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Evaluating the Sustainable Practices in the Delivery of Industry Equipment in Europe

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ABSTRACT

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Climate change has been a concern for the world, and transportation, especially freight transport, is considered one of the major causes of climate change due to the use of fossil fuels, which cause greenhouse gas emissions and the production of pollutants.

The aim of this thesis was to analyse the existing sustainable practices implemented by logistics service providers (LSP), including the role of European Union regulations and standards in endorsing and implementing sustainable transportation. The purpose was to understand what was already implemented by transport organisations. The thesis also looked at how the variety of industry equipment affects delivery operations and how these factors are similar and different from one another. Factors like material handling systems, packaging materials, route optimisation, and transport equipment were evaluated. Finally, this thesis examined the reasons for the readiness and reluctance of stakeholders to implement sustainable delivery practices in their operations.

This thesis is built on a literature study and qualitative research. The literature study was derived from existing data, while the qualitative data was obtained through a survey and interview. Survey questions were created on a Google Form, and the link was sent to the logistics service provider by email. Interviews were conducted through teams and WhatsApp, and the questions asked were the same as the survey questions. The questions posed in the survey and interviews examined the current sustainable delivery methods that LSPs now use, the variables affecting the delivery of various industry equipment, the factors that encouraged the stakeholders to embrace these sustainable methods, and the challenges faced by stakeholders in implementing these practices.

The conclusion derived showed that the respondents have implemented the existing sustainable delivery practices in their business operations. The variables affecting the delivery of various industry equipment, such as streamlining material handling processes and the use of sustainable packaging, were not implemented in their delivery operations, but route optimisation was a factor adopted by LSPs. The motivation behind adopting sustainable practices included corporate social responsibility, brand loyalty, reputation, competitive advantage and concern for climate change.

Keywords: sustainable transport, industry equipment, logistics service provider, green transport, route optimization.

CONTENTS

1 INTRODUCTION

In recent times, there has been a strong awareness of sustainability. We see a lot of business organisations promoting sustainability awareness and adopting green practices. For instance, the airlines encourage their passengers to add a euro or two to promote the use of green fuel. Other organisations promote the use of sustainable packaging, encourage recycling, reduce waste, or improve energy consumption. Even consumers are not left out. They encourage businesses to implement sustainability in their business processes and in the creation of the goods and services they advertise. Transport is regarded as the bloodline of any country, and as crucial and advantageous as transport is, it also comes with great disadvantages, and these disadvantages are related to climate change and pollution. The use of industry equipment cuts across all industries in the world, and it plays a role in the production of goods and services, the creation of jobs, the development of infrastructure, sustainability, and the country.

This study aims to assess the sustainable practices adopted in the delivery of industrial equipment across Europe by first examining sustainable practices currently implemented, then investigating if there are similarities and differences in the delivery of diverse industrial equipment in the areas of packaging material and the type of mode suitable for delivery. Lastly, to evaluate and understand the readiness or reluctance of stakeholders to implement sustainability in their business operations. The European Union and other institutions have been vocal about implementing sustainability, setting targets to reduce greenhouse gas emissions, and promoting green initiatives. This study will present a detailed assessment of sustainable industry delivery operations in Europe through the use of qualitative surveys and interviews. The findings will offer valuable insights that can help improve sustainable operations and promote a greener future.

2 PURPOSE OF THE PROJECT

2.1 Limitation and Ethical Concerns

There are limitation and ethical concerns that hinder the evaluation of sustainable practices in the delivery of industry equipment in Europe. These concerns can be seen below:

2.1.1 Data Availability

To be able to make a proper and accurate analysis of sustainable practices in the delivery of industry equipment, the quantity and quality of data is considered as a critical factor. Data is collected through survey, interviews, and questionnaires. The fundamental requirement for transport planning and decision making is obtaining accurate, comprehensive, reliable, and updated data. A primary obstacle encountered during data collection is maintaining consistency and comparability among the diverse databases utilized. It is more difficult to obtain accurate data or get effective result when data is unavailable or incomplete, or when information and figures are scattered among multiple databases or sources (Moschovou et al., n.d., p. 2). Issues with the availability of reliable data also make it more difficult to carry out a reliable quantitative assessment for the goal of implementing sustainable policy (Kaszubowski, 2019, p. 9).

2.1.2 Stakeholder`s Participation

Key stakeholders in the industry may be unwilling to anticipate or prioritize sustainable practices in their supply chain operations. The scope and depth of study may be affected when transport organisations and operators of private fleet are not motivated to provide researchers with their data. The inability to obtain comprehensive data results in assumptions and hypotheses, which reduces the likelihood of obtaining plausible models (Moschovou et al., n.d., p. 3).

All stakeholders, including cargo owners, infrastructure operators, supply chain operators, transportation operators, industry equipment manufacturers, warehouse operators, and industries need to be taken into account, including their agendas and objectives (Shah et al., 2021).

In 2017, a study was conducted at the Technical University of Denmark regarding the involvement of stakeholders in supporting sustainable transport appraisals. The result of the study demonstrates how increasing stakeholder involvement in decision-making processes related to transportation plans can enhance decision-making while also advancing more sustainable growth in the field of transportation planning (Barfod, 2018, p. 1053). Additionally, there are barriers that restrict a stakeholder from participating in sharing freight transport data. One of these barriers is the legal barrier and these are laws that prohibits a stakeholder from sharing company data. Another is the resource barrier, and this means there is lack of resources and funding. The rest are competition barriers by private companies and institutional barriers between various public organisation (Moschovou et al., n.d., p. 2).

2.1.3 Sustainable Transport Indicator

There are a lot of factors under sustainable transport indicator that can bring about limitation. One of the factors is a comprehensive sustainable transport indicator. This covers a variety of impacts and considers economic, social, and environmental factors when evaluating the degree of sustainability. Litman and Burwell (2006) claim that the primary determinants used to assess sustainability in transportation are measured by the economy, environment, climate efficacy, and effectiveness of transportation system (Rotimi, 2023, p. 181).

The environmental factors considered are climate change emissions, which measure the per capita fossil fuel consumption and emissions of CO2, other air pollution such as conventional air pollutants, noise pollution, water pollution, land use impact, habitant protection, and resource efficiency (Litman & Burwell, 2006, p. 338). Another factor to be considered is the overlapping indicator

issue. Some of these indicators overlap. For example, measuring the energy efficiency and vehicle fuel efficiency may overlap because they are closely related. Another example is measuring transportation carbon footprint and greenhouse gas emissions. Another aspect to consider is the limited data. Certain indicators call for data that could be challenging to obtain or analyse. This is why it is vital to take in to account the cost of data collection and the ease of use before selecting indicators. On the other hand, choosing indicators solely based on data accessibility runs the risk of undervaluing and ignoring some crucial goals (Litman & Burwell, 2006, p. 338).

For example, electric vehicles are often regarded as a more sustainable option than fuel vehicles. Electric vehicles are known to reduce air pollution, but they introduce other issues such as thermal pollution, and high cost of electricity.

2.2 Ethical Concerns

Issues regarding ethical concerns arise in research due to the interactions between the researcher and the participants. Given the nature of qualitative research, ethical challenges can occur due to anonymity, confidentiality, and granted permission. These ethical concerns are addressed below:

2.2.1 Relationship between Researcher and Interview Participants

A variety of ethical issues might arise from the closeness and relationship that develops between the researchers and participants in qualitative studies. Qualitative researchers must balance issues including maintaining privacy, fostering candid and transparent communication, and refraining from deceit.
Ethical conflicting circumstances may occur if the researcher engages the participant with controversial issues and chooses a different methodological approach (Sanjari et al., 2014, p. 3).

2.2.2 Privacy and Confidentiality

When collecting data from participants especially regarding business operations, the researcher must uphold privacy and confidentiality. There is less reliance on private data access. Due to financial concerns, private companies in the freight value chain are hesitant to divulge information (Sakhrani Vivek et al., 2017, p. 2).

2.3 Conceptual Framework

Transportation is considered effective when passengers and the ideal quantity of raw materials, semi-finished materials, and finished materials are moved from a point of origin to a point of destination using various modes of transportation such as rail, air, road, water, and pipelines. Freight transportation focuses on transporting all forms of materials and cargo, which has a significant impact on the wellbeing of a country as well as the social, economic, and environmental aspects of the country. As a result, freight transportation plays a major role in the development of a country. Additionally, it has long-term negative effects on sustainability, such as increased air pollution, noise pollution, greenhouse gas emissions, traffic jams, and accidents. Approximately 80–90 percent of carbon emissions are derived from freight transportation (Soti et al., 2023, p. 1).

In Europe, freight transport accounts for a sizable portion of all transport activities. According to data from 2020, the EU transports more than 50% of its freight by road, which significantly increases greenhouse gas emissions. According to Eurostat, in 2022, total EU road freight transportation was estimated to be more than 13.6 billion tonnes and 1920 billion tonne kilometers (*Road Freight Transport Statistics - Statistics Explained*, 2023).

In 2021, road travel accounted for nearly one-quarter (24.6 percent) of freight transport performance in the EU, while maritime transport accounted for over two-thirds (67.9%) (*Freight Transport Statistics - Modal Split - Statistics Explained*, 2023).

Freight transportation is mostly related to the use of fossil fuels, and it has made it one of the biggest sources of emissions, which has a significant detrimental impact on health issues, climate change, and the quality of the air (Moschovou et al., n.d., p. 2). This is one of the major reasons why transport operations must embrace sustainability. Embracing sustainable practices in supply chain management improves supply chain efficiency and increases economic, social, and environmental benefits. Research has shown that sustainable transportation will have a positive impact on reducing resource depletion, traffic congestion, and environmental pollution. Incorporating sustainability in supply chains offers a competitive advantage to organisations by enhancing brand image, boosting economic performance, and improving efficiency and the local community (Shekarian et al., 2023, p. 2).

According to Rodrigue, sustainable transportation is defined as the ability to serve society's transportation demands in a way that harms the environment the least and doesn't affect present or future generations' mobility needs (Rodrigue, 2020). This thesis seeks to do a couple of things, and the first is to evaluate the current sustainable practices in the delivery of industry equipment in Europe. Transport organisations that are responsible for delivery industry equipment are usually referred to as logistics service providers (LSPs). These providers are known as organisations that offers service management in the movement of goods and materials from a point of origin to the customer’s destination point. They primarily manage delivery, warehousing, labelling, and packaging for shipments (Tran et al., 2019, p. 416). All modes of transportation can be utilized in delivering industry equipment to Europe. Transportation companies and logistics managers consider a lot of factors when choosing a transport mode; they consider the size and weight of the industry equipment, the distance to be traveled, time constraints, and any unique handling requirements.

Environmental sustainability has become a serious source of concern to both scholars and authorities. Over the years, the government has made laws and regulation regarding implementing sustainability in transportation. Organizations are now obligated by a regulatory government body to take action against

environmental damage and to increase their support for environmental protection. Additionally, brand owners have made efforts to cut unnecessary waste and emissions throughout their entire supply chain including upstream (suppliers) and downstream (distributors and customers) bodies. When sustainability and ecofriendly measures are executed in the supply chain operations, it results to an improved customer service, better environment, and boosts competitiveness which ultimately results in profitability for companies (Tran et al., 2019, p. 418).

Few decades ago, logistics service providers (LSP) have made significant advancements in developing and adopting green logistics in their supply chain operations, and this was due to the recent adoption of new technology into the control system. The integration of this technology made it possible for logistics firm to choose the most effective and efficient transportation mode and route. This technology also made it possible to calculate CO2 emissions on operating cars on the road. Furthermore, logistics providers have changed their supply chain structural design to integrate green solutions, including the logistics functions which facilitates the effectiveness of management tactics (Tran et al., 2019, p. 421).

A study was carried out on DHL to evaluate how sustainable their operations are, and it was discovered that in 2017, DHL created an Environmental protection program called GoGreen logistics solutions. This program was geared towards improving fuel efficiency and reducing air and noise pollution. DHL is working tireless to ensure that by 2025, they have reduced emissions by 50% in any transport related activities and the remaining 50% in 2050. This means that by 2050, DHL should be able to achieve zero net carbon emissions by working on four aspects and these are local emissions, global emissions, green solutions, and employee engagement (Tran et al., 2019, p. 425).

The trucks and tractors used to transport heavy goods and materials from the port to the destination are usually regarded as heavy-duty vehicles. Heavy Duty Vehicle (HDV) categories are normally determined by the gross vehicle weight rating, which is based on the truck's maximum loaded weight (GVWR)

(Saidani et al., 2018, p. 3) which is usually over 3,5 tons maximum permissible gross weight.

