detailed when drawing conclusions?

Figure 4.32: Questions used to conduct the completeness check

The Goal & Scope was clearly defined in that it was backed primarily by interviews conducted with directors, specialists, and other people with knowledge and experience in the area of social sustainability. All stakeholders set out in the Goal & Scope were accounted for, with varying degrees of indicator amount for the different stakeholders.

The set "knowledge boundary line" allowed for greater certainty for the different phases, as it established whether the assessment measured potential risks or actual performance. The study found primary, on-site information regarding the production at GKNA which enabled a complete *Social Performance Assessment* and the development of an accurate "current state" representation of the organization's social performance. The production for suppliers was anticipated to go through a *Social Performance Assessment* but due to varying degree of data availability and quality, secondary data had to be used to complement the assessment, as anticipated in Goal & Scope. This led to the data concerning this stage of the life cycle represented a more inaccurate picture of the "current state" of the suppliers' social performance.

The data collected were considered to be sufficient to evaluate the identified social aspects. As acknowledged, certain corrections had to be made to the nature of the data collected, with the consequence of the evaluation being more inaccurate than if it were based on primary data collected on-site. In terms of whether the assessment done is sufficient for addressing the different phases' performance and/or potential risks, the authors recognise that there are some indicators where neither primary or secondary data could be found, which meant that the assessment did not provide

a full representation in line with the expectation of the assessment. Excluding the *Extraction & Processing* phase, 25 indicators were used to assess the performance and potential risks for all phases. A small minority of indicators were not assessed for some phases due to varying degrees of data quality and availablility, but there's still confidence in the precision of the assessment as a clear majority of the indicators were assessed in all phases. Additionally, correspondence with research fellows at universities deemed 25 indicators to be an adequate amount to assess broader organizational performance.

4.3.2 Consistency check

A consistency check was conducted to ensure that all methods, such as data collection, assessment types, or reference scale grades were done in a consistent manner as set out in the Goal & Scope. This is done with a series of guiding questions that were picked out of a list of standard example questions that UNEP (2020) provided, as shown in figure 4.33.

Assessment phase	Guiding questions
GOAL AND SCOPE	• Has the terminology in the study been used consistently, i.e. risk vs. performance vs. impact? • Does the procedure defined for measuring the social aspects or impacts reflect the epistemological underpinnings of the study, i.e. are the values underlining the study explicitly declared where relevant? • Is the methodology applied coherently according to the decision that the study intends to support and the goal it aims to achieve?
INVENTORY	• Are there differences in the quality of data, i.e. qualitative vs. quantitative vs. semi-quantitative, primary vs. secondary, site-specific vs. generic? If so, are they coherent with the Goal and Scope of the study? • Have allocation rules and system boundaries been consistently applied and defined? When the S-LCA entails the comparison among two product systems, was it considered if any cut-off has been applied that may bias the comparison?
IMPACT ASSESSMENT	• Is the impact assessment method (risk vs. performance vs. impact) coherent with the stated goal(s) of the study? • When implementing the reference scale approach, are performance reference points defined consistently within the study, for the different social aspects, and are the points of reference duly documented?
INTERPRETATION	• Have the results been aggregated in a way that allow to interpret the results in line with the stated goal(s) of the study?

Figure 4.33: Questions used to conduct the consistency check

Regarding the terminology used in this study, the study set out in the Goal & Scope that social performance could only be associated with primary data related to the actual stage of the life cycle, such as observations on the factory floor, review of company policy, or interviews with people in the organization. As such, it could be ensured that the picture painted of the stage was one of a "current state" of the

organization, and not one taken from general averages or other secondary data. The study made a conscious decision to call the outcome from the *Social Risk Assessment* "potential risks", as risks are proved to exist via established performance data, whereas the ambiguity of secondary data meant that the study could not establish the risks with the same certainty, therefore adopting the term "potential risks".

The methodology was applied consistently as explained in the Goal & Scope, with a reference scale approach that graded collected data towards a set reference scale. The indicators varied as mentioned between the *Extraction & Processing* phase and the other selected phases, as the software used for that particular phase already had a selected subset of indicators, some of which were the same as for the other phases and some differed. This meant that the evaluation for *Extraction & Processing* was not as comparable to the other phases.

There were no changes in the system boundaries in the sense that the definition of the phases' beginning and end in the value chain remained the same. There were some changes in the type of assessment performed at the different stages. For instance, it was expected that a *Social Performance Assessment* could be performed on the immediate suppliers' production, but varying degrees of access, availability and quality of data led to it being necessary to back it up with secondary data. In contrast to this, a *Social Risk Assessment* based solely on secondary data was expected to be conducted on Company D's production and the usage phase. However, thanks to correspondence with specialists, directors and other knowledgeable personnel at GKNA, primary data for some indicators was uncovered, improving the representation of the "current state" of the phase.

The reference scale used was consistent in its scaling, in that it used a three-tier scale and the same descriptions for all indicators, excluding the *Extraction & Processing* phase, which had some overlapping indicators but mainly focused on the hotspots extracted from Ansys.

4.3.3 Uncertainty and sensitivity check

Uncertainty and sensitivity checks were performed in order to assess the reliability of the data and consequently, the robustness of the results based on that data. From the set "knowledge boundary line", primary data was found in great detail for GKNA's production, but were harder to come by for the suppliers' production.

When collecting data, it was clear that the quality of the primary data had a high degree of variation. One supplier evaluation model that the study got access to had not been officially updated since 2012, although it provided primary data on the supplier, it had an increased risk of being outdated due to the length of time since the evaluation. Some SEMs were also incomplete, which made it more difficult and sometimes not possible to find primary data about the supplier. However, after correspondence with personnel in the sourcing, procurement, and quality department, the regularly conducted business reviews, audits, and assessments were considered

to be sufficient to keep track of the associated supplier's activities.

Qualified assumptions had to be done on numerous occasions as data quality and availability varied. This was done by consulting with internal specialists, discussing with workers on the factory floor and by mail correspondence with S-LCA experts. This introduces a degree of uncertainty and sensitivity in the results, as results became more subjective in their nature and dependent on the professional opinion or experience of particular individuals, and not as objective as the assessment was aspired to be.

The use of generic data sources for the *Social Risk Assessment* and to back up the *Social Performance Assessment* was also identified as a key source of uncertainty and sensitivity, as in the majority of the cases the generic data came from country-specific averages. This has the risk of not accurately depicting site, sectoral, or even regional-specific social conditions, which is why indicator scores based on secondary, generic data were interpreted as "potential social risks" rather than actual measurements of the "current state" of the organization's social performance.

The use of the inter quartile range for quantitative indicators introduced a degree of subjectivity, as the scores reflect a normative simplification of an underlying dataset that the indicator uses as a reference. For instance, if the ranges were adjusted to be of a tertile nature (**-1** = [0-33.33%), **0** = [33.33-66.66%), and **+1** = [66.66-100%]), it would have led to many indicators shifting from a score of **0** to a score of **-1** or **+1**, due to the increase in the width of the ranges. IQR is grounded in established statistical practices where it is used to summarize distributions and identify relative performance levels of a selected dataset.

The majority of the indicators were qualitative in nature and based on appropriate literature such as ILO conventions, UN declarations, governmental regulations, and ISO standards. There exists no standardized reference scale with detailed descriptions of every reference level, which meant that subjective assessments had to be made by the authors on the literature in the creation of the different reference levels for the indicators. This was done both solely by the authors and in conjunction with GKNA personnel with relevant experience and knowledge on the subject matter.

