University of South-Eastern Norway

Thesis title

Learning opportunities of maritime traffic management from road traffic management within the context of Intelligent Transport Systems.

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Master Thesis

May 2023

Abstract

Digitization has led maritime traffic management to update and improve their operation to reduce the challenges caused by increased demand and busier ports. Due to technological development, other domains, such as road traffic management, have made remarkable progress in their traffic system. Maritime traffic management can improve its operation by learning the best practices. The present study will explore the best practices and areas where maritime traffic management can be improved.

The thesis