According to the European Environment Agency, the transportation sector in the European Union is responsible for one-third of energy consumption. Heavy-duty vehicles make use of diesel, and they are frequently used when transporting industry equipment, which makes them one of the largest contributors to emissions amongst the other modes of transportation (Ziółkowski et al., 2022, p. 2). The use of Heavy-Duty Vehicles pollutes the environment greatly, especially when it comes to greenhouse gas emissions, which can be decreased by encouraging sustainability. For instance, heavy-duty vehicle can have positive impact if they can be designed in a way that it uses less energy and other resources (Saidani et al., 2018).

The trucks used for transporting Industry equipment in DHL has met the standard of Euro 6 and Euro 5 +EEV (Tran et al., 2019, p. 428). The European Union imposed some standards to regulate the emission of new vehicles and these standards are Euro 6, Euro 5 and EEV which means enhanced environmentally friendly vehicle. Euro VI standards for heavy duty truck (HDV) are more aggressive and stricter because the great majority of HDVs in Europe uses diesel engines power. Euro VI standards address hydrocarbons (HC), particulate matter (PM), and NOx, limit value for NH3 emissions, and a solid particle number (PN) limit for the first time (Grigoratos et al., 2019, p. 348).

Another current sustainable practice in delivery industry equipment is the use of rail transportation. A survey was done in Russia in 2014, and it was discovered that there was a steady increase in freight turnover and a discernible rise in the amount of freight shipment utilizing rail transportation and this was because Russian Railways is actively involved in environmental protection initiatives and effectively used the notion of green logistics to attract new customers. The environmental protection initiatives include noise protection, protection of atmospheric air, and use and protection of water resources (Kiriliuk et al., 2021, p. 186). Another sustainable logistics operation is the European railway sector, Deutsche Bahn Schenker Rail, a German carrier, was the first to

provide a mode of freight transportation that eliminates carbon dioxide emissions (Kiriliuk et al., 2021, p. 186).

Another issue this thesis seeks to address is to discover if sustainable practices for equipment delivery vary across different industries, considering the diversity of industry equipment and their specific logistics requirements. In other words, I seek to evaluate whether sustainable practices used for the delivery of diverse industry equipment across different industries are similar or different in operation. Industry equipment varies from one sector to another.

In the medical sector, industry equipment includes medical gas systems, implantable devices, x-ray film processors, CT scanners, portable suction pumps, and ventilators (Binseng et al., 2006). In the food sector, industry equipment includes, but is not limited to, the following: food processors, packaging machines, conveyers, cooling machines, dispensers, and slicing machines (Aarnisalo et al., 2006). In the construction industry, equipment like a dozer, loader, clamshell equipment, and excavator (Schaufelberger & Migliaccio, 2019, p. 3).

In the automotive industry, industry equipment is used for manufacturing all types of vehicles, including conveyor belts, which are used to move large parts and components around the factory; robots, which are used for various activities such as welding, assembling parts, and painting cars; CNC machines, which are used to cut metal parts to exact specifications; jig welders, which are used to hold parts in position as they are welded; and engine machining stations, which are used to make the engine blocks that power cars (*5 Common Machines Used in Automotive Manufacturing | Midsouth Mechanical Contractors*, n.d.).

The automotive industry has various equipment and machines used to manufacture all kinds of vehicles. Regardless of the equipment transported in different industries, they generally follow the same principle. Before equipment can be transported for delivery, it must be packaged sustainably to reduce damage to the product and its negative impact on the environment. Naturally, the main

purpose of packaging in the automotive industry is to safeguard parts and products while minimizing overall logistics costs. According to Stock and Lambert (2001), packaging is considered one of the major logistical activities, which also has a significant impact on the costs and efficiency of logistics, particularly in the areas of warehousing and transportation. Packaging is required to do the following: To protect the product and ecosystem through waste minimization, safety, and natural deterioration; logistics containment and handling (unit, bulk, container, pallet); and information (logo, description, symbol) (Vöröskői & Böröcz, 2016, p. 195).

Packaging is a logistics activity that is common to all industries. While the packaging needs of various industry equipment vary, they all go through the same sustainability procedure. There are three categories of packaging: the first is the primary packaging, which is the necessary and direct container that holds the product itself; the next is the secondary packaging, which is the material that safeguards the primary package and is thrown away when the product is ready to be used; and the last is the shipping package, which refers to packaging required for transportation, storage, and identification. This package is disposed of once the product arrives at its destination (Wu & Dunn, 1995a, p. 28). In this report, we would be focusing on the shipping packages used by Logistics service providers to deliver industry equipment in Europe. There are different packaging solutions for different industries. The packaging alternative can either be one way, or a returnable packaging system.

The European Union made a regulation regarding packaging, including packaging design and packaging waste management, with the purpose of tackling the growing quantities of packaging waste that cause environmental problems and to eliminate obstacles in the internal market due to the different packing design regulations adopted by EU member states (*Packaging Waste - European Commission*, n.d.). The most recent revision of Directive 94/62/EC focuses on preventing the production of packaging waste and promoting the shift to a circular economy by encouraging the recovery of packaging waste through recycling, reuse, and other means rather than disposing of it (*Packaging and Packaging Waste*, n.d.).

Nowadays, numerous LSPs have begun utilizing heavy-duty containers and plastic totes because they are cost-efficient and useful for numerous trips. Examples of biodegradable materials that are preferred for packaging include paper, cardboard, corn starch, and bubble wrap. In addition, packages are filled with bio-degradable Styrofoam (A. Gupta & Singh, 2020).

Another sustainable measure that is used in the delivery of diverse industry equipment across different industries is choosing a transportation mode that reduces environmental impact. Transport mode selection has a significant impact on the environment; for instance, barge and rail modes utilize less energy or are more efficient when compared to other modes such as road haulage and air cargo. Mode selection is influenced by environmental impact, transport costs, freight delays, and inventory carry costs, amongst many others. These aspects have a direct or indirect impact on traffic congestion and air pollution (Wu & Dunn, 1995b, p. 26).

Logistics managers ought to weigh environmental effects against financial costs before making choices. In general, rail is deemed as the better alternative to road transport because it utilizes land efficiently, uses renewable energy sources, reduces pollution and noise, and eases traffic congestion in cities (Wu & Dunn, 1995a, p. 26). For example, the German automaker Bayerische Motoren Werke AG (BMW) is shipping more and more of its parts and completely assembled cars by rail throughout Europe in an effort to reduce environmental impact and save money on packing and transportation (Wu & Dunn, 1995a, p. 27).

Barge transportation is used for transporting containers on inland waterways. One popular way for moving industrial equipment and machinery is by container shipping. Container barges are used in moving containers. Barges are a sustainable option because they are used to reduce transport costs, reduce congestion caused by trucks on the road, move large and heavy equipment, and transport containers, especially when compared to trucks. Due to the advantages mentioned above, the Port of Rotterdam Authority (2011) and the European Commission (2011) hope to replace trucks with barges and trains

as the primary modes of transportation. The downside is that it is regarded as one of the slowest forms of transportation (Zweers et al., 2019, p. 253).There are different types of barges, such as oil barges and dumb barges. Dumb barges have various uses in different industries, and they can be used to transport heavy equipment, construction materials, waste, coal, agricultural products, and oil (*Transporting Goods by Barge: A Comparison of Dumb and Oil Barges - Articles - Ship Building Shipyard Indonesia - Ratson*, 2023).

The last thing this thesis seeks to evaluate is whether the reluctance of stakeholders, such as industry equipment manufacturers, to prioritize sustainable practices within their supply chain operations is a potential issue. Before any project can be considered completed, it must have served the needs of stakeholders by ensuring that their demands and expectations are met. A stakeholder is defined as a person or people who own an interest, rights, or ownership in the project and have the potential to influence or be affected by the project's work or results. Stakeholders are divided into four categories: upstream stakeholders, who are generally the end-users and paying customers; downstream stakeholders, who are suppliers; external stakeholders, who are the general community and independent concerned parties; and invisible stakeholders, who collaborate with the project team to deliver the company's ultimate benefit but whose cooperation and support are essential to the company's success. The invisible stakeholders work together with the highly visible project stakeholder group (project delivery team and project sponsor). In supply chain management, we have upstream and downstream stakeholders (Walker et al., 2007, pp. 73–74).

Stakeholder participation is a key issue in the implementation of sustainability in industrial equipment delivery services. Stakeholders can influence the goals of an organisation and they are also affected by the organization's performance. In sustainable supply chain management, the primary stakeholders are customers, employee, supplier and top managers while the secondary stakeholders are government and non-government organisation, community, trade association, competitors and media. Regulations imposed locally, nationally, and internationally by national governments or transnational

regulatory bodies are usually the source of government pressure and incentives. External stakeholder groups have an impact on the competitive advantage and reputation of a company by compelling them to transparently evaluate and manage their sustainable corporate social responsibility performance (Rebs et al., 2018, p. 201).

In recent times, there has been a dramatic increase in public concerns over the role that organizational play in environmental issues. Businesses are under pressure to implement environmentally friendly practices because of growing awareness of environmental issues among customers, governments, and non-profit groups. Furthermore, the stakeholders are forced to address environmental issues due to regulatory and market pressure on organization. Given that investors are drawn to businesses that seem to care about the environment, stakeholders are becoming more aware of the significance of sustainable development goals and the effects of greenwashing on businesses (Inês et al., 2023, p. 1).

Stakeholders are evaluating their whole business operations, especially the supply chain management system, because it is considered the central focus of business. This is due to the fact that the supply chain has a significant impact on the environment because it involves the constant flow of information, capital, and material from obtaining raw materials to the production, packaging, and distribution of goods and services to the final consumer. Organizations are now obligated to reduce the negative impact of their business operations on the environment by pursuing sustainable practices because stakeholder awareness of the environment is increasing (Inês et al., 2023).

From this, we can see that the participation of stakeholders in implementing or not implementing sustainable practices in their supply chain operations plays a major role in the environment. Despite the pressure from the government and other stakeholders, some organisations that manufacture industry equipment have been having challenges in implementing sustainable supply chain innovations. Many obstacles stand in the way of these organizations' attempts to innovate for sustainability such as limited availability of resources. The

obstacles must be recognized and removed in order to facilitate the adoption, implementation and optimization of sustainable supply chain innovation. The scarcity of resources will prevent the removal of obstacles thereby making it impossible for stakeholders to adopt sustainability in their supply chain operations (H. Gupta et al., 2020).

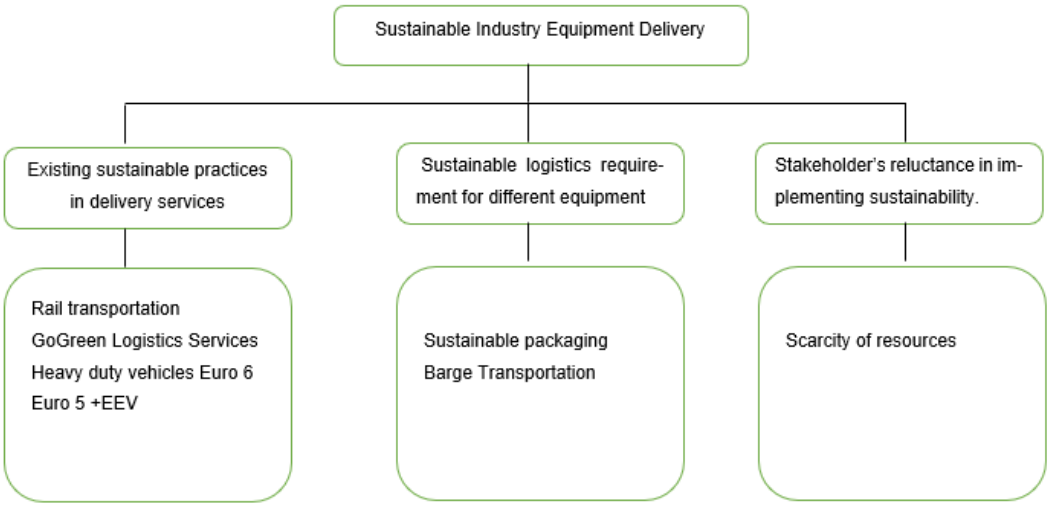

Figure 1. Conceptual framework

2.4 Objectives and Research Questions

The objective of this study is to assess and measure the effectiveness and impact of sustainable transport practices within transport organizations. This study aims to review their business operations and assess their environmental impact.

2.4.1 Research Questions

1. What are the most efficient and sustainable practices used by transport organizations for transporting industrial equipment in Europe?

2. Do sustainable practices for equipment delivery vary across different industries, considering the diversity of industry equipment and their specific logistics requirements?
3. Could the reluctance of stakeholders, such as industry equipment manufacturers, to proactively engage in or prioritize sustainable practices within their supply chain operations be a potential issue?