5
Discussion

5.1 Applicability of S-LCA

This study indicates that Social Life Cycle Assessments can be applied within the aerospace industry in order to identify social hotspots. Even though the method made it possible to analyse several aspects tied to different stakeholder, the methodology come with some difficulties.

The methodology for Social Life Cycle Assessment that was used in this study is well elaborated in UNEP's guidelines, which provided a good, structured framework that the study could follow. However, while the methodology outlines the procedures for data collection across the different life cycle stages, the implementation in practice present some challenges. In particular, the overall robustness and reliability of the assessment is highly reliant on the quality of the data collected. As such, the actual validity and comparability of the results ultimately relies to what extent accurate and consistent data can be gathered throughout the assessment.

Some indicators could not be assessed due to the absence of reliable or relevant data, while other indicators were supported by on-site, high quality data. This variation complicates comparisons between indicators in different life cycle stages, as the evaluation is not performed on equal terms. As a result, the overall consistency and reliability become undermined, as the varying degree of data quality made it challenging to draw clear conclusions.

In order to obtain a more consistent level of data quality across the entire value chain, one approach that could be taken is to conduct a *Social Risk Assessment* for the entire life cycle. This approach would enable a more fair comparison between the indicators, and could be used for screening purposes when looking for potential social risks in different regions or countries. However, relying on secondary data comes with its own distinct limitations. Secondary data is quite broad, as it presents averages and medians, which may not accurately reflect the specific conditions of a particular supplier or organization. For instance, initial screening efforts based on general databases showed a high likelihood of substantial social risks in Mexico. However, this finding was directly contradicted by first-hand insights obtained during interviews with GKNA personnel, who reported that their contracted Mexican supplier operated under considerably better conditions than the screening showed. This shows the inherent risk of using secondary data, as without further verification

such as site audits or assessments, these types of data can lead to misleading conclusions.

Indicators can be regarded as the heart and soul of this methodology, as they fundamentally shape the entire assessment process. The selection of indicators does not only determine which data must be gathered, but also how the data is gathered and consequently how the results of the study are interpreted. Therefore, a great deal of time and care should be put into the selection of these indicators, in order to really make sure that they are aligned with the goals of the study. For some cases, a limited set of indicators may be chosen. This enables more time and resources being put into finding high-quality data that in the end provide a more representative image of the "current state" of the context's social performance. However, choosing too few indicators may lead to the assessment not being able to capture a full picture of the assessed organization's social performance. This trade-off means that time and care need to be put into finding the appropriate balance for each individual assessment.

Additionally, for certain indicators, no data was found at all. This could be because no databases providing relevant data was found or that no company-specific data was found. These situations can be interpreted in different ways. It could be that there actually is no documented data regarding that indicator, and that the problem lies in that the indicator may be overly specific. On the other hand, the organization may not want to reveal that particular data point relevant to the indicator, as doing so may be unfavourable to their reputation. For instance, when considering the indicator "Right to collective bargaining", it seems unlikely that an organization restricting that right would publicly disclose that information in official documents. Instead, these types of issues would be excluded from public documentation, leading to a situation where "no data was found".

There is also an additional issue related to S-LCA's in the aerospace industry that was presented in the interview study, which is that the aerospace industry is a relatively narrow market, with few actors and suppliers available that meet the industry's stringent quality, safety, and regulatory requirements. As such, some suppliers and actors "fall through the crack", despite not performing at an optimal social rate, as organizations are dependent on a small number of actors that meet the quality, safety, and regulatory requirements. This dependency highlights a structural constraint in applying S-LCA in the aerospace industry, where social considerations may need to be "overlooked" due to an overriding need to comply with technical and safety regulations.

The aerospace industry is also a highly global industry, with actors and suppliers spanning all over the world. This means that, due to resource constraints, a lot of the primary data collected is based on correspondence with associated people in organizations and reviews of publicly available documents. As no specific site assessments were done by the authors, outside of the one at GKNA's production facility, the results are based largely on the organizations' self-reported information, rather than independent observations. This presents a limitation to the methodology, as

the accuracy and completeness of organizational documents cannot be fully ensured without verifying them on-site.

5.2 Case study discussion

This section discusses the results of the conducted S-LCA, and in particular, the uncovered social hotspots gathered across the life cycle.

5.2.1 Extraction & Processing

The *Extraction & Processing* phase was different from the later stages as it used a unique database with a separate set of indicators, with some indicators overlapping with the indicators of the other phases. This means that eventual comparison becomes harder, as data collected does not as accurately provide an equal representation of the different phases. The assessment was based solely on assumption, as the exact origins of the raw material could not be found. This presents a substantial uncertainty, as the result become purely speculative and non-indicative of a particular organization's "current state".

The results from this phase indicate that there are a great number of potential social risks in China. However, as previously mentioned, this indication remains uncertain due to the lack of precise information regarding the origin of the raw materials. Despite these limitations, this approach could still serve as an exploratory, screening function. In particular, if applied as a preliminary screening tool, where identification of multiple potential social risks can act as a trigger for further and more detailed investigation.

5.2.2 Production (Suppliers)

With respect to Company A, primary data was available through a self-assessed supplier evaluation model, a third party audit, and publicly available documents. The presence of these data sources strengthened the credibility of the assessment and provided a better picture of the organization's "current state". From what was gathered in the S-LCA, no significant social hotspots were discovered in Company A's value chain. The primary concern raised was that there were a few indicators were credible data was not found, in particular for the stakeholder **Local community**. As previously discussed in chapter 5.1, the absence of data does not necessarily translate to the absence of social risks, which means that this outcome may need to be investigated further. Company A showed no potential hotspots in this particular assessment.

For Company B, primary data was limited to publicly available documents on their website. As such, more secondary data had to be used and therefore the assessment was less accurate in its reflection of Company B than Company A. Despite these limitations, the assessment identified several potential hotspots in Company B's value chain. Although the overall data quality was lower than for Company

A, some findings still point to some potential social risks. Notably, the stakeholder **Workers** scored **-1** on three separate indicators, which indicates an increased likelihood of social hotspots for that particular stakeholder. Furthermore, two out of three indicators for the stakeholder **Consumers** scored **-1**, which also indicates an increased likelihood of social hotspots for this stakeholder.

Regarding Company C, primary data was found for a majority of the indicators, where publicly available documents were the main bulk of the data which was complemented by a supplier survey sent by GKNA to Company C. The presence of primary data sources enhanced the credibility of the assessment and provided a better picture of the organization's "current state". No indicator scored indicated a social hotspot for Company C, with the main issue being the lack of data for some indicators, in particular for the stakeholder **Local community**. The implications of these sorts of data gaps have been discussed in 5.1.

One common observation across all suppliers was that there was difficulty in obtaining data related to the **Local community**, where several indicators such as *Casualties or injuries associated with organizational activities* or *Disturbance due to noise* repeatedly lacked data. The reasons for this are uncertain. One explanation could be that the selected indicators were too specific and not aligned with data typically released or acquired by suppliers, which made them obsolete in this assessment. Additionally, it could be that suppliers actively choose not to release information related to these indicators, possibly due to the sensitive nature of such data.

5.2.3 Production (GKN Aerospace Trollhättan)

For GKNA, primary data was available in abundance. Via data collection methods such as inspections at the factory floor, interviews with relevant personnel, and review of internal documents, the S-LCA was able to determine the social performance of GKNA to a high degree of certainty. The stakeholder **Workers** performed well, with eight indicators out of eleven scoring **+1**, indicating the social conditions at GKNA are of high quality. This can be explained by long-standing working practices focused on the welfare of the worker, with risk assessments regularly conducted at every workplace to ensure that conditions are satisfactory.

Similarly as in chapter 5.2.2, no data was found for *Disturbance due to noise* (**Local community**) associated with GKNA. The indicators chosen for the S-LCA were chosen with some expectation that a majority of them could be scored in this particular phase, as data collection was expected to be easiest for this phase. As such, only one indicator was not able to be scored, which was *Absence of lowest paid worker compared to statutory minimum wage* for the stakeholder **Workers**. Due to Sweden not having a statutory minimum wage, the indicator scored **N/A** in the reference scale. A more fitting indicator could have been related to a collective bargaining agreement and the absence of any worker being paid below that, which is one improvement this S-LCA could have made.

In conclusion for this phase, the social conditions presented in this S-LCA were informed by a greater extent of primary data than was available for other phases of the assessment. In addition, other assessed organisations using comparable sources of primary data may offer a different basis for comparison than phases relying more heavily on secondary or generic data. Data quality and availability therefore differed across the assessed life cycle phases.

5.2.4 Production (Company D)

The results for Company D show positive social performance across a majority of the assessed indicators. This was supported mainly by reviewing organizational documents but also by correspondence with GKNA personnel with subject-matter knowledge. Similarly to the suppliers, the data collection for Company D when it came to **Local community** was left incomplete, as no data was found for three different indicators.

The only assessed hotspot for Company D was *Organization efforts to minimize use of hazardous substances*, which was found in a review of the organization's hazardous waste figures, which had almost doubled in the last ten years. This may be explained by it increasing in size and production, and therefore a larger need for chemical products for surface treatments and waste from advanced alloys. Additionally, figures could be reported more accurately across all Company D's operations amid growing regulatory pressure such as REACH that require extended documentation. As such, this indicator could be worth looking into further to confirm the reported figures. For the other stakeholders, Company D performed well, with no other social hotspots determined by this study.

5.2.5 Usage (Company F)

The results for Company F showed positive social performance across a majority of the assessed indicators. The majority of the primary data gathered for Company F was done by reviewing organizational documents, with some supplementary data originating from independent, third-party organizations.

This reliance on self-disclosed data affects the reliability of the results, as Company F has control over which information is made publicly available. It is therefore likely that the company emphasizes favorable aspects of its operations while providing more limited insight into areas of weaker performance. Nevertheless, data were available for nearly all selected indicators, which may suggest a relatively high level of transparency across multiple aspects of the company's activities. At the same time, the potential for bias remains, as the disclosed information could be selective.

The only scored hotspot for Company F was *Organization efforts to minimize use of hazardous substances*, as shown in figure 4.28. Much like Company D, Company F are a major operator in the aerospace sector which is heavily reliant on processes

such as surface treatments, coatings, and the use of advanced alloys that involves hazardous substances. The dependence on these substances, driven by strict quality, safety, and regulatory requirements, could limit the extent to which Company F reduces its use of hazardous substances.

5.3 Suggestions for future research

There were a few learnings that emerged from conducting the thesis. Firstly, the choice of indicators were shown to be very influential in how the outcome of the assessment turned out. Because indicators determine what data are collected, they also influence what aspects of social performance and social risks are evaluated. As such, it became evident that time and care should be put on the selection of indicators to ensure their relevancy and their alignment with available, good-quality data sources. Some indicators chosen in the conducted S-LCA led to repeated data gaps or the need to use secondary data, which reduced the overall effectiveness and robustness of the results.

Secondly, the conducted S-LCA also highlighted the advantages when using quantitative indicators. Quantitative data is generally easier to compare across different stakeholders and life cycle stages, which improved the consistency and the objectivity of the assessment. Although some subjectivity is still present in that reference scale levels must still be set manually, qualitative data are usually more subjective in that it is more reliant on judgements and interpretations, such as when reviewing policies, interviews, or internal documents. The thesis recognise that although qualitative indicators are important and necessary to capture certain aspects of social conditions, more quantitative indicators than the ones selected in the conducted S-LCA would have enhanced the objectivity and consistency of the overall assessment.

Thirdly, the conducted S-LCA had equal weighting, in that all indicators had the same "worth", because of the challenge of impact characterization and aggregation. For an Environmental Life Cycle Analysis, the different indicators can more easily be linked to a functional unit of kilograms emitted of carbon dioxide, methane or any other greenhouse gas as the global warming effects of those gases are universal. This objectivity in an E-LCA makes it easier in the end to compare and find hotspots in a more consistent manner. In a S-LCA, the impacts are more context-dependent, in that in some regions of the world certain social conditions are considered adequate or good, whereas in other regions they would be inadequate. Additionally, no universal answer exists that determines if a certain social indicator should be weighted more or less compared to another one, which introduces a level of subjectivity that the conductors of the assessment have to provide. As such, time and care should be put into choosing a functional unit and weighting criteria that are well-founded, fair, and representative of the context of the assessed social indicators and life cycle stages.

6
Conclusion

This master's thesis evaluated Social Life Cycle Assessment and its applicability and effectiveness as a methodology for assessing social sustainability within the aerospace industry. It did this by conducting a cradle-to-gate case study of Product X at GKN Aerospace.

The findings demonstrate that S-LCA is, in theory, a very valuable tool capable of mapping complex global value chains and identifying social hotspots across that value chain. When primary, on-site data is available, which was the case in the internal assessment of GKN Aerospace Trollhättan, the framework provides a "current state" representation of an organization's social performance. Furthermore, the application of the reference scale approach effectively highlights areas where organizational social conditions meets, falls below, or exceeds global, established benchmarks.

However, the practical execution of the S-LCA methodology within the aerospace industry comes with some considerable systematic constraints. The primary concern is the lack of data availability and transparency across the value chain. In particular, for the raw material *Extraction & Processing* phase, tracking the specific origins of materials such as titanium proved to be exceedingly difficult, forcing the study to rely on speculative assumptions and country-average databases. Similarly, data collection for suppliers was hindered by missing evaluation records, outdated records, or a systematic reliance on self-reported information, which comes with a non-neglible risk of organizational selective disclosure or bias.

Additionally, this thesis highlighted the unique structural constraints of the aerospace industry. Due to high quality, safety, and regulatory requirements, the industry is characterized by a limited number of technical suppliers, which in turn dictates the purchasing organization's ability to demand high social compliance from associated suppliers. The overriding need to comply with performance and safety regulations means that social conditions have a tendency to be overlooked or marginalized in favour of quality and cost.

In conclusion, although S-LCA is a promising approach that supports the long-term necessity of social sustainability, its implementation, and in turn, its effectiveness in the aerospace industry are strictly dependent on methodological standardization and increased data transparency.

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A

Appendix 1 - Information gathered in Inventory Analysis

A.1 Company A

A.1.1 Workers

A.1.1.1 Absence of lowest paid workers compared with the minimum wage

Company A does not release publicly available wage data. However, from the supplier evaluation, Company A answered YES to the question “Is every employee paid at least the minimum wage”. Additionally, GKN’s Code of Conduct expects all suppliers to work towards paying the national living wage.

A.1.1.2 Average number of hours worked by employees in a year

Company A answers yes to the following question "Working hours in your company are in compliance with statuary requirements in the country or region". Additionally, GKN’s supplier code of conduct expect their suppliers to operate in consideration of the International Labor Organisation (ILO). Generic data provided that employees in Mexico works on average 1629 hours yearly.