Over the years, sustainability has been a worldwide issue due to the adverse effects of transportation on the environment, economy, and society. Transportation has major benefits, but it also poses a threat to the environment when its operations are not sustainable. These research questions were chosen because when evaluating sustainability practices in the delivery of industry equipment in Europe, it is necessary to first assess the present sustainable methods used by transport organizations, then explore the various sustainable logistics requirements for different industry equipment, and finally, investigate the plausible causes of stakeholders' reluctance to implement sustainability in their supply chain processes.

3 EXISITING SUSTAINABLE PRACTICES IN TRANSPORT OF INDUSTRIAL EQUIPMENT IN EUROPE

Nowadays, environmental concerns are one of the most significant challenges facing modern civilization including the logistics sector. It appears that sustainable development and logistics are related, and for this reason, organisations are even more focused on performing specific tasks that promotes environmental protection, economic sustainability, and public welfare (Cosimato & Troisi, 2015, p. 257). Although it has long been acknowledged that the transportation sector especially freight transport contributes significantly to CO2 emissions and, in turn, to climate change, but little progress has been made in reducing emissions in the area. Sustainable practices adopted by transport organisation are intended to minimize CO2 emissions, increase opportunities for uniformity in transport and enhance consumer welfare and quality of life (Silva Cruz & Katz-Gerro, 2016).

The implementation of sustainable practices on logistics relies on the actions of three main players: the government, organizations, and consumers. The government is responsible for making laws and regulations regarding sustainability and green logistics effective; organizations are responsible for implementing sustainability in their supply chain management; and customers are required to promote green consumption (Cosimato & Troisi, 2015, p. 259). Organisation in this context refers to Logistics service providers, non-governmental organisations such as Green Freight Europe (GFE), and auto manufacturers. In recent years, due to the public awareness of environmental protection, the growing demand for sustainable development, and the environmental laws, academics and practitioners are driven to focus their research on green supply chain management (GSCM). This has led logistics organizations to perform a sustainable assessment of their business operations and to implement GSCM plans in order to lessen pollution discharge and cut down on waste in the areas of production, packaging, transportation, distribution, and consumption (Cosimato & Troisi, 2015, p. 259).

3.1 Governmental Sustainability Obligations

In the area of sustainability, the government plays three roles: regulator, facilitator, and buyer. The government first establishes a range of policies and regulations at the federal, state, and local levels regarding vehicle emission standards, recycling requirements, and noise control. For example, governments in Europe and Canada have set strict principles on recycling waste, source reduction, and material reuse. Secondly, the government also encourages organizations to develop new environmental technology by providing funds for research and offering financial investment and regulatory incentives.

In the logistics industry, the government is the key player in the development of transport regulation and infrastructure such as high-speed rail and alternative fuels. Thirdly, since the government is considered one of the single biggest consumers of goods and services in many countries, the government can utilize its purchasing power to make green purchases by offering financial incentives to government contractors (Wu & Dunn, 1995b, p. 21).

In summary the government is expected to adopt and establish legislation and regulations, implement sustainable freight and passenger transport strategies, and provide financial incentives for pursuing sustainable transport pathways. Policies implemented by the government can either be long-term and short-term. For instance, long-term plans include the construction and modification of transport infrastructure and transport networks. The government ensures that these plans are guided by sustainable policies and regulations and that direct investment is made in sustainable infrastructure, such as modifying existing systems and infrastructure and networks (United Nations, 2021).

Due to the high expense and inherent risk associated with building transportation infrastructure and networks, governments collaborate with private entities. This alliance is referred to as a public-private partnership (PPP). Collaborating with the private sector can reduce risk associated with investments in sustainable transport infrastructure because some of the risks are shared. (United Nations, 2021). The European Commission is one organization inside the

European Union that carries out this function. For instance, the European Commission funded maritime ports in Ireland, Greece, Spain, Latvia, Lithuania, Netherlands, and Poland to improve onshore power supplies that will lower greenhouse gas emissions from moored vessels (Directorate-General for Mobility and Transport, 2023).

The European Commission has been promoting sustainability through a number of initiatives, one of which is the introduction of the European Green Deal plan. This purpose of this agenda is to reduce emission by 90% in 2050. They plan to achieve this by transitioning to more environmentally friendly transportation which entails prioritizing the needs of users and offering them more accessible, economical, healthy, and eco-friendly options. To achieve their plans, they hope to boost the uptake of clean vehicles and alternative fuels, increase the use of multimodal transportation, adopting digital technology in the whole transport system, expanding the EU Emission Trading System to maritime industry and lowing the free allowances for airlines, and promoting initiatives such as the Connecting Europe Facilities (CEF) and the ReFuelEU Aviation (Directorate-General for Mobility and Transport, n.d.).

The European Commission has already implemented plans and polices to promote sustainable transportation through the use of electric heavy-duty vehicles, hydrogen refueling, carbon reduction efforts, recharging pools across the Trans-European Transport (TEN-T) (European Commission, 2023).

So far, they have installed more than 500,000 public recharging stations across its 27-member states. The AC (alternative current) charging stations are 455,902 while the DC (direct current) charging point is 56,437 (European Union, 2023). As of 2021, the total number of refueling points for alternative fuels such as compressed natural gas (CNG), liquified natural gas (LNG), liquified petroleum gas (LPG), and hydrogen (H2) is 3778, 421, 30,744, and 136, respectively. As of 2021, the total number of alternatively fueled heavy-duty trucks (N2 and N3), which includes BEV, PHEV, H2, LPG, CNG, and LNG, is 3786, 115, 55, 10809, 20434, and 8608, respectively. N2 and N3 refer to the weight classification of medium- and heavy-duty vehicles, while BEV and

PHEV mean battery electric vehicles and plug-in hybrid electric vehicles (European Commission, 2024).

The polluter pays principle is another contemporary sustainable policy that is imposed by the legislation of European countries. The responsible party is required to cover the cost of the emissions under the European Union's new environmental policy. This resulted in public pressure placed on businesses, which prompted them to expect more environmentally conscious behavior and more attention to environmental values in all facets of corporate activity (Larina et al., 2021, p. 184). The European Commission has created models used to assess and implement sustainability and one of these models developed for both passenger and freight transport is the TREMOVE model. This model is used to evaluate the emission standards for Euro 5 and 6 cars and Euro 4 for heavy-duty vehicles in Europe, and it also covers all inland urban and inter-urban transport modes (road, rail, water, and air) (European Commission, 2014). This transport and emission simulation model is also used to calculate transport demand, vehicle stock turnover, the modal spilt, air pollution emissions and welfare level (Zito & Salvo, 2011, p. 180). The use of rail transportation is also a way for reducing emissions. For the past 20 years, the European Union has developed sustainable transport, especially intermodal transport. Rail and sea intermodal transport have been considered the best means of improving environmental sustainability (Bask & Rajahonka, 2017, p. 561)

The EU is responsible for the development of the Trans-European transport network (TEN-T) policy because it is a vital tool for promoting comprehensible, multimodal, efficient, and high-quality transport infrastructure across the EU. The TEN-T is made of core and comprehensive network which consists of roadways that connect metropolitan nodes, inland and marine ports, airports, and terminals, as well as railroads, interior waterways, and short sea commerce routes (European Commission, n.d.). Currently, the TEN-T road network has 9 revised corridor work plans. The development of the core network corridors is guided by the updated work plans through 2030, when the core network is expected to be completed (Directorate-General for Mobility and

Transport, 2020). The revised corridor will increase enhance connectivity and improve efficiency as well as sustainability through intermodal transportation. There are financial institutions that fund sustainable transportation, and these institutions come from public, private, and multilateral sources. An example of this is the European Investment Bank (EIB) group. In November 2019, this bank became the EU climate bank. EIB has offered long-term financial assistance to the growth of numerous transport networks and electric charging networks and has performed various functions, such as helping European entrepreneurs bring their ideas to market so that they can compete internationally and promoting research and development in the areas of alternative fuels, fuel cells, artificial intelligence, and charging stations. They are heavily invested in sustainable transportation both inside and outside of the EU. This bank plays a crucial role in promoting and implementing green transportation that is safe and available to everyone (EIB, 2021).

Examples of project sponsored by the bank includes the cleaner transport facility (CTF) project which was created as an initiative in 2016 to assist the adoption of new and cleaner technology in the transportation sector by utilizing the resources and tools provided by the EIB and the commission. Resources provided includes charging and refueling facilities amongst many others. Their aim is to quicken the adoption of cleaner transport vehicles and to promote socioeconomic benefits such as lower heath expenses due to cleaner air and lower noise levels. Others includes investing in maritime transport to promote environmentally conscious and energy-efficient ship technologies and industries. The ferry company Finn lines retrofitted its current ships with scrubbers to remove sulphur and other dangerous particles from exhaust emissions, using a €100 million loan from the EIB (EIB, 2021).

EIB is an EU organisation and because of this, it is more than just a financial institution because this conversion affects both the market and EU governance. The European Union has been reaching out to the European Investment Bank (EIB) constantly to help meet these dynamic issues and to be part of EU's Green Deal because EIB is an EU institutional entity that is mandated by treaties to support EU policy efforts. As such, it is expected to follow rather

than lead the Commission. The EIB is comparatively well-positioned to take the lead in formulating policies and they are considered as a major stakeholder (Helen Kavvadia, 2021, p. 186).

Lastly, at the domestic level, the government also addresses variety of issues relating to sustainable transport regulations and policies such as the mode of transport, vehicles and vehicle use, transport services, engineering, and technology. For instance, vehicle regulations are created to increase vehicle efficiency and reduce emissions from road transport, and these regulations include road safety measures, requiring automakers to manufacture more zero-emission vehicles, monitoring the import of new and used cars, including prohibiting the import of cars that use fossil fuels after a certain age, enforcing stricter requirements for fuel economy and CO2 emissions in new cars, establishing stricter specifications for fuel, such as using low-sulfur petroleum products, and managing the recycling and reuse of end-of-life vehicles. (United Nations, 2021, p. 2).

3.2 LSP and Automakers Sustainability Obligations

Fossil fuels continue to be the primary energy source used to meet the world's energy needs, despite the fact that they are a rapidly depleting resource. In the power and transportation sectors, emissions are directly connected with fuel use. It is important to note that these pollutants have a detrimental impact on the environment and quality of life. Since the development of a country heavily relies on its transportation system, alternative energy sources have been sought after in order to successfully address the issues concerning climate change and energy security. Various alternatives, including biodiesel, methanol, ethanol, butanol, dimethyl ether, diethyl ether, bioethanol, synthetic natural gas (SNG), and hydrogen, have been developed through ongoing research to replace fossil fuels in the future (Ahmed et al., 2016).

Within the transportation industry, companies such as automakers and logistics service providers have an obligation to implement sustainable business practices in compliance with government rules and regulations. LSPs are vital to the development of sustainability because they provide solutions for the supply chain. They are also known for contributing more to environmental deterioration than other industry sectors in terms of noise and air pollution, carbon discharges, global warming, fuel consumption, and resource scarcity. Therefore, in order to address present and future environmental concerns, LSPs must start implementing sustainable logistics solutions. (A. Gupta & Singh, 2020).

3.2.1 Logistics Service Providers

Logistics service providers are sometimes referred to as third-party logistics (3PL). The reason why companies outsource some roles is so that they can focus on core competencies, globalization, organizational restructuring, value-added services, cost-effective operations, etc. The most outsourced functions are warehousing, inbound and outbound logistics, and customs brokerage (Jharkharia & Shankar, 2007).

Presently, LSP has started incorporating sustainable practices in their operations to reduce carbon emissions by reducing dependence on fossil fuels and switching to alternative fuels, converting fleets from conversional to hybrid or compressed natural gas, using biodegradable materials for secondary packaging, incorporating smart warehousing systems, and the proper allocation of resources to reduce waste. Previous studies have been done in developing countries by researchers to evaluate the sustainable practices implemented by LSP. In an effort to protect the environment, LSPs have been noted for emphasizing the reduction of fuel use (fossil fuels) and carbon emissions. This is achieved through the use of renewable energy sources such as solar, alternative fuels, electric vehicles, and hydropower (A. Gupta & Singh, 2020, p. 4).

A case study of current sustainable practices adopted by logistics services is DHL transporting products from Voith Paper Company by sea transportation with the use of biofuel. This company from Germany is known to manufacture machines for the paper industry, drive and braking systems for automotive customers, and technical equipment for hydropower plants. Every year, they move approximately 2500 cubic meters using DHL services, with the majority of their shipments being oversized. They use LCL ocean freight to ship their products, and their ships use sustainable biofuels as an alternative fuel (DHL, n.d.). The three most popular biofuels are biodiesel, bioethanol, and biokerosene. Plant-based biofuels are obtained sustainably in such a way as not to impact land use, particularly in food production. The cleanest and most sustainable biofuel currently on the market is one that is derived from plant waste products (DHL, 2019, p. 12).