A.1.1.3 Average holiday time used by workers (paid time off + federal paid holidays)

Company A answered yes to the following question “Do all employees receive paid leave according to statutory regulation?”. GKN’s Code of Conduct also expects suppliers to operate in accordance with the ILO’s standards on annual leave. Generic data provides that mexico has 27 paid days each year.

A.1.1.4 Occupational injury rate

No data found.

A.1.1.5 Presence of perceived noise reduction measures

Noise is identified as an risk in forge operations by the third party audit that was conducted. However no quantified data has been found on noise reduction measures.

A.1.1.6 Presence of health and safety requirements within workplace

Company A answers yes to numerous questions, all regarding health and safety requirements in their operations.

A.1.1.7 Existence of legally recognised unions

In the 2012 evaluation, Company A answered No. "Does your company uphold the employees right to freely join and take actions in or form worker organizations including unions of their own right without the explicit authorization of your company?".

However, more recent official records from the Mexican labour authority, show that Company A has a registered collective agreement with a trade union, indicating that legally recognized unions are present and allowed in the company today.

A.1.1.8 Right to collective bargaining

The same reasoning can be applied here. As Company A answers No to "Does your company uphold the employees right to freely join and take actions in or form worker organizations including unions of their own right without the explicit authorization of your company?".

Nevertheless, official records confirm that a collective bargaining agreement is in place and that a salary revision was conducted in October 2023. This indicates that collective bargaining is currently practiced and allowed at Company A.

A.1.1.9 Systems, policies and actions in place to prevent discmination

Company A answers yes to the following question "Are all employees treated in a non-discriminatory manner regarding benefits, hiring procedure, job assignment, retirement provisions, and access to services independent of gender, religion, age, union membership, race, caste, national origin, disability, sexual orientation or political affiliation?"

A.1.1.10 Social benefits provided by employer

We know that Company A provides statuory leave for all employers from answering yes to the question "Do all employees receive paid leave according to statury regulation". Additionally the third party audit identifies health programs and medical services for the employees. While this does not provide detailed information on employee benefits, it indicates that health-related support and basic social protection measures are in place at Company A

A.1.1.11 Presence of policy against child labour

No present policy found, however Company A answers yes to following question "Are all employees employed by your company at least the minimum age required

by country law or other regulations". The third party audit also reported no findings of related to child labor, though no policies have been found against it.

A.1.2 Local community

A.1.2.1 Presence of organisational information to community members in their spoken language

No data found

A.1.2.2 Organisation efforts to minimize use of hazardous substances

Although, no % reduction found on hazardous materials. The third party audit claims that their handling, storage and generation of hazardous waste are in compliance with environmental legislation. The audit also describes structured procedures on which aims at minimizing hazardous waste.

A.1.2.3 Organisation support for community initiatives

Yes, Company A has an active foundation. It was established in 2005 with the mission to assist vulnerable, ill, and challenged people. The foundation seeks to support projects by establishing alliances with non profit organizations.

A.1.2.4 Organisation support for community initiatives

Company A has a foundation that supported over 60 organisations in 2020, where around 80,000 people benefit annually from this foundation. It works in a way that a percentage of Company A's profits is allocated to this fund.

A.1.2.5 Disturbance due to noise

No data found for this indicator

A.1.2.6 Number of casualties or injuries per year in the community due to the activites by the organisations

No data were found

A.1.3 Value chain actors

A.1.3.1 Degree of presence of explicit code of conduct that protect human rights of workers among suppliers.

Company A has a Compliance Policy that includes a Code of Conduct and Integrity Policy. This policy addresses issues such as forced labour and workplace harassment, showing a commitment to ethical labour practices. While human rights are not explicitly stated, related aspects such as dignity, respect, and compliance with labour regulations are reflected in the policy.

A.1.3.2 Level of interaction between organisations

From interviews with people in sourcing at GKN, data was collected showing that business reviews are conducted with Company A one to two times per year.

A.1.3.3 Suppliers from countries with high-estimated proportion of moderns slavery

No data

A.1.4 Consumers

A.1.4.1 Does the organisation track health and safety isseus linked to product usage.

No data

A.1.4.2 Presence of mechanism to provide feeback

No formal data has been found. However, we know that for the selected product and for GKN, business reviews are conducted one to two times per year in order to provide feedback and see over the relationship.

A.1.4.3 Publication of sustainability report

No dedicated sustainability report for Company A was found. However, sustainability reports are available at group level, but nothing is connected specifically to the forging operations.

A.1.4.4 Consumer access to product information

No data found for this indicator

A.1.5 Society

A.1.5.1 Presence of promises or agreements on sustainability issues

Company A does not have measurable and quantified targets. Although sustainability priorities are available, including pollution prevention, resource efficiency, waste reduction, and reduction of greenhouse emissions.

A.1.5.2 presence of policy concerning the handling and usage of conflict minerals

Yes, there are policies for Company A suppliers on how they need to take action and deal with conflict minerals. Their suppliers must comply with conflict minerals regulations, exactly the 1502 of Dodd-Frank Act.

A.1.5.3 Usage of conflict minerals

Yes, from available LCA studies conducted for the same product, tin occurs in the material, meaning that conflict minerals are present.

A.1.5.4 Policies and commitment of the organisation to prevent corruption

From the supplier evaluation, Company A answered yes to "Does your operation have policies and procedures in place to prevent and detect corruption by your employees, officers, managers, and any other working behalf of your operation, including but not limited to bribery, excessive gift-giving, extortion, or embezzlement, on the part of suppliers. contractors or agents represening the facility?" Additionally, this is supported in their available compliance policy.

A.2 Company B

A.2.1 Workers

A.2.1.1 Absence of lowest paid workers compared with the minimum wage

No primary data was found, but in Company B code of conduct states that the company always should comply with all applicable laws and regulations. Meaning that the company should respect the minimum wage.

A.2.1.2 Average number of hours worked by employees in a year

No data was found. However, generic data can be used, which indicates that in the US, the average is 1,789 hours per year.

A.2.1.3 Average holiday time used by workers (paid time off + federal paid holidays)

No public or internal data on paid holidays or paid time off at Copmany B were identified. As the facility is located in the United States, generic data indicate that private sector workers receive on average approximately 7–8 paid holidays per year.

A.2.1.4 Occupational injury rate

No primary data on injury rate was found. As the facility was located in the United States, generic data indicate that the manufacturing sector reports approximately 27 recorded injuries per 1000 full time workers.

A.2.1.5 Presence of perceived noise reduction measures

No data found.

A.2.1.6 Presence of health and safety requirements within workplace

Yes, Company Bs code of conduct states that the use of personal protective equipment that is required for the job, such as safety glasses, hard hats, safety shoes and protective clothing.

A.2.1.7 Existence of legally recognised unions

The company does not explicitly state a commitment to collective bargaining and the existense of legalised unions in their code of conduct. No active unions can currently be identified. Available research indicates that, the largest union closed down in 2022.

A.2.1.8 Right to collective bargaining

No official explicit statements were found indicating that Company B supports the right to collective bargaining. Historical evidence suggests that Company B has actively resisted this right.

In 2017, approximately 100 workers formed a union, and the company initially refused to recognize and bargain with the union. The National Labor Relations Board ruled that this constituted an unfair labor practice and ordered the company to recognize the union and begin bargaining. Although the company was legally required to negotiate, the process was prolonged due to legal appeals and delays.

During this period, non-union workers received wage increases, while union members did not, effectively weakening union representation at the site, eventually was the union decertified in 2022.