Biofuels are energy-enriched compounds that are derived from biomass, which is abundant in nature. Biomass is the end product of photosynthesis, which uses water and sunlight to convert atmospheric carbon dioxide into sugars. The use of biofuels has significant economic impact to countries that are trying to seek independence from imported oil. It also provides other benefits such as decarbonizing society, resource efficiency improvement, and utilizing local renewable energy source. There are two countries in Europe that are leading in the production of biofuels, and they are Germany and France while others are Netherlands and Spain (Darda et al., 2019).

Due to the decarbonizing benefits biofuel offers, including the reduction of greenhouse emissions, the European Union (EU) is encouraged to promote the production and utilization of biofuel through legislative and formal directives. The EU production of biofuel is plagued with low yields, restricted production areas, and high production costs. A rule was made to ensure that the biofuels imported into the EU were obtained through sustainable means, and this was due to the growing concerns about the global effects of biofuels on food prices, the loss of rainforests, and social issues. By 2010, the EU hopes to have replaced 5.75% of all fossil fuels with biofuel, and by 2020, 10%. The

EU is also focusing on other renewable energy sources, such as electricity or hydrogen, and not on biofuels alone (Rösch & Skarka, n.d., p. 31).

Maersk is another logistics service company that transports cargo throughout Europe using alternative fuel. Biofuel is used onboard ships. They transitioned from very low sulfur fuel oil (VLSFO) to biofuel in an effort to cut well-to-wake (WTW) emissions by 90–100% (Maersk Mc-Kinney Moller, 2023, p. 10). In 2017, Maersk was the first operator to implement slow steaming to reduce fuel consumption and emissions. Slow steaming is when vessels operate at a speed lower than the maximum engine load as the standard. All of Maersk's vessels have seen a 27% drop in average speed since July 2008. Although, if not properly handled, operating below capacity could cause stress on the engines of the ship. Maersk Line actively contributed by sharing its technological knowledge with the sector, and as a result, slow steaming became the norm on the vast majority of trade routes. In fact, 70–80 percent of the fleet in the sector was slow-steaming by 2012. Apart from the reduction of fuel use and emissions, there are several additional advantages that slow steaming provides such as extended engine lifespan, fuel efficiency, cost savings and providing reliable services to their customers. Maersk Line was able to meet schedules and deliver on time by using slow steaming, which allowed them to change speed in the event that unforeseen events caused a vessel to delay in port (Forest L Reinhardt et al., 2012).

In 2018, DHL added four heavy duty trucks to its fleet in Belgium with LNG drive system and a total authorized weight of 40 tonnes. In 2020, Sweden added two large vehicles equipped with bioLNG to its fleet of drop-in biodiesel vehicles. With the backing of the Swedish government, six more vehicles are scheduled to be purchased by 2023. Furthermore, DHL with other logistics companies in the Netherlands, Germany, and Belgium have joined the H2-Share initiative which is financed by the European Regional Development Fund. The goal of this initiative is to ensure that all participating companies will drive a 27-ton, zero-emission hydrogen truck for three months starting in 2020. In 2019, DHL acquired an additional fuel cell and a range of up to 500 kilometers to meet the goal. The Ministry of Transport and Digital Infrastructure of

Germany provided financial help to enable their procurement (DHL, 2019). Additionally, DHL launched GoGreen service which entails calculating the amount of CO2 emissions generated from when the cargo is received till when it is delivered. Customers have the option to pay 3 percent more than the standard rates and these funds is received to finance climate protection programs around the world (Kiriliuk et al., 2021, p. 186).

Another example is DB Schenker who is considered as the first logistics service provider in Germany to operate a full cell electric heavy-duty truck in the 40-ton class. This hydrogen powered semitrailer tractor has a range around 400 kilometers and as an added advantage, it can be refueled in around 15 minutes. DB Schenker intends to use it as a means of decarbonizing land transportation (DB Schenker, 2023, p. 7). Carriers are actively working to reduce their C02 footprint through the provision of engine solutions. They achieve this using CNG (compressed natural gas) and biogas engines. When compared to diesel engines, CNG engines emit less NOx and CO2, and very little PM10. One disadvantage here is that the cost of buying a CNG truck is roughly 5–10% higher than that of a similar diesel truck. Another technology solution adopted by carriers is the use of electric vehicles. These vehicles do not release any CO2 or produce any local pollutants. The method used to generate the electricity determines how much CO2 is released overall. They also have drawbacks, such as low battery capacity, expensive batteries, and lengthy battery charging times (Quak, 2012, pp. 166–167). UPS and FedEx are experimenting with all-electric vehicles with a range of more than 50 miles (Bai et al., 2017). UPS uses hybrid cars, which use 35% fewer fuel gallons annually than cars with internal combustion engines. After then, CO2 emissions can drop by 42%. (Aleksandrova, 2011).

One of current sustainable practices adopted by transport companies in Europe is Intermodal transportation. Transportation that uses may modes can either be referred to as intermodal transport, multimodal transport, or combined transport. According to United Nations Economic and Social Council, intermodal transportation is defined as transporting materials or products using a single loading unit or road vehicle that combines two or more modes of

transportation in succession without requiring the commodities to be handled in different modes (Song & Panayides, 2015, pp. 109–110). The combination of intermodal road/rail transportation is beneficial because it reduces the environmental impact of freight transportation and this is because rail transportation releases less greenhouse gases than road transportation (Heinold & Meisel, 2018). DHL has also adopted the use of rail transportation. In 2021, they operated more than 3,500 trains across Europe. This noteworthy addition states that, on average, DHL Freight Germany reduced CO2 emissions by 39% when compared to road operations (Stefan Brunner, n.d.).

3.2.2 Automanufacturers

Automobile manufacturers are another entity tasked with integrating sustainability into their operations. Recently, the public and the government have increased pressure placed on the automotive industry which has a great possibility to address environmental challenges. For instance, government regulation such as the EU Directive of End of Life (EOL) Vehicles have prompted car manufacturers in the European region to hasten greening their supply chain. Due to this pressure, the automotive industry, now known as auto-SSCM, has been investigating and integrating sustainable operations and practices into the various stages of automotive SCM, such as design, procurement, supplier collaboration, logistics, warehousing, and packaging (Masoumi et al., 2019, p. 2).

Examples of car manufacturers that have implemented sustainability in their products and business operations include the Swedish automaker Volvo, which manufactures vehicles that use renewable gas for transport operations. Volvo has increased its focus on alternative fuels by launching a stronger gas-powered truck that runs on biogas, and it is capable of reducing overall CO2 emissions while carrying heavy loads over long-distance operations. According to Daniel Bergstrand, their product manager, biogas has great compatibility with electric transportation, and when they are both combined, it helps hauliers achieve their sustainability goals and transition towards climate-neutral

transportation. The performance of this truck is on par with that of its diesel counterparts. Also, long distance transportation is made possible because of Europe's expanding network of more than 600 Liquified natural gas (LNG) and bio-LNG fueling stations. By 2024, around 78 bio-LNG plants in Europe are expected to be operational. In keeping with its mission to promoting sustainability, Volvo has also manufactured battery electric trucks, fuel cell trucks, and combustion engines that are powered by renewable fuels such as biogas, Hydrotreated vegetable oil (HVO), and green hydrogen. The three versions of gas-powered trucks (Volvo FH, FM, and FMX) are equipped with Euro IV-E engines which have a 4 percent higher fuel efficiency (Volvo, 2023). According to the European Commission, the production of bio-LNG in Europe would increase rapidly in order to replace the use of fossil LNG. This proposal called REPower EU has the purpose to significantly expand domestic energy production capacity. Furthermore, as of March 2021, Volvo trucks and DHL freight collaborated to promote sustainability in long-distance heavy transport. The collaboration has been extremely fruitful and has resulted in an exclusive fully electric Volvo FH truck with a maximum weight of 60 tons, or roughly 34 tons of payload. This truck covers a distance of 150 km one way, and it operates in Sweden between Gothenburg and Jönköping cities. The DHL Volvo project is a part of the initiative in Sweden that promotes the shift to an electrified freight transport system which is funded by the Swedish Energy Agency and Vinnova, Sweden's innovation agency (Stefan Brunner, n.d.).

Another example is the German automaker (BMW). This automaker evaluates the financial cost vs environmental impact of his logistics operation. To reduce environmental impact and save transportation and packaging expenses, BMW uses more of rail transportation to ship its parts and fully assembled cars in Europe (Wu & Dunn, 1995a, p. 27).

Sustainability should not only be the responsbility of logistics service providers but also the responsibility of shippers. A study was conducted recently, and the results showed that shippers do not regard sustainability as an important feature when choosing logistics providers. Shippers were asked to select the main element they consider when choosing a logistics service provider, and

price had the highest index score of 100 percent, reliability came in second at 94 percent, and sustainability was 45 percent (Kaledinova et al., 2015, p. 78). A platform was created for shippers and carriers to share their successful sustainable transport projects.

In 2012, an organization known as Green Freight Europe (GFE) was established with the sole purpose of uniting shippers and carriers in promoting sustainable logistics. The objective of GFE is to collaborate with producers, its members, knowledge partners, and other external stakeholders to ensure that technologies, vehicles, operational activities, and equipment have the capability to reduce greenhouse gases from freight transport through the development of test protocols, strategy evaluation, and effectiveness confirmation. In 2014, GFE created a database and compiled it with the experiences of its members who have completed successful project experiences in order to help other members make their transport projects sustainable. The platform is used not only to learn about best practices to adopt in sustainability but also the worst mistakes to avoid when adopting sustainability (Kaledinova et al., 2015, p. 79).

Shippers such as HP, P&G, Wabco, Philips, Heineken, and Aviko are among the many companies that are members of GFE. Among the many companies that make up GFE's membership are carriers and LSPs such as Deutsche Post DHL Group, FedEx Express, VOS Logistics, UPS, SeaWay forwarders and logistics, and Gefco logistics for manufacturers. Their European associations includes Post Europ, Euro Commerce, European intermodal association, European shippers council amongst many others. When a person becomes a member of GFE, they go through four stages. In the first stage, they are given a carbon reporting and monitoring tool to measure their carbon dioxide emissions. The GFE member will input their truck type, country, the quantity of fuel per year, the number of shipment per year and the number of distance per year to measure the level of emissions. Then the GFE provides the CO2 improvement toolkit which contains verified technologies such as aerodynamics and other proven emission reducing technologies, supply chain management and organisational elements such as modalshift and supply chain collaboration, and behaviour orientation to help employees and employers to transition into

sustainable transportation. The last stage is gain recognition, GFE award and community of practice (Barbarino, n.d.).

4 ADAPTING DELIVERY LOGISTICS TO NATURE OF EQUIPMENT

The goal of logistics service provider is to meet customer demand, optimize profits and conquer competitors in the increasing international market (Ma & Suo, 2006, p. 127). They do this by analyzing their business operations such as order processing, material handling, distribution, warehousing, inventory management, information technology, packaging, custom clearance, transportation of products and services and reverse logistics (Skender et al., 2016, pp. 28–29). Logistics services include both non-physical (such as supply chain design contractor selection and negotiating freightage) and physical tasks (such as handling, transportation and storage). Most of logistics service operations are bidirectional. Bidirectional means operating in two directions. Information system comprises of decision-making modeling, administration, and more crucial concerns are tracking and tracking. Infrastructure includes transportation, communications, warehousing, financial, human, and packaging resources (Tseng et al., 2005). The machinery and equipment industry in Europe comprises all kinds of machinery and tools used for general purposes and process-specific purposes. This industry includes agricultural and forestry machinery, domestic appliances, machine tools, arms and ammunitions, industrial processing machinery, general purpose machinery, and special purpose machinery (Eurostat, n.d.).

4.1 Material Handling System

It is important to remember that the majority of industrial equipment is classified as heavy equipment and machinery. Before industry equipment can be

delivered, it is important to first consider factors that can influence the transportation of the products. One of the first factors to consider is material handling and this deals the weight, dimension, storage and specific transport requirements of the equipment. Material handling equipment addresses issues such as transport and handling technology, order picking technology, sorting and storage technology (Tadić et al., 2023). Material handling involves a short distance transport that typically occurs inside the boundaries of a building such as a structure, warehouse or between a building and a transport agency (Michael G. Kay, 2012). A material handling (MH) system is made up of hardware, software, human and management sub-systems and these systems collaborate to carry out all handling related tasks. The hardware and software include variety of equipment categories which includes packaging, information processing, control, transfer, unit loading, storage, identification, support equipment, and communication. The hardware includes automated sortation system and an automated guided vehicle (AGV) network. Each of the material handling equipment are further broken down into different classifications. For example, the transfer equipment category includes conveyors, trucks, and cranes. The conveyors group is further divided into belts, and rollers. A material handling system (MH system) is designed to facilitate facility operations by ensuring that the appropriate materials are delivered at the appropriate time and location (Mohsen, 2010, pp. 249–250).