A.2.1.9 Systems, policies and actions in place to prevent discmination

Company B includes in their Code of Conduct that unlawful discrimination is not tolerated. They state that employees are treated equally regardless of sex, race, religion, or sexual orientation. However, no actions were found.

A.2.1.10 Social benefits provided by employer

No data available

A.2.1.11 Presence of policy against child labour

No explicit statement on child labour is found publicly or in their Code of Conduct. However, it is integrated in their supplier integrity guide, where Company B prohibits their suppliers from employing workers below the age of 16.

A.2.2 Local community

A.2.2.1 Presence of organisational

No data found

A.2.2.2 Organisations efforts to minimize use of hazardous substances

No concrete and concise actions were found for Company B. However, is it publicly stated on their website that Company B is "Minimizing the creation of waste, including hazardous waste. and disposing of all waste in a safe and responsible manner.

A.2.2.3 Organisation support for community initiatives

No data found

A.2.2.4 Disturbance due to noise

No primary data available.

A.2.2.5 Number of casualties and injuries per year in the community due to the activites by the organisaton

The company does not disclose any statistics or data related to injuries, fatalties or incident rates affecting the local community.

A.2.3 Value chain actors

A.2.3.1 Degree of presence of explicit code of conduct that protect human rights of workers among suppliers

Yes, Company B provides a supplier integrity guide. This integrity guide sets out clear expectations for the suppliers and requires them to comply with several provisions, including human rights.

A.2.3.2 Level of interaction betweens suppliers

No primary data found

A.2.3.3 Suppliers from countries with high estimated proportion of mordern slavery

No data found

A.2.4 Consumers

A.2.4.1 Does the organisation track health and safety issues linked to product usage

No data

A.2.4.2 Presence of mechanisms for customers

No data found

A.2.4.3 Publication of sustainability report

No, company B does not have a publicly publiced sustainability report. Instead, the company provides limited sustainability related information through its website.

A.2.4.4 Consumer access to product information

No data found

A.2.5 Society

A.2.5.1 Presence of promises or agreements on sustainability issues

Company B don't present clear and quantified sustainability targets. However, there are general commitments to sustainability through its code of conduct. For example, the company commits to operate with environmental laws, reducing waste and minimising environmental impacts.

A.2.5.2 Presence of policy concerning the handling and usage of conflict minerals

Yes, Company B has a policy for handling conflict minerals. The company follows US SEC rules under the Dodd-Frank Act, applying to minerals like tantalum, tin, tungsten and gold

A.2.5.3 Degree of usage of conflict minerals

Yes, from available LCA studies conducted for the same product, tin occurs in the material, meaning that conflict minerals are present.

A.2.5.4 Policies and corruption of the organisation to prevent corruption

Compay B has policies to prevent corruption, mainly through its code of conduct and its supplier integrity guide.

A.3 Company C

A.3.1 Workers

A.3.1.1 Absence of lowest paid workers compared with the minimum wage

No statistics published by Company C on their wages. However Company C have agreed to GKNA's supplier code of conduct, which states that "we expect our supplier to work towards paying their employees the national living wage".

A.3.1.2 Average number of hours worked by employees in a year

Similarly, are there no publicly available statistics on their website. Although, they've agreed on GKN code of conduct which says that all suppliers must operate with ILOs regulating working hours. In order to get a quantified number, we use generic database here aswell. Company C is located in UK, where they work on average 1523 hours annually

A.3.1.3 Average holiday time used by workers (paid time off + federal paid holidays)

No data was found, but Company C has agreed to GKN's Supplier Code of Conduct, which contains ILO standards for annual leave. We also checked generic data, which states that in the UK, there are around 34 days off annually.

A.3.1.4 Occupational injury rate

Company C is covered by a group-level sustainability report from Senior plc. In this report, they state a Lost Time Injury and Illness Rate of 6.3 injuries per 1,000 employees in 2025. This is defined as work-related injuries or illnesses where an employee loses at least one full work shift.

A.3.1.5 Presence of perceived noise reduction measures

No data found.

A.3.1.6 Presence of health and safety requirements within workplace

Yes, Company C follows global health and safety rules. They report HSE requirements for the entire group. No data solely on the UK site is available.

A.3.1.7 Existence of legally recognised unions

No explicit data available on the existence of unions. Although data found on that Company D does not prevent its employees from joining a union if they wish to do so.

A.3.1.8 Right to collective bargaining

Company C does not prevent its employees from joining a union if they wish to do so. This policy is applied globally, including the UK department.

A.3.1.9 Systems, policies and actions in place to prevent discmination

Again, there are global policies and systems in place to prevent discrimination, aiming to provide a working environment free from discrimination and ensure equal opportunities for all employees.

A.3.1.10 Social benefits provided by employer

There are global policies that Company C is following. This includes well-being initiatives, such as health campaigns, mental health support, and activities for employees. However, there are no clear benefits regarding health insurance or pensions.

A.3.1.11 Presence of policy against child labour

Yes, but again this policy is global for all of Company D and their branches. The policy states that Company C supports "the eliminations of all forced or compulsary labour" and "the effective abolition of child labour".

A.3.2 Local community

A.3.2.1 Presence of organisational information in their own language

No data

A.3.2.2 Organization efforts to minimize hazardous substances

No polices or efforts found to reduce hazardous waste, although the company reported 492 tonnes hazardous waste generated of which 196 tonnes was recycled leaving a total of 296 tonnes for combustion.

A.3.2.3 Organization support for community initiatives

Company C's business actively support local communities through donations, education initiatives and charity activitites.

A.3.2.4 Disturbance due to noise

No data were found.

A.3.2.5 Casualties or injuries associated with Company C

No data were found.

A.3.3 Value chain actors

A.3.3.1 Degree of presence of explicit code of conduct that protect human rights to workers among suppliers.

Yes, Company C has a Supplier Code of Conduct that includes human rights.

A.3.3.2 Level of interaction between organisation

No data was found. From interviews with Company C's contact person at GKN, we know that general business reviews are not conducted for Company C, as it is not considered a major supplier.

A.3.3.3 Suppliers from countries with high estimated proportion of modern slavery.

No data.

A.3.4 Consumers

A.3.4.1 Does the organisation track health and safety issues linked to product usage

No data

A.3.4.2 Presence of mechanisms for customers to provide feedback

No real feedback mechanisms were found publicly available.

A.3.4.3 Publication of sustainability report

Yes, Company C has a globally published sustainability report covering sustainability, social sustainability, and governance.

A.3.4.4 Consumer access to product information

The company provides basic product information on its website, also disclosing what certifications the product has.

A.3.5 Society

A.3.5.1 Presence of promises or agreements on sustainability issues

Company C has concrete goals on their website. However, their target year is 2025, meaning that they are not publicly updated. Company C is also committed to achieving net zero by 2050.

A.3.5.2 Presence of Policy concerning the handling and usage of conflict minerals

Yes, there is a Conflict minerals compliance policy for Company C. The company requires suppliers to carry out certification of sourcing practices.

A.3.5.3 Usage of conflict minerals

Yes, from available LCA studies conducted for the same product, tin occurs in the material, meaning that conflict minerals are present.

A.3.5.4 Policies and commitment of the organisation to prevent corruption

Yes, Company C has four policies that prevents corruption, embedded in their code of conduct: Agents policy, Gifts and Hospitality Policy, Fraud Policy and Whistle - blowing policy.