In logistics and manufacturing facilities, material handling (MH) systems are one of the physical resources that need to be adequately designed. A poorly designed MH system can cause delay in operations, damaged or contaminated product, and therefore the price of moving across a facility could go up, raising operational costs. An adequately designed MH system can assist logistics facilities to develop their productivity, improve quality of products, and decrease operational costs. MH is regarded as a vital feature of supply chain that has an impact on organizational operations. For instance, when designing warehouse, material handling systems are considered important. When setting up material handling, the selection of material handling equipment is crucial (Mohsen, 2010, p. 246). Logistics service providers are required to optimize their material handling systems to reduce waste and promote sustainability. It

has been established in this report that there are various types of industry equipment in different sectors with different material handling requirements. Using the wrong material handling equipment will increase cost, cause damage, increase waste and accidents.

A logistics service provider is required to optimize their MH technologies because it enhances the entire process of delivery goods by removing factors that causes delay in delivery, and eliminates increased traffic congestion, damaged goods, and wrong delivery. Additionally, utilizing the adequate MH technologies can increase work safety, and reduce labor cost and the number of employees (Tadić et al., 2023, p. 2). All these improves the sustainability in delivery processes and eliminates waste that can occur from damaged goods and wrong deliveries. Material handling equipment is influenced by the industry equipment's size (depth, height, width), shape (irregular, round, rectangular, long, square), weight (per unit volume or weight per item) and other (fragile, slippery, dangerous goods, sticky) (Michael G. Kay, 2012, p. 3). Material handling systems are divided into four categories: transport equipment, positioning equipment, storage equipment, unit load formation equipment, and identification and control equipment. Transport equipment is used to move materials from one location to another, and the major subcategories are conveyors, cranes (jib crane, bridge crane, gantry crane, and stacker crane), and industrial trucks. Examples of conveyors used for heavy machinery and equipment includes chain conveyor, screw conveyors, bucket conveyors, magnetic conveyor, flat belt conveyor, roller conveyor, slat conveyor, vertical conveyor, tow conveyor, amongst many others. Examples of industrial trucks are powered pallet jack, walkie stacker, pallet truck, platform truck, counterbalanced lift truck, narrow-aisle straddle truck, narrow-aisle reach truck, turret truck, order picker, sideloader, tractor-trailer, and automatic guided vehicle (Tow, assembly, forklift and unitload AGV) (Michael G. Kay, 2012, p. 8). Examples of smart solutions are Smart Automated Guided Vehicles (SAGV) forklifts, Goods-To-Person (GTP) Autonomous Mobile Robots (AMRs), and Unmanned Aerial Vehicles (UAV) (Tadić et al., 2023).

For example, in DHL, all their material handling processes are automated. They make use of indoor mobile robots (AGV and AMR) and stationery robots (industrial and collaborative robots). Additional measures have been taken to prevent theft and optimize storage capacity. These solutions are an autonomous security robot (ASR), locus robotics, and an automated storage and retrieval system (ASRS). This will increase efficiency, lower expenses, and reduce waste (DHL, n.d.-c).

Apart from ensuring that adequate material handling equipment is used, the activities performed have to be efficient and effective to improve performance and sustainability. An example of how inadequate material handling operations promotes inefficiencies in an organization is a case study in a company called Scapa Bedding AB. This company manufactures middle-size beds in Sweden, and they had issues regarding their material handling operations. Research was carried out to locate and identify inefficient material handling activities and streamline them to minimize the material handling process. In order to address their material handling issues, tools like PDCA and DMAIC, which are known as lean and Six Sigma techniques, were utilized. The model's objective is to support users in their efforts to eradicate redundant, non-value-adding tasks in order to create an efficient flow and lower expenses inside a facility (Dino Besic, 2013).

4.2 Packaging

Packaging is one of the factors to consider when transporting diverse industry equipment. One of the most important components that can actively enhance supply chains and increase the sustainability of logistical operations and procedures is packaging design (García-Arca et al., 2020). So, packaging should be created not only to distinguish the product but also to make all logistical tasks carried out along the chain easier and simplified, so lessening the overall negative effects on the environment and society at large. This goes beyond the packaging's traditional and crucial role in product protection. According to some researchers, packaging serves three primary purposes: commercial,

logistically advantageous, and environmental. Other researchers have further developed these three primary functions to nine different sub-function and these are commercial, protection, logistics, production, environmental, purchases, packaging, ergonomic and legal. All these sub functions make up conceptual scope of sustainable packaging logistics (García-Arca et al., 2017). Logistics packaging can help to fulfill the terms of the sale of goods contract, safeguard products, make storage and transportation easier, and enhance sales (Shao & Cui, 2023). From an economic standpoint, best packaging is linked to higher sales and lower expenses. However, packaging is supposed to be made in a way that promotes product efficiency in the logistics and production stages. Packaging efficiency considers factors such as supplying, packing, handling, storing and transportation. These factors will eradicate waste along the supply chain and promote sustainability. Examples of this kind of waste could be found in product damage, underutilized or wasted spaces in warehouses, transport and point of sale, and use of surplus materials (García-Arca et al., 2017).

Environmental considerations are taken to account when evaluating the efficiency of packaging. Packaging design influences the quantity of resources utilized or not. These resources refer to materials used in creating the package itself as well as additional materials in the supply chain such as fuel which is used for transporting the packages. Likewise, the design of packaging affects the environment by increasing or decreasing waste or contamination. This is why it is important to not undervalue the environmental impact of damaged and spoiled products caused by improper packing design (García-Arca et al., 2020).

It is vital to minimize the environmental impact of packaging design and this can be done by decreasing packaging waste and the amount of raw materials used; encouraging returnable packaging, recycling, and recovering packaging waste; and the strengthening of product protection to prevent damages. This has prompted the European commission to create legislative laws and policies regarding reducing packaging waste(García-Arca et al., 2017).

Sustainable packaging logistics (SPL) is defined as a procedure that entails designing, executing, and managing the integrated packaging product and supply chain operations in order to ensure that products are prepared in a manner that is safe, secure, efficient, and effective in handling, transport, delivery, storage, retailing, consumption, recovery, reuse, disposal, and related information, with the goal of optimizing social and consumer value, sales, and profit from a sustainable standpoint, as well as ongoing adaptation (García-Arca et al., 2017, p. 4).

Furthermore, it is crucial to note that packaging is divided into three levels and these are the primary packaging, secondary or transport packaging (boxes) and tertiary packaging (pallet). The primary packaging is usually regarding as the first container, and it is first layer of protection that the product experiences. The secondary packaging is generally known as retail packaging and it is created to group products together and by doing so, it protects the products and makes handling easier during distribution and sales. The tertiary packaging is usually referred to as transport packaging and it is the combination of many secondary packing components put together on a pallet or roll container to enable handling, storage and transport (García-Arca et al., 2020).

According to researchers, and various packaging, environment and logistics related organizations such as (ECOEMNES, ECR_EUROPE, AENOR), sustainable packaging design can be promoted through dimensional changes (resizing packages), material changes (biodegradable materials), change in product quantity per packaging, modifications to the packing process, change in the quantity of primary packing compared to secondary and/or tertiary packaging, material and dimensional standardization, aesthetic changes, returnable packaging, and shelf ready packaging (SRP)(García-Arca et al., 2017).

4.2.1 Packaging Materials

There are various types of industry equipment in different industries. Products like production machines and manufacturing equipment are usually heavy and have irregular or massive dimensions. Some industry equipment is easy to break down into parts, while others are typically impossible. Additionally, some parts are extra-long, and they require extra crates before they can be transported. Generally, wooden crates, pallet, and boxes are some of the sustainable options used to package heavy and bulky industry equipment before storage and transportation. Pallets are a crucial component of logistics, playing a major role in handling, loading and unloading, storing, packing, shipping, and turnover. They are essential for increasing the effectiveness of logistics and lowering associated expenses. Additionally, pallets come in a variety of forms, features, and materials that are commonly used in the market, such as wood, metal, plastic, fiberboard, and so on. Wooden pallet is regarded as one of the most common and widely use pallet in the world, due to its affordable price, versatile application, and exceptional precision (Shao & Cui, 2023).

In logistical activities, pallets are used extensively and when a business chooses pallet, they take some factors into consideration such as durability (pallet lifecycle, pallet residual value and recovery rate), stiffness (compressive performance, bending resistance), strength (repairability, impact strength, durability, environmental adaptability), function (stackable, non-slip, bundling, shelf loading), and the cost to fulfill the case's minimum performance requirements. The durability of a pallets is a vital component, so the life cycle of the pallet should be thoroughly considered. A product's material and energy consumption are gathered and calculated across the course of its life cycle, from cradle to grave, using life cycle assessment (LCA). Using a life cycle assessment, one can analyze loads placed on the environment and then suggest ways to lessen their effects and advance sustainability (Shao & Cui, 2023).

Research was conducted to determine the environmental impact of pallets made from different materials which is wood pallets and plastic pallets. Materials including data of raw materials, energy utilization and post-use pallet

disposal data were collected for this research. The result showed that wooden pallet is more environmentally friendly than plastic pallet. During the raw material stage, the environmental impact of plastic pallets is greater than that of wooden pallets because plastic pallets are derived from petroleum, whereas wood pallets are made from trees. During the production stage, plastic pallets are obtained using a variety of techniques, such as blow molding, injection molding, and foaming. The environmental impact of wooden pallets is lower than that of plastic pallets because plastic pallets require that petroleum be melted at high temperatures, whereas wooden pallets can be formed by simple nailing. The final disposal stage refers to the last treatment and disposal of packaging waste. Wooden pallets have a greater global warming potential (GWP) value than plastic pallets. Wooden pallets are recycled, ground into chips, and then blended into organic fertilizer while for plastic pallets, recycling amounts to 10 percent while the rest are for landfill and incineration (Shao & Cui, 2023, pp. 3–5).

An example of a logistics service provider who has implemented sustainability in their packaging operations is DHL. DHL has fully adopted the Packaging Act, which went into full effect in 2019. The Packaging Act seeks to make the recycling of used packaging effective, environmentally friendly, and consumer-friendly while also establishing a packaging recycling quota. This is why freight, sustainable packaging, and business practices are top priorities. Reusable materials such as heavy-duty boxes and euro pallets are used in transporting industry equipment. The Euro pallet is mainly used because their ecosystem footprint is minimal, which contributes to their little environmental impact. When considering the full life cycle, according to HPE-certified pallets, wooden pallets have a much better energy and environmental balance than plastic pallets. They are never treated with wood preservatives and are produced without water. When a wooden pallet is beyond repair or use, it can be recycled and burned without any issues. Also, in DHL, padding is made of cardboard instead of PE (Polyethylene) foam. This cardboard fixing pad is made of sustainable materials that safeguard delicate items like filter cartridges and pumps while they are being transported. It is important to note that this single-material solution is composed entirely of recycled materials, producing significantly fewer

CO2 emissions than solutions derived from polyethylene (PE) foam (DHL, 2021).

Additionally, DHL ensures that industry equipment is packaged in a sustainable and hazard-free manner by ensuring the following:

1. All liquids or fuels are entirely drained before transportation.
2. Industrial equipment must be transported in crates or safely strapped to pallets, covered firmly with edge protectors and reinforced cardboard.
3. Heavy equipment with large top are stacked on a wide base to diminish instability during transportation.
4. Equipment that are too large to be securely stacked upon will attract surcharges (DHL, n.d.-b).

In DB Schenker, products such as industry equipment are package in a way that reduces damages. They use package technologies such as a dynamic shaker, inclined plane, climate chamber and drop test device. Additionally, they use Euro pallets that has be manufactured by certified manufacturers in accordance with UIC regulations 435-2 and the IPPC standard (ISPM15) (DB Schenker, n.d.-b).

DB Schenker offers guidance to its industrial clients regarding the layout and construction of their packaging; however, a custom-built wooden crate is typically the preferred option. This wooden crate is usually ten meters or longer on the sides. Additionally, they are tightly fitted aluminum composite bonnets that keep out water vapor and shield the components from corrosive elements. Moreover, desiccants prevent moisture from getting inside machinery and systems. The heavy equipment that weighs several tons needs to be fastened to the ground (DB Schenker, n.d.-a). Other packaging solutions used to pack industry equipment such as heavy machinery parts, tools and equipment are cargo boxes with a pallet base, wooden crates, corrugated small cargo carriers (KLT), Corrugated cardboard small cargo carriers, Euro standard cardboard boxes, Euro pallets, IPPC wooden pallets, wooden disposable pallets, and bubble wrap (DB Schenker, n.d.-c).

Packaging also plays a major role in the optimization of a warehouse structure. For example, standardized reusable containers help to lower operating expenses and packaging waste in warehouses throughout the supply chain (Wu & Dunn, 1995a, p. 27). An example of this type of planning is a warehouse tool called BinPacker used by DB Schenker. BinPacker automates activities relating to the optimal use of transport units (such as containers, trucks, or pallets) and the minimization of empty space. This directly affects CO2 emissions and the cost of transportation. Other uses for BinPACKER include the computation of truck loading meters and the palletization of mixed or unit loads (DB Schenker, 2023, p. 9). Finally, packaging operations can be optimized to promote sustainability. Packing elements such as shape, size, and material choices have an effect on logistics costs. When packaging operations are optimized, accompanied by reorganized pallet configurations, the utilization of materials is reduced, handling time is decreased, and space is increased in the warehouse or trailer. The outcome is less waste from packaging, less need for vehicles as there is more space used, and handling in warehouses is made simpler. Reduced environmental effects are a direct result of this efficiency (Wu & Dunn, 1995a, p. 29).

4.3 Transportation

Transport management consists of matters relating to transport mode, route selection, vehicle scheduling, fleet size, and freight consolidation. Activities in this segment is closely related to outbound logistics. Outbound logistics focuses on physical distribution activities which are collecting, storing, and distributing finished products to customers. Also, it includes material handling, warehousing (finished goods), network planning and management, order processing, and vehicle scheduling and routing. Before any product can be transported, network design, planning and management is one of the primary concerns of a logistics service provider. Other concerns are choosing between intermodal or single mode, direct shipping or hub-and-spoke, distributed network or central warehouse, and private fleet or third-party services. During this process, a lot of trade off must be made from a standpoint of customer

satisfaction, profit generation, company's product, logistical available resources, and sustainability. Sustainable practices include less handling, shorter transit time, more direct routes, fewer shipments, and better space use (Wu & Dunn, 1995a, p. 29)

4.3.1 Route Optimization

Apart from the use of alternative fuel and switching to less polluting modes such as rail transportation, the use of software for more efficient loading, scheduling, and routing is another way to reduce pollution and increase sustainability. This software coupled with an effective information system and creative management techniques can reduce traffic jams and pollution (Wu & Dunn, 1995a).

One of the issues plaguing logistics is identifying the best route for freight transportation to reduce transit time. Modern information technologies have made it possible for the development of logistics operations. These technologies have provided accurate data on logistics operations and automatically fostered comprehensible management judgments (Ivanova et al., 2021).
Route optimization focuses on maximizing vehicle efficiency and identifying the most cost-effective driving route map to deliver items to customers as quickly as possible (Xin et al., 2022). Logistics service providers often make use of software or excel sheet to optimize their route planning operations. For example, DHL funded a startup called Greenplan, which is used to promote sustainable logistics through route optimization algorithms that reduce operating costs and the environmental effects of deliveries. Greenplan guarantees that the delivery vehicle's capacity is used effectively, and the routes are calculated with the best delivery conditions, including start time and traffic flow. This system was designed to handle increasingly complex deliveries. It considers factors such as vehicle characteristics and cargo constraints to maximize fleet utilization and minimize costs, as well as daytime dependent and road specific journey times to guarantee accuracy. Additionally, Greenplan was created in collaboration with the University of Bonn's Research Institute for

Discrete Mathematics. According to Dr. Clemens Beckmann, the CEO of Greenplan, the system eliminates every unnecessary driven kilometer by optimizing delivery routes and stop sequences, resulting in significantly shorter operation times and lower operating expenses (DHL, 2020).

UPS is another logistics service provider that uses software for route optimization. UPS uses Orion (on-road integrated optimization and navigation) which recalculates and updates routes throughout the day based on traffic, delivery, and pickup commitments. The system was first implemented in 2012 and it offers truckers the most cost-effective paths across over 66000 routes across North America, Europe and Canada (UPS, 2020).

4.3.2 Transport Equipment

The transportation of oversized and overweight loads is subject to a number of regulations pertaining to vehicle fleet size, towing capacity, road surface conditions, and cargo safety. This is because the process's organization may be constrained by factors such as tunnel size, railway crossings, electrical transmission lines and communications, weather, and time of year. LHG refers to a load that needs special permits and handling on a designated route because it exceeds the standard or ordinary legal size and/or the limits of a gross combined mass or mass limits per axle. Heavy goods vehicles, often known as large goods vehicles, are specialized automobiles used for the transportation of LHG (LGV). Within the European Union (EU), trucks exceeding 3,500 kg in gross combined mass are considered such vehicles. However, to cross EU borders, the truck's length must not exceed 18.75 meters and its loaded weight cannot exceed 40 tonnes (Sierpiński, 2019).

Large and heavy goods (LHG) and need a specialized transport equipment such as flatliner, pole trailer, low-bed vehicle, and transport truck. Generally, a vehicle that is larger than what is allowed on the road needs a special permission that costs extra to obtain in order to utilize the roads. This permit outlines the route that the load must travel and the times and dates that it is permitted

to be transported. Before Large and heavy goods can be transported, there are factors to consider, and these are:

1. Vehicle selection considering the characteristics of the
2. Route development considering traffic volumes and the operational and technical characteristics of the routes.
3. Vehicle selection with consideration for the highest possible of gross combined mass and axle loads.
4. Choosing an appropriate road tractor for a semi-trailer while keeping in mind the maximum load that may be placed on the fifth wheel coupling.

Examples of transport equipment used to transport industry equipment which are usually known was heavy goods or large and heavy goods are tractor unit, rigid trucks, trailer, semi-trailer, road tractor, flatbed barges, and container shipping (Sierpiński, 2019).

DHL transports shipments in accordance with their customers' transport requirements. They make use of modern and functional equipment, which are the Eurotrailer, Megatrailer, Jumbotrailer, Curtainsider, Maxitrailer, Module Trailer, B-Link (Nordic Traffic), Thermo/Temperature Control, and Huckepack Trailer (Rail Transportation). The maximum payload allowed by DHL freight is 24 tons, or a 5-axel combination (3-axel semitrailer and 2-axel truck). They have a trailer called the coil trailer, which can take significantly heavier single pieces. Each country in Europe has a maximum truck load and thermos weight permitted. DHL ensures that these restrictions are addressed appropriately (DHL, n.d.-a).

5 ASSESSING STAKEHOLDERS' READINESS IN ADOPTING SUSTAINABLE PRACTICES

Stakeholders are generally referred to as all the groups of people who could be impacted by the success or failure of the organization's product or service. The stakeholder list begins with the end user and the external customer, who chooses what product or service to buy (Ulrich & Eppinger, 2016, p. 68).

According to Freeman (2004), stakeholder theory connotes that an organization's capacity to sell its products will depend on how well its managers and the corporation's value align with society's challenges and stakeholder expectations (Meixell & Luoma, 2015, p. 70). In the development of environmentally sustainable transportation, there are many stakeholders involved, including policymakers such as the European Union (EU), national governments, and NGOs, as well as members of the supply chain such as logistics service providers (LSPs) and shippers (Bask & Rajahonka, 2017). In the supply chain, stakeholders are important in a variety of ways. Internal stakeholders are known for putting pressure on sustainability and persuade companies to embrace sustainable ways and objectives while external stakeholders have the power to control and influence public opinion (Meixell & Luoma, 2015).

Transport and industrial activities have made major economic contributions to the nation, but they have also influenced the global environment and caused harm to human life. Due to this increase in negative influence, numerous stakeholders, including policy specialists and environmental activists, have been compelled by the escalating severe global environmental challenges to push for more government controls. The government, in turn, has responded to these demands by implementing strict rules, policies, and regulations regarding sustainability and enforcing industries and institutions to adhere. Despite all this, some firms and organizations are still finding it difficult to implement sustainable practices in their business operations. These organizations encounter numerous obstacles when attempting to adopt sustainable innovations in their supply chain operations. The removal of these obstacles will require

resources, but when there is a scarcity of resources, implementing sustainable innovations is hindered (H. Gupta et al., 2020, p. 1).

In this report, we will be analyzing the obstacles stakeholders, especially in the industry equipment and logistics service provider sectors, face when attempting to adopt sustainable practices in their business operations. A good understanding of the nature of the obstacles will enable supply chain players to develop techniques for addressing and overcoming these barriers and influence change in the direction of supply chain sustainability innovation goals. The goal of sustainable supply chain management is to maximize profit, decrease operation costs and resource consumption, minimize environmental impacts, and maximize social wellbeing. Supply chains and organizational innovation are significantly influenced by sustainability. Put differently, innovation is what makes sustainability possible. Although companies want to implement sustainable innovation in their business operations, unfortunately, they are faced with obstacles that hinder this implementation. These obstacles arise from a lack of a suitable policy framework that could offer these companies methodical assistance in their innovation processes. Another barrier is that strategies and techniques adopted by companies to overcome barriers are not customized enough to address the issue.

The success of sustainable innovation in an organisation is reliant on the organization's financial capacity, highly skilled personal, understanding the market, research and development (R&D), and successful collaboration and partnership with other supply chain participants. As a result, businesses are required to detect and prioritize obstacles that hinders the adoption of sustainable innovation (H. Gupta et al., 2020, p. 2).

Financial capacity is one of the barriers stakeholders faces when attempting to research and implement sustainable innovation in their supply chain operations. For example, a small group of researchers came together and conducted a study to determine the barriers to sustainability innovation. They investigated how capitalization can be utilized by institutional innovation middlemen to assist in removing obstacles to sustainable innovation. They discovered that

capitalization or financial mobilization activities such as financial cooperation between public and private institutions, availability of financial instruments and policy and regulatory support for innovation can enable policy makers and regulatory bodies in addressing and removing the financial, technological, and regulatory barriers that prevents sustainable innovation (H. Gupta et al., 2020). This means that regardless of the eagerness of a stakeholder to adopt sustainable practices or the presence of stricter sustainable regulations by the government, if the stakeholder has limited access to capital, they would be unable to remove obstacles that prevent sustainable innovation in their business operations.

Another aspect of financial capacity is the funding received internally and externally to promote sustainability. Another study was conducted by a group of researchers to determine the impact of financial barriers on sustainable innovation. During the research, they evaluated the impact of internal funding and public funding on innovation, and they discovered that one of the biggest obstacles to sustainable innovation is the lack of internal funding. While the absence of external funding, such as from government agencies, hinders sustainable innovation, the impact of the absence of internal funding is greater.Other barriers that affect the readiness of stakeholders in adopting sustainable practices includes the lack of awareness regarding the advantages associated with sustainable technologies, insufficient skilled workforce to apply sustainable technologies, lack of consumer acceptance and ignorance on sustainable products, insufficient funding in research and development for sustainable product and treating sustainable innovation as an expense rather than an investment for the future (H. Gupta et al., 2020).

A review was made by two researchers from a university in Morocco to discover the barriers and drivers of implementation of sustainability in supply chain management. They discovered a total of 60 elements, including 28 drivers and 32 barriers. The internal and external barriers identified from various industries includes lack of IT system integration, weak GSCM organisation culture, employee resistance, inadequate training and technical knowledge, lack of government initiatives, insufficient familiarity with the Green System among

experts, difficulties in determining and weighing advantages and costs, market competition and uncertainty, and poor application of GSCM practices (Hebaz & Oulfarsi, 2021).

6 RESEARCH METHODOLOGY

This section explains how the data and information used for this thesis will be obtained and evaluated. Methodology describes how the entire study design is implemented through rational, methodical, and consistent research judgements in order to survive criticism regarding the attainment of legitimate and trustworthy results. Methodology encompasses all phases of social research, including formulating research questions, gathering and evaluating data, and interpreting conclusions. After the objectives and the research questions have been finalised, the first thing to ask is, ‘What kind of data do I need to gather in order to address my research questions??’’ (Symeou & Lamprianou, 2008)

6.1 Qualitative Research

In this research is applied qualitative research approach. This approach collects the participants' experiences, views, and behaviours through a specific set of research techniques such as interviews, focus groups, surveys, visual techniques, content analysis, and biographies (John Dudovskiy, n.d.). Qualitative research is more focused on the individual’s unique experiences with the problem being investigated. It is the process of gathering, evaluating, and interpreting information from people's actions and words. It speaks of the definitions, meanings, traits, metaphors, symbols, and descriptions of many objects. Qualitative research generally represents research in philosophy, anthropology, philosophy, and sociology (Habib et al., 2014). According to Creswell (2007), qualitative research can be categorised into five main approaches: narrative research, phenomenology, ethnography, case studies, and grounded theory.(L. Haven & Van Grootel, 2019).

Qualitative data analysis has four major steps, which include gathering data, reducing data, displaying data, and verifying (making a conclusion). Qualitative data analysis involves describing, classifying, and connecting phenomena with the researcher's perceptions. First, the researcher should thoroughly define and interpret the phenomena being studied. Then, multiple cases are examined, and the similarities and differences are grouped separately. After that, concepts can be created and linked to each other (Mirko Palic & Stephen Henderson, 2016).