A.4 GKN Aerospace

A.4.1 Workers

A.4.1.1 Absence of lowest paid workers compared with the minimum wage

Unlike the majority of EU countries (Eurostat, 2026), Sweden does not have a statutory minimum wage, which meant the indicator is not applicable in this situation. However, it should be noted that GKN Aerospace and its employees in Trollhättan have a collective bargaining agreement with several trade unions, where minimum wages are set. Additionally, GKNA has policies in place where the salary is based on the amount of responsibility, the current market, and the employee's performance to ensure that a fair salary is provided.

A.4.1.2 Average number of hours worked by employees in a year

At GKN Trollhättan, there are several types of shifts that employees work, which meant that assumptions had to be made for the indicator. After correspondence with a production engineer and a manufacturing engineer, the most common shift was found to be one called "GKN-shift", which consists of a three-week cycle where employees work overtime the first two weeks and one weekend out of the two in order to get the whole third week off. In total, operators work 105.5 hours every three-week cycle, which after subtracting the 25 days of paid leave and the median amount of 8 public weekday holidays amounts to 1533 hours worked per year.

A.4.1.3 Average holiday time used by workers (paid time off + federal paid holidays)

For the operators working full-time at Trollhättan, GKNA is required by law to provide five weeks paid time off, which was reflected in conversations with production engineers as well as review of their holiday policy. In addition, Sweden has a number of federal public paid holidays which varies by a few days depending on the calendar year. With the assumption of 8 annual federal public paid holidays, it summarizes to 33 days off in a year.

A.4.1.4 Occupational injury rate

GKN Aerospace Trollhättan releases quarterly and yearly injury data for their factory, which in 2025 totaled 7 reported injuries requiring medical attention. Factoring in the 2491 workers at GKN Aerospace Trollhättan, that amounts to 2.81 injuries per 1000 workers per year.

A.4.1.5 Presence of perceived noise reduction measures

The production process consists of 31 distinct workcenters, with a large variety of processes applied to the product. Select workcenters such as forging, milling and turning reach noise levels that are hazardous to operators if exposed for prolonged periods of time and without ear protection. This could be seen in TSRA/MRA risk assessments of the workcenters but also via observations at the factory floor. As a result of this, workcenters where noise levels are elevated beyond safe limits, ear protection has become mandatory to protect workers from long-term health risks.

A.4.1.6 Presence of health and safety requirements within workplace

The product goes through a broad selection of workcenters with varying degrees of health and safety risks depending on the processes applied. Steel cap boots and safety glasses are mandatory at all times on the factory floor and during processes with added risk such as heat treatment, etching, and forging, extra protective gear, such as gloves, are mandatory. This was assessed not only with the help of TSRA/MRA risk assessments, but also via observations conducted on the factory floor.

A.4.1.7 Existence of legally recognised unions

GKN Aerospace Trollhättan have several operating trade unions represented, whose activities are protected and enshrined in GKNA's code of ethics (källa). Currently, the unions present at the site are Unionen, IF Metall, Ledarna and Akademikerna.

A.4.1.8 Right to collective bargaining

There are two collective bargaining agreements currently in effect at GKN Aerospace Trollhättan, bargained by IF Metall and Unionen/Ledarna.

A.4.1.9 Systems, policies and actions in place to prevent discrimination

Both GKN Aerospace Trollhättan and its parent company Melrose Industries have enshrined policies, systems and tools in their code of conducts and code of ethics. GKNA also provide whistleblower functions and education opportunities to further combat and prevent inequality in the workplace.

A.4.1.10 Social benefits provided by employer

GKN Aerospace Trollhättan provide numerous benefits to their employees in accordance to Swedish law, such as paid parental leave and paid sick leave. Furthermore, they provide additional benefits beyond regulatory requirements such as wellness allowances, eyeglasses, health insurance and rebates for gym memberships, golf clubs, hotel chains and car dealerships.

A.4.1.11 Presence of policy against child labour

GKN Aerospace's parent company Melrose Industries has a outspoken and formalized policy against child labour which permeates throughout their operations and subsidiaries. GKN Aerospace operates a strict juvenile work policy, where 16 & 17-year olds are allowed to work, but under specific conditions of what work they are allowed to do, when they can work and how they can work in accordance with Swedish law and the definition presented in chapter 3.3.2.2.

A.4.2 Local community

A.4.2.1 Presence of organisational information to the local community in their spoken language

Outside of the plant there are information signs informing the public of operations, that it is a protected area crucial to Sweden's national security and of the noise and smoke that may arise when test firing engines at the factory.

A.4.2.2 Organization efforts to minimize hazardous substances

Substituting hazardous substances are part of Health & Safety goals set every year at GKNA in order to reduce risks to their workers and the environment as a whole. During 2025, the factory has managed to substitute several different hazardous substances (defined as substances with a danger level of 5 or above in the chemical management system Chemsoft) and also eliminated the use of thermoplastics in 10 different departments of production.

A.4.2.3 Organization support for community initiatives

GKN Aerospace Trollhättan sponsors and partners with community events such as Trollhättan Action Week, which is a week-long (sometimes up to 10 days) multi-sport event focused on community engagement, movement, and outdoor activity. It takes place in the city of Trollhättan and organizes, amongst other activities, trail

races, city races and relay races for running, cycling, roller ski and inlines. Additionally, it organizes kids' activities and family events in order to promote community engagement and togetherness. GKNA also has collaborations with educational centers such as Högskolan Väst, where it has been a collaborative partner since the university's founding in 1990.

A.4.2.4 Disturbance due to noise

No data found.

A.4.2.5 Casualties or injuries associated with GKN Aerospace Trollhättan

No data was found that indicate that there were any casualties or injuries in the local community related to production activities during 2025.

A.4.3 Value chain actors

A.4.3.1 Presence of supplier code of conduct

GKN Aerospace has an explicit supplier code of conduct that all suppliers have to follow in order to enter into business agreements with GKNA. The supplier code of conduct includes, but is not limited to, requirements such as human rights protections, compliance with laws and regulations, anti-discrimination, health and safety principles and labour protections.

A.4.3.2 Interaction between organizations in value chain

Directors at the procurement and supply chain departments once or twice a year perform "Business reviews", where they meet in person with the associated suppliers' representatives, where concerns, performance and information is shared. This is done in order to check how well past plans have turned out but also as a way to plan ahead and review the alignment between GKNA's and the supplier's idea for the years head to maximize the potential value gained in the relationship. In addition to this, GKNA have designated people working specifically with one supplier or one organization, where contact and informal meetings are prevalent.

A.4.4 Consumers

A.4.4.1 Presence of feedback mechanisms

GKN Aerospace Trollhättan have numerous designated employees that work with Company D specifically within areas such as supply chain, quality, or sourcing. Feedback raised by Company D can be channeled via those employees and also in addition to this, Company D operates a global supplier portal that enables communication with GKNA, including the sharing of new requirements, feedback, and general information.

A.4.4.2 Presence of policy to protect consumer privacy

No data found.

A.4.4.3 Publication of a sustainability report

GKN Aerospace's parent company Melrose Industries publishes a sustainability report annually, which summarizes the impacts, efforts and contributions GKNA has made in relation to sustainability. It is publically accessible, comprehensive and consistent in how it is structured.

A.4.4.4 Consumer access to product information

For the selected product, there is detailed public information on GKNA's website on what materials and processes are used in the making of the product (GKN Aerospace, 2026). Additionally, information is provided on what function the product plays in the final product developed by Company F, as well as the capabilities and achievements of the product.