6.2 Data Collection Methods

There are various ways research data is collected. For qualitative methodology, researchers emphasise the themes, patterns of meaning, and experiences associated with the occurrences.(Habib et al., 2014).

6.2.1 Survey in Qualitative Research

The term "survey" in sociology refers to the long-standing practice of studying a population by member observation during censuses. Surey, in qualitative research, is defined as the study of diversity in a population rather than distribution. The goal of a qualitative survey is to ascertain the diversity of a certain topic of interest within a specific population rather than establish frequencies, means, or other criteria. This means that a survey in qualitative research is not centred on counting the number of people who share the same feature (value of a variable) but on focusing on meaningful variance (important dimensions and values) (Jansen, 2010).

When creating a survey, ask questions such as, What do I want to know (information)? Who do I want to ask (the audience)? How should I distribute the survey format, and how will that affect the number of responses (questions)? The survey has either closed or open questions. Open questions allow the participant to elaborate in great detail about their opinions and personal

experiences, while closed-ended questions restrict the answer to a single category (Gournelos, 2019).

In evaluating the sustainable practices of delivery industry equipment in Europe, I will obtain my primary data through a survey (Appendix 1) and interviews (Appendix 1) with logistics service providers. The survey applied to the study is known as a semi structured survey which is defined as a combination of closed and open-ended questions. The question in the survey addresses the three research questions, which are: the current sustainable practices implemented in industry equipment delivery in Europe; adapting delivery logistics to the nature of equipment; and assessing stakeholders' readiness to adopt sustainable practices. The platform used for the survey is Google Forms.

In constructing and arrange the questions in the survey, the funnel technique was applied. This type of survey technique is referred to as a direct questionnaire, and it usually starts with closed questions. More open-ended questions are asked as one goes into the tunnel. At first, the participants are given a set of generic questions on the subject, and subsequent questions are tailored to be more precise and direct. These defined questions are open-ended to ensure that every potential angle of the subject is explored (Habib et al., 2014). This means that the survey began with broad questions about general knowledge of sustainability, then moved to more precise aspects of sustainability in their delivery operations, and finally asked comprehensive questions about specific operations and experiences.

The first section of the survey addresses the information about the participants, where I asked for their name, company name, and role, industry sectors, the number of years their company has been involved in industrial equipment delivery, and privacy and confidentiality questions.

The second section focused on their general understanding of sustainability. The questions focused on evaluating their level of familiarity with sustainability, the significance of sustainability to their organisation, how well the concept of sustainability in the context of industrial equipment delivery is understood, and

lastly, what aspects of their business operations are integrated with sustainability.

The third section focused on current practices. The purpose of this section is to understand the current sustainable practices adopted by their company in the delivery of industrial equipment. Some of the questions in this section are open-ended questions. The questions focused on their sustainability goal in relation to industrial equipment delivery, the efficacy of their sustainable equipment delivery procedures, the motivation behind adopting these practices, ways this commitment is communicated to their stakeholders, the use of sustainable packaging materials (if applicable), the application of green transport initiatives in industrial equipment delivery, and the measurement of carbon footprint in relation to industrial equipment delivery.

The fourth section concentrated on challenges and opportunities. The questions asked elaborated on the main challenges faced when implementing sustainable practices in relation to industrial equipment delivery, the level of challenges experienced (on a scale of 1-4), the impact of governmental regulation or industry standards on their sustainable approach (if any), the extent to which technology plays in optimizing sustainable delivery processes, and finally, their plans for future improvement and expansion.

6.2.2 Survey Participants

The survey was sent to Logistics service providers in Finland, Nigeria, Czech Republic, Poland, and Lithuania (Appendix 2). I sent to 39 companies in Finland, 33 companies in Poland, 55 companies in Lithuania, and 26 companies in Czech Republic. After sending the survey, a follow-up call was made to most of the companies in Finland, but only one company responded.

6.2.3 Interview in Qualitative Research

Interviews are considered one of the most common methods of collecting qualitative data and the backbone of primary data collection. The goal of a qualitative study is to investigate and provide evidence for the reasons behind the nature of a given phenomenon. According to Sewell, from an academic point of view, interviews in qualitative research are defined as an attempt to comprehend the world from the subject's perspective, uncover the significance of people's experiences, and unravel their actual reality before scientific explanations. The qualitative interview is focused on data gathering. It is crucial to note that the information collected needs to be more credible, and the researcher must establish a positive rapport with the source.(Adhabi & Anozie, 2017).

Interviews as qualitative research are particularly useful when the researcher wants to collect information about a specific topic, generate data to support the development of theories, encourage participants to share their experiences, and acquire insight into the respondent's stories or life. The three methods used in conducting interviews are structured (formal), semi-structured, and unstructured interviews. A structured interview is when the interviewer asks all the participants the same standard questions from a questionnaire, either over the phone or in person. The interviewer has complete control over this kind of interview (Saunders & Lewis, 2018).

From a general point of view, an interview has many advantages. For instance, it allows the researcher to chime in when necessary to ensure that the participant is aware of the subject or issue being studied. Furthermore, interviewers are able to apply their interpersonal abilities to delve into important topics brought up by the interviewee, which is considered a crucial component of thorough data gathering. The disadvantage of an interview is that it is expensive and time-consuming. The interviewer might be required to travel or to pay for transport expenses for the participant to the interview location (Adhabi & Anozie, 2017).

The ethical concern surrounding interviews is that the interaction between the participant and interviewer during data collection can have moral ramifications. Therefore, it is necessary to establish and follow clear rules to prevent ethical consequences. Other ethical concerns stated by research scholars include lowering the risk of unforeseen harm, safeguarding the participant's information, properly educating them about the purpose of the study, and reducing the possibility of exploitation (Adhabi & Anozie, 2017).

A structured interview was applied to this study. The questions asked were the same questions constructed in the survey. The interview was conducted through teams in the month of April, and it took less than 30 minutes. One of the logistics service providers was from Nigeria while the second one was from Rauma in Finland. The two interviews proceeded smoothly, and they indicated that they want the names of their businesses mentioned in this study. The first respondent for the interview works for a haulage firm in Nigeria, and the second participant works in Euroports Rauma Oy.

Finally, the secondary data will be obtained from existing data on sustainable practices implemented in the delivery of industry equipment in Europe. This existing data will be obtained from transport government agencies such as the European Commission, non-governmental agencies, documents and news articles from logistics service providers such as DHL and Maersk, amongst many others, and articles and relevant literature are gotten from websites such as Science Direct, Research Gate, Academia, Ebsco, Emerald Insight, SAMK

6.3 Validity and Reliability of Research

Validity in research refers to how effectively the data collected represents the actual field of study. In essence, validity means measuring what is intended to be measured (Taherdoost, 2018). There are different types of validity, and they include face validity, content validity, construct validity, criterion validity, and reliability.

Content validity is defined as the extent to which items in an instrument reflect the content universe to which the instrument will be generalised. In general, content validity is assessing a newly developed survey instrument to make sure it has all necessary questions and excludes any that are not relevant to a specific construct area. Construct validity is the degree to which you were able to operationalize—that is, convert a concept, idea, or behaviour that is a construct into a reality that functions and operates (Hamed Taherdoost & Lumpur, 2016). Criterion validity is defined as the degree to which a measure is connected to an outcome. It gauges the accuracy with which one measure forecasts the result of another. This kind of validity is conferred upon a test that may accurately forecast behaviour or performance in a different context (past, present, or future) (Taherdoost, 2018).

For this research, the validity method will be a combination of content validity, construct validity, and criterion validity. For the literature review, I will be applying content validity to ensure that it is relevant and credible. I focused on academic journeys, industry reports, and publications from reputable transport organisations and logistics service providers that have implemented sustainable practices in their delivery throughout Europe.

For the survey questions and interview, I applied construct validity and criterion validity. The construct validity will ensure that the questions in my survey effectively capture the data required to evaluate the sustainability practices of the operators, while the criterion validity will ensure that the questions included in the survey and interview are related to established sustainability frameworks and measures utilised in the logistics sector, such as carbon footprint.
Reliability means the degree to which a measurement of a phenomenon yields a consistent and steady result. Repeatability is another factor that affects reliability (Taherdoost, 2018). In the research, literature reviews are derived from reliable and credible sources, and additionally, I will triangulate these multiple resources and verify that the information on specific sustainable practices corroborates.

7 EMPIRICAL ANALYSIS

Empirical research is described by Calfee and Chambliss (2005) as a structured method for answering specific kinds of questions by collecting data and other evidence under well-defined, repeatable settings (*Defining Empirical Research - Empirical Research: Defining, Identifying, & Finding - Research Guides at University of Memphis Libraries*, 2024).

7.1 Survey Response

A respondent working in a company that specialises in logistics and sea freight responded, and they did not consent to the use of their company name in this study. The respondent responded to the survey on the 27th of March 2024 and for the purpose of this study, this company shall be Company A. The respondent stated that Company A has been involved in the delivery of industry equipment for 20 years. The concept of sustainability is familiar to them. He further explained that sustainability is important to company A and that they averagely understood sustainability in the context of industrial equipment delivery. The respondent explained that sustainability is integrated into the company's business operations, especially in using energy-efficient warehouse operations, route planning optimisation, and collaborating with sustainable partners. However, when asked if company A has specific sustainable goals related to industrial equipment delivery, the respondent gave no response.

The respondent stated that carbon footprint is a measurement used to check the efficacy of sustainable practices in delivering industrial equipment. However, when asked the motivation behind the adoption of these sustainable practices, the respondent gave no response. The respondent gave no response when asked how their commitment to sustainability is communicated with clients and stakeholders.

The respondent stated that sustainable packaging materials were not used in packaging industry equipment. Packaging materials is the responsibility of

their customers. The respondent explained that green initiatives in place for industry equipment delivery include the use of alternative fuels, intermodal transportation, and route optimization. However, the respondent did not respond when asked how the company measures and reports its carbon footprint as it relates to industrial equipment delivery. The respondent said that the challenges faced by the company is moderately high. He specified that technological changes pose a high level of challenge to the company. At the moment, technology is crucial to maximising the delivery of equipment for the sustainable sector. The respondent did not give a response when asked if there were any governmental or industry standards that influenced their approach to sustainable industry equipment delivery and the future improvement for sustainable industry equipment delivery.

7.2 Interview responses

7.2.1 First interview

The first interview is with BHN Limited, a haulage service provider. They consented to the use of their company name in this study and are experts in road logistics. The interview was held on WhatsApp on March 5th, 2024, at 12:20 p.m. The interview duration was thirty minutes.

When the call connected, pleasantries were exchanged, and the question of privacy and confidentiality was asked, and the participant agreed to have the company's name published. The interview was conducted using the survey question. The participant stated that BHN has been involved in the delivery of industry equipment for 20 years (since 2004). They are very familiar with the concept of sustainability, and it is a very important aspect in their company. They were well-versed in the meaning of sustainability as it related to the supply of industrial equipment.

The participant explained that the areas where sustainability is integrated includes the use of electric and hybrid vehicles to reduce carbon emission, the use of alternative fuels to reduce carbon emission, route planning optimization,

collaborating with sustainable partners and implementing reverse logistics for product returns and recycling. Based on the concept of climate change, BHN established sustainable targets for the delivery of industrial equipment. They measure the efficacy of sustainable industry equipment delivery practices based on energy consumption (renewable energy), compliance with regulations and transport standards, customer feedback, resource utilisation (fuel, material, packaging), and transport efficiency.

He stated that they are motivated as a company to adopt these sustainable practices because it was a global trend and corporate responsibility propelled them to research and adopt these practices. He went on to say that their motivation sprang from the desire for a cleaner environment around the world. Their commitment to sustainability is communicated with clients and stakeholders through usual customer service channels. By sending information on innovations (new practice introduction) and inviting them for launching ceremonies and inspection tours, and lastly requesting for feedback from clients.

However, when asked if his company utilises sustainable packaging materials for industrial equipment delivery, he said it is not applicable to them as a company. It is the client's responsibility to ensure that packaging materials used utilize sustainable materials. The green transport initiatives in place for industry equipment delivery are electric and hybrid vehicles, alternative fuel, route optimization and collaboration with institution that promote sustainability.

When asked how his company measures and reports on its carbon footprint related to industrial equipment delivery, he said that it is not yet finalized and that it is still in process. They are currently developing a measuring tool in collaboration with private and government stakeholders.

The participant stated that it is extremely challenging to implement sustainable practices for industry equipment delivery. The challenges include a lack of technical know-how and sustainability awareness, a lack of financial resources, technological change, a lack of government initiatives, and an insufficiently skilled workforce. Technology plays a major role in optimising sustainable industry equipment delivery in their company.

When it comes to the sustainable delivery of industry equipment, they are not greatly impacted by government rules or industry standards. He stated that there is no firm governmental regulations or industry standards yet. Companies are currently being encouraged to adopt sustainable practices. But the government is about to roll out policy and regulatory guidelines in this aspect. As at now, there is not much in place.

When asked what the plans for future improvement in sustainable industrial equipment delivery were, he said that despite current challenges, there is no going back in sustaining and expanding the scope of the ongoing process. Additionally, they are looking into the possibility of phasing out hydrocarbon fuels completely and using only electric and CNG powered automobiles.

7.2.2 Second Interview

The second interview is with Euroports Rauma Oy, a maritime logistics company. They consented to the use of their company name in this study. The interview was held on Teams on April 23rd, 2024, at 10:19am. The interview duration was thirty minutes.

When the call connected, pleasantries were exchanged, and the question of privacy and confidentiality was asked, and the participant agreed to have the company's name published. The interview was conducted using the survey question. The respondent stated that Euroports has been involved in the delivery of industrial equipment since 1897. They are very familiar with the concept of sustainability, and it is a very important aspect of their company. They excellently understand the meaning of sustainability as it relates to the supply of industrial equipment.

The areas where sustainability is integrated in the delivery of industrial equipment includes the use of alternative fuels to reduce carbon emissions, Route planning optimization, The use of electric and hybrid vehicles to reduce carbon emissions, collaborating with sustainable partners, implementing reverse logistics for product returns and recycling, and using energy-efficient warehouse operations. Their goals are it relates to industrial equipment delivery includes

finding the cleanest equipment for the operation. For example, the new hybrid cranes. These cranes have an advantage because they use land-based electricity. They measure the efficacy of sustainable industry equipment delivery through carbon footprint, lifecycle assessment, energy consumption (renewable energy), resource utilization (fuel, material, packaging), and transport efficiency.

The respondent explained that there are multiple reasons behind the adoption of sustainable practices. For example, they are willing to be the first in Finland to have sustainable operations. They collaborated with customers because the customers have new sustainability programmes, and lastly, in the future, adopting sustainable practices will bring an advantage in competition.

They communicate their commitment to sustainability with their clients and stakeholders through collaboration with stakeholders' sustainability programmes and customers. However, when asked if his company uses sustainable packaging materials for industrial equipment delivery, the respondent stated that they are a service-oriented company and that packaging materials come from customers. The green transport initiatives in place for industry equipment delivery include alternative fuels, electric and hybrid vehicles, route optimisation, collaboration with institutions that promote sustainability, and a sustainable group located in Belgium.

The carbon footprint at the company is measured and calculated through consumption, and they are procuring new measuring equipment for it. He stated that it is challenging to implement sustainable practices in industrial equipment delivery. When asked to elaborate on the kinds of challenges faced, he said technological changes and that winter create hindrances to using electrical equipment.

When it comes to the sustainable delivery of industry equipment, they are not greatly impacted by government rules or industry standards rather, they are greatly impacted by technological changes. Technology currently plays a high role in optimising sustainable industry equipment delivery. When asked what the plans for future improvement in sustainable industrial equipment delivery

were, he said that creating and researching new innovations and evaluating how suitable they are for the company.

7.3 Main Findings from Survey and Interview

7.3.1 Sustainable Practices Adopted in Delivery Operations

Looking through the lens of the first research question, we would examine the current sustainable practices implemented by these respondents. The survey and interview showed that the respondents are very familiar with sustainability, which is considered an important aspect of their company. Three third (3/3) of the respondents stated that sustainable measures implemented include the use of alternative fuels to reduce carbon emissions, route planning optimisation, the use of electric and hybrid vehicles to reduce carbon emissions, collaborating with sustainable partners, implementing reverse logistics for product returns and recycling, and using energy-efficient warehouse operations. Additionally, when asked about green initiatives adopted, they answered alternative fuel, intermodal transportation, route optimisation, electric and hybrid vehicles, and collaboration with institutions that promote sustainability. The measures not chosen were the use of eco-friendly packaging materials and streamlining material handling processes.

7.3.2 Similarities and differences in delivering diverse industrial equipment

Looking through the lens of the second research question, we would examine the similarities or differences in operations in the delivery of diverse industrial equipment in terms of using sustainable packaging materials, material handling processes, and route optimisation. Three-third of the respondents chose route optimisation. Three-thirds of the respondents said that packaging materials is the responsibility of their customers, and none chose to streamline material handling processes.

7.3.3 Reluctance or Readiness of Stakeholders to Implement Sustainable Operations

When the respondents were asked about what motivated them to implement sustainability, only two-thirds of the respondents' answers were provided. One of the participant responded that climate change is their strong motivation, and this is related to corporate social responsibility. Adopting sustainable delivery practices enhances their reputation and brand loyalty, as well as reducing pollutants in the environment.

One of the respondents stated that the motivation behind implementing sustainable delivery is due to competitive advantages, which are related to corporate social responsibility. They are eager to be the first in Finland as it relates to implementing sustainable delivery practices. This builds their brand image and attracts customers, improves operational efficiency, which saves costs and reduces waste, and also protects the environment from pollutants and climate change. Finally, being able to collaborate with customers that have new sustainability programmes is also a motivating reason for them.

When asked about the level and types of challenges faced in adopting sustainability, three-thirds of the respondents responded that it was challenging and extremely challenging. The reasons they gave include technological changes, winter weather, a lack of financial resources, a lack of technical know-how and sustainability awareness, a lack of government initiatives, and an insufficiently skilled workforce. A stakeholder may become hesitant to adopt sustainable practices in delivery as a result of these issues.

When asked about their future goals, only two-thirds of the respondents provided answers. One of the respondents stated that they are looking into the possibility of phasing out hydrocarbon fuels completely and using only electric and CNG-powered automobiles, while the other respondent stated that they are researching new innovations to determine their suitability for their organisation.

8 CONCLUSIONS

The aim of this study is to assess and evaluate the efficacy of the sustainable practices implemented by transport organisation by reviewing their business operations in the delivery of industrial equipment. After an extensive examination and analysis of literature review and empirical data, this study seeks to answer the questions and provide new insights.

The first research question is aimed at investigating the current sustainable practices implemented by transport organizations. The first research examined the sustainable regulations and practices endorsed by regulatory bodies in Europe and implemented by car manufacturing companies and logistics service providers. From the secondary data, it was discovered that governmental bodies in Europe play a major role in regulating, facilitating, endorsing, and buying sustainable practices to promote a greener standard of living. Apart from endorsing regulations, they develop transport infrastructure and influence the business operations of transport organisations by providing financial incentives.

From the empirical data, it is seen that when the respondents were asked if governmental regulations or industry standards had played a role in influencing their approach to sustainability, one-third of the respondents stated that the government is about to roll out policies and regulatory guidelines in the aspect of promoting sustainability in transportation, but as of now, there is not much in place. While the second respondent said no and that technological changes are bigger issues. The second part of RQ1 addresses the current sustainable implementation adopted by logistics service providers. The secondary data stated that sustainable practices implemented by LSPs include the use of biofuel, alternative fuels, renewable sources such as electricity, solar, and hydrogen, incorporating smart warehouse systems, using biodegradable material for secondary packaging, slow steaming, and intermodal transportation.

From the empirical data, sustainable practices adopted by these companies include the use of alternative fuels to reduce carbon emissions, the use of electric and hybrid vehicles to reduce carbon emissions, implementing reverse logistics for product returns and recycling, using energy-efficient warehouse operations, and intermodal transportation.

The second research question further explored the similarities and differences in sustainable practices in the delivery of diverse industry equipment. The literature review data pointed out that logistics activities such as material handling systems, packaging materials, route optimisation, and transport equipment can adopt sustainability. The empirical data showed that the use of sustainable packaging material is the sole responsibility of their customers, and that route optimisation is one of the sustainable practices integrated into their business operations.

The third research question addresses the motivation behind the readiness or unwillingness of stakeholders to implement sustainable practices in their business operations as it relates to the delivery of industrial equipment. The literature review data examined reasons behind the reluctance of stakeholders, and they include financial constraints, scarcity of resources, lack of awareness, insufficient skilled workforce, lack of consumer acceptance and ignorance of sustainable products, insufficient funding in research and development for sustainable products and having the wrong mindset about sustainability, lack of government initiatives, insufficient familiarity with the Green System among experts, difficulties in determining and weighing advantages and costs, market competition and uncertainty, and poor application of GSCM practices.

The respondents were asked what motivated them to adopt sustainability practices in their companies and what challenges they faced in the implementation. Their motivations are centered on climate change, competitive advantage, the reputation of the company, a cleaner environment, and better collaboration with sustainability-minded customers. This is rooted in corporate responsibility.

The major challenges faced by all respondents are technological changes. Others include winter weather disrupting electrical components, a lack of financial resources, a lack of technical know-how and sustainability awareness, a lack of government initiatives, and an insufficiently skilled workforce.

9 FUTURE RESEARCH

During the process of gathering primary data through a survey and interview, there was a challenge in the number of responses acquired. Due to the low responses from the respondents, it is vital to do further research on the variables that influence the delivery of diverse industry equipment.

The information derived in assessing the current sustainable practices implemented by logistics service providers, the challenges faced in implementing these practices, and the motivation behind implementing these practices is sufficient. But in the area of evaluating variables that influence the delivery of diverse industry equipment, such as streamlining material handling processes and the use of sustainable packaging materials, the information gotten was not sufficient, and it will be necessary for further research to be conducted in order to get a holistic view of sustainable practices in the delivery of industry equipment in Europe.

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APPENDIX 1:

SURVEY AND INTERVIEW QUESTIONS

1. Participant Information
    - Company Name
    - Industry Sector
    - Position/Role
    - Number of years your company has been involved in industrial equipment delivery.
    - Privacy and confidentiality (I consent / do not consent to the publication of my company's name).

2. General Understanding of Sustainability
    - On a scale of 1 to 4, how familiar are you with the concept of sustainability?
    - On a scale of 1 to 4, how important is sustainability in your company?
    - On a scale of 1 to 4, how well do you understand the concept of sustainability in the context of industrial equipment delivery? (1 - Poor, 4 - Excellent).
    - In what aspects of your business operations is sustainability integrated (Select all that apply)
        - Streamlining material handling processes
        - Using energy efficient warehouse operations
        - Eco-friendly packaging materials
        - The use of alternative fuels to reduce carbon emission
        - Route planning optimization
        - The use of electric and hybrid vehicles to reduce carbon emission
        - Collaborating with sustainable partners
        - Implementing reverse logistics for product returns and recycling
        - Others.

3. Current Practice

- Does your company have specific sustainability goals related to industrial equipment delivery?
- How do you measure the efficiency and effectiveness of your sustainable industry equipment delivery practices?
    - Carbon footprint
    - Lifecycle assessment
    - Compliance with regulations and transport standard
    - Customer feedback
    - Resources Utilization (fuel, material, packaging)
    - Energy consumption (renewable energy)
    - Transport efficiency.
- What motivated your company to adopt these sustainable practices?
- How do you communicate your commitment to sustainability to your clients and stakeholders?
- Does your company use sustainable packaging materials for industry equipment shipments. If yes, please specify.
- Are there any green transportation initiatives in place for delivering industrial equipment? If yes, please select.
    - Alternative Fuel
    - Electric and Hybrid Vehicles
    - Intermodal Transportation
    - Route Optimization
    - Sustainable Packaging Materials
    - Slow steaming (Sea transportation)
    - Collaboration with institution that promote sustainability. For eg. GFE (Green Freight Europe)
    - Others

- How does your company measure and report on its carbon footprint related to industrial equipment delivery?

4 Challenges and Opportunities

- On a scale of 1 to 4, rate the challenges your company faces in implementing sustainable practices for industrial equipment delivery (where 1 is not challenging and 4 is extremely challenging)
- Please elaborate on the main challenges your company faces in implementing sustainable practices for industrial equipment delivery.
    - Lack of financial resources
    - Insufficient Skilled Workforce
    - Lack of Customer Acceptance
    - Market competition and uncertainty
    - Technology Changes
    - Lack of Technical Know How and sustainability awareness
    - Lack of Government Initiatives
    - Resistance from stakeholders in the company
    - Regulatory obstacles
    - Muu:

- Are there any governmental regulations or industry standards that influence your approach to sustainability in delivery operations of industry equipment? If yes, could you please mention them.
- To what extent does technology currently play a role in optimizing sustainable delivery processes for your company? (High extent, low extend or moderate extent?
- What are your plans for future improvements or expansions in sustainable delivery practices in industry equipment?

APPENDIX 2:

LIST OF RESPONDANTS

Confidential