A.4.5 Society

A.4.5.1 Promises or agreements on sustainability issues

GKN Aerospace, as well as its parent company Melrose Industries have several targets and commitments in numerous areas of corporate sustainability such as employee health and safety, net zero pledges, and hazardous substance reduction. In addition to this, they broadcast regularly internally and externally the progress for these promises, internally via their intranet and externally via their sustainability report and publications on their website.

A.4.5.2 Degree of usage of conflict minerals

In the selected product, three out of the six selected parts have Ti-6-2-4-2 in them, which consists of 2 % tin, a designated conflict mineral. Looking at the total weight, tin make up 1.13% of the total weight of the selected parts.

A.4.5.3 Presence of policy concerning the handling and usage of conflict minerals

GKNA have a conflict minerals policy, prohibiting the usage of minerals originating in designated conflict zones. It expects the same from its suppliers and expects them to their own due diligence to ensure that conflict minerals are sourced from conflict-free zones.

A.4.5.4 Policies and commitment of the organization to prevent corruption

GKNA and its parent company Melrose Industries both have substantial anti-corruption and anti-bribery policies in place to prevent abuse of power, embezzle-

ment, fraud and other illegal and unethical practices. GKNA have a code of ethics which further outlines how company employees should act to anticipate and prevent corruption-like instances from happening. Additionally, GKNA provides a whistle-blower function employees can use if they spot something that is non-compliant with said policies.

A.5 Company D

A.5.1 Workers

A.5.1.1 Absence of lowest paid workers compared with the minimum wage

Company D does not have publicly available data on their internal salaries. Although they publish annual reports each year. In this annual report we can find general statements, such as providing competetive and performance aligned compensation.

A.5.1.2 Average number of hours worked by employees in a year

Company D has not publicly released any statistics, such as hours worked. This means that generic and sector-specific data were used instead. Company D is mainly based in the UK, where employees work approximately 32 hours per week on average.

A.5.1.3 Average holiday time used by workers (paid time off + federal paid holidays)

Again, no statistics were available for this. However, Company D refers to 33 vacation days on their career site. The assumption is therefore that the company provides a minimum of 33 days.

A.5.1.4 Occupational injury rate

The injury rate is presented by the company. Data provided on their website shows that they had a record of 3 injuries per 1,000 employees in 2025.

A.5.1.5 Presence of perceived noise reduction measures

No measured and quantified decibels are publicly disclosed. However, noise is included as a safety risk in Company D's health and safety standards for contractors. This shows that noise is recognised as a workplace risk and is managed within their operations.

A.5.1.6 Presence of health and safety requirements within workplace

Company D presents their "Life saving rules" in their code of conduct. One of these rules is that the personel always have to wear personal protective equipment.

A.5.1.7 Existence of legally recognised unions

Yes, there are legally recognised unions that Company D both acknowledges and respects. This commitment is embedded in company policy and supported by evidence of recognised union representatives. This is stated in their human rights policy.

A.5.1.8 Systems, policies and actions in place to prevent discrimination

Company D has formal anti-discrimination policies, such as “Equal Employment Opportunity” and “Dignity & Respect”. These policies are implemented in order to prohibit discrimination. Unfortunately, no data are available regarding the number of discrimination incidents.

A.5.1.9 Social benefits provided by employer

Company D clearly states that pay is important, but not the only reward that company D is offering. They "offer an attractive total reward package that goes beyond your pay, recognising your skills, impact, and contribution". Although, no clear details on what these rewards are is publicly available.

A.5.1.10 Presence of policy against child labour

Company D has publicly announced a modern slavery statement. This statement includes a commitment to upholding global policies and processes to mitigate related risks, including child labour. Clearly stating that "We are opposed to the use of any form of child labour or practises that inhibit the development of children".

A.5.2 Local community

A.5.2.1 Presence of organisational information to the local community in their spoken language

No data found.

A.5.2.2 Organization efforts to minimize hazardous substances

No policies were found on the reduction of hazardous waste. However, the company reported 21,900 tonnes of hazardous waste. Their data charts do not show an effort to reduce hazardous waste, as the values fluctuate heavily from year to year, with no stable decrease.

A.5.2.3 Organization support for community initiatives

Company D has numerous community contributions. Publicly on their website it is stated that a total of 5 million pounds have been contributed to the community. These are divided into four parts, charitable contributions and social sponsorships, community investment, commercial initiatives with social dimensions, and the value of STEM contributions. However, no concrete community initiatives were found.

The trend is also quite consistent, as the company shows a decreasing trend in contributions over time.

A.5.2.4 Disturbance due to noise

No data found for Company D.

A.5.2.5 Casualties or injuries associated with Company D

As mentioned, they report an injury rate of 3 employees per 1,000 on their website. They also report 0 fatalities during 2025. This was also confirmed by a specialist involved in the production of the product, who confirmed that 0 fatalities have been caused by Product A.

A.5.3 Value chain actors

A.5.3.1 Presence of supplier code of conduct

No data found

A.5.3.2 Interaction between organizations in value chain

No data found

A.5.4 Consumers

A.5.4.1 Presence of feedback mechanisms

Yes, suppliers can provide feedback through Company D's own "supplier portal". This was confirmed by people at GKN who work directly with Company D.

A.5.4.2 Publication of a sustainability report

No report specifically named a sustainability report is published. However, Company D publishes an annual report. This report is public and covers topics such as environment, employees, and company policies.

A.5.4.3 Consumer access to product information

It is possible to access information about the engines on Company D's website, including how they are built and what is included. The website provides an interactive view of the engine, where users can explore different parts and understand the main components and functions. This gives a good general understanding of the product.

A.5.5 Society

A.5.5.1 Promises or agreements on sustainability issues

Company D has publicly stated sustainability commitments including environmental, ethical and social principles supported by quantified targets.

A.5.5.2 Policies and commitments against conflict minerals

Yes, Company D has policies for conflict minerals, especially for its suppliers. Company D requires responsible sourcing of minerals in line with Organisation for Economic Co-operation and Development guidelines.

A.5.5.3 Usage of conflict minerals

Yes, from available LCA studies conducted for the same product, tin occurs in the material, meaning that conflict minerals are present.

A.5.5.4 Policies and commitment of the organisation to prevent corruption

Company D includes anti-bribery and corruption in its code of conduct, where it states that such behaviour is not tolerated. The code of conduct also gives guidance on how employees should act in different situations to avoid corruption. These requirements also apply to suppliers.

A.6 Usage (Company F)

A.6.1 Workers

A.6.1.1 Absence of lowest paid workers compared with the minimum wage

No specific data is found that states that the minimum wage is lower than or equal to the minimum salary. However, Company F does state that they are in compliance with the International Labour Organization. They also clearly and concisely write in their own remuneration philosophy that *"The Company's remuneration philosophy aims to provide remuneration that will attract, retain and motivate high-calibre executives, whose contribution will help to ensure that the Company achieves its strategic and operational objectives, thereby delivering long-term sustainable returns for all shareholders and other stakeholders in a manner consistent with the Company's identity, mission and corporate values."*

A.6.1.2 Average number of hours worked by employees in a year

Again, no statistics are publicly available on the exact average number of hours worked. However, Company F states in their human rights policy that Company

F will act in accordance with ILO standards regulating working hours, and that all hours worked beyond the normal work week will be compensated.

A.6.1.3 Average holiday time used by workers (paid time off + federal paid holidays

Similarly, no statistics were published on the amount of holiday time used. However, Company D acts in accordance with ILO standards regarding annual leave, as stated in their human rights policy.

A.6.1.4 Occupational injury rate

The occupational injury rate for Company F is unknown. However, the Lost Time Injury Frequency is known, which is stated to be 1.56 per 1,000,000 working hours, and a total workforce of 156,921 employees in 2025, according to their annual report. With an assumption that each employee works 2,000 hours each year, the injury rate per 1,000 employees can be calculated.

$$
\begin{aligned}
Hours\text{Total} &= 156{,}921 \times 2{,}000 = 313{,}842{,}000 \text{ hours} \\
Injuries &= 1.56 \times \frac{313{,}842{,}000}{1{,}000{,}000} \approx 489 \\
InjuryRatio &= \frac{489}{156{,}921} \times 1{,}000 \approx 3.1 \text{ injuries per } 1{,}000 \text{ employees}
\end{aligned}
\tag{A.1}
$$

This value should be interpreted as an approximation, as it is based on assumed working hours rather than reported data.

A.6.1.5 Presence of perceived noise reduction measures

Company F does not provide publicly available data regarding noise exposure levels for workers. However, Company F operates within the aerospace industry, where airport operations, aircraft maintenance, and aircraft handling expose workers to high noise levels. The main source of noise is aircraft engines during take-off, landing, and engine testing operations, where noise levels frequently exceed 85 dBA. According to the Occupational Safety and Health Administration and the National Institute for Occupational Safety and Health, long-term exposure above 85 dBA during an eight-hour workday increases the risk of hearing loss.

Studies on aircraft maintenance workers also show that most workers are exposed to noise levels above 85 dBA during a standard eight-hour workday. Beach et al. (2014) found that approximately 89.5% of examined aircraft maintenance workers were exposed to noise levels at or above 85 dBA during daily operations. High noise exposure in aviation environments is associated with hearing loss, fatigue, stress, and communication difficulties among workers.

Company F states that occupational health and safety is managed through structured safety management systems in accordance with the ISO 45001 standard. Air-

bus describes that workplace risks are identified, assessed, reduced, and monitored through standardized safety procedures intended to protect workers from hazardous working environments.

A.6.1.6 Presence of health and safety requirements within workplace

Company F has adopted the ISO 45001 standards for occupatonial health and safety management systems. Meaning that they has implemented implemented a structured approach to identifying, assessing, and controlling workplace risks in order to prevent injuries and illnesses.

A.6.1.7 Existence of legally recognised unions

Company F operates globally and has several legally recognised trade unions across its operations. These include, for example, IG Metall in Germany, Unite in the United Kingdom, and CGT in France, which actively represent employees in labour relations and collective bargaining processes.

A.6.1.8 Right to collective bargaining

Yes, Company F accepts the right to collective bargaining. This is reflected in its Code of Conduct, which includes labour relations as a core component and aligns with internationally recognised frameworks such as the UN Global Compact and ILO conventions.

A.6.1.9 Systems, policies and actions in place to prevent discrimination

Company F has a section in their Human Rights Policy, as well as in their Code of Conduct, on “harassment and bullying”, stating that the company is committed to providing a work environment that is free from physical, psychological, sexual, and verbal harassment.

A.6.1.10 social benefits provided by employer

Company F provides social benefits such as pension, insurance, and well-being benefits. However, these are country specific.

A.6.1.11 Presence of policy against child labour

There is no single policy that focuses only on preventing child labour. However, Company F claims to support the ILO’s child labour standards, which include the prohibition and elimination of child labour related issues such as slavery, hazardous work, and illicit activities.

A.6.2 Local community

A.6.2.1 Presence of organisational information to the local community in their spoken language

No data found

A.6.2.2 Organization efforts to minimize hazardous substances

Company F is an aircraft manufacturer, meaning that the most significant environmental and social impacts associated with its products occur during the use phase, when the aircraft are in operation. During this phase, emissions from fuel combustion, such as NOx and particulate matter, are generated, making this stage relevant for the assessment of hazardous emissions.

The International Civil Aviation Organisation states that NOx and particulate matter contribute to elevated concentrations of pollution in and around airports, leading to more toxic air for airport workers and the local community. ICAO also states that these concentrations are higher near airports and correlate with flight activity. Furthermore, emissions from aircraft during landing and take-off operations have been shown to contribute to premature mortality among populations living near major airports.

Studies from Arter et al (2022) quantify these emissions and show that NOx and particulate matter from aircraft landing and take-off operations contribute to decreased air quality and are associated with modelled estimates of approximately 100 to over 1,000 premature deaths in 2016 across the United States.

So, what actions does Company F take to reduce these emissions? Company F is currently developing new technologies, including a new aircraft expected to reduce fuel burn by 20–30%. It is intended to be powered by hydrogen cell technology, which produces no CO2 or NOx emissions. So, Compq

A.6.2.3 Organization support for community initiatives

Company F operates their own foundation, in which they support all kind of initiatives. The foundation focuses on key areas such as humanitarian support, capacity building, environmental action, and youth development and education. Through partnerships with organizations and other stakeholders, it uses its products, services, and expertise to support communities in crisis, strengthening the communities worldwide.

A.6.2.4 Disturbance due to noise

Company F does not publicly disclose data related to noise emissions. However, the company acknowledges that noise generated by flight paths and aircraft operations has negative impacts on surrounding communities. Aviation noise is linked to several adverse effects on exposed populations, including sleep disturbance, increased

annoyance, and reduced overall well-being (Benz et al. 2022).

The Federal Aviation Administration defines a threshold of an average noise level of 65 dBA as a significant community noise exposure.

A.6.2.5 Casualties or injuries associated with Company F

Company F presents its statistics on fatalities publicly. In 2025, the company reported 3 fatalities. However, when discussing with a production line manager at GKN Aerospace, it was stated that none of these fatalities were related to the selected product. This means that it can be assumed that there were 0 fatalities associated with the product.

A.6.3 Value chain actors

A.6.3.1 Presence of supplier code of conduct

Yes, there's a supplier code of conduct presented by company F.

A.6.3.2 Interaction between organizations in value chain

No data found for this indicator.

A.6.4 Consumers

A.6.4.1 Presence of feedback mechanisms

Yes, Company F provides structured feedback mechanisms, through technical platforms and customer satisfaction surveys.

A.6.4.2 Publication of a sustainability report

No, company F does not solely provide a sustainability report. Although, they provide an annual report in which sustainability is one of four chapters.

A.6.4.3 Consumer access to product information

Company F is very transparent with their product information. It is very accessible in their website.

A.6.5 Society

A.6.5.1 Promises or agreements on sustainability issues

Company F has set up commitments, mainly regarding environmental issues. Goals presented on their website is

1. Committed to reaching net-zero carbon emissions by 2050.
2. Flying with 100% SAF by 2030 for all aircraft.
3. Aiming to decrease fuel burn and reduce NOx and particulate matter.

A.6.5.2 Presence and policy concerning the handling and usage of conflict minerals

Company F has signed policies regarding the handling and usage of conflict minerals. The policy states that the company is committed to responsible sourcing of minerals and aims to ensure that they do not contribute to conflict or human rights abuses, mainly specifying tin, tungsten, tantalum, and gold.

A.6.5.3 Usage of conflict minerals

Yes, from available LCA studies conducted for the same product, tin occurs in the material, meaning that conflict minerals are present.

A.6.5.4 Presence and commitment of the organisation to prevent corruption

Company D has a comprehensive anticorruption policy. Where they provide formal anti corruption policy, mandatory ethics and compliance training and whistleblowing mechanisms that enable employees to report concern.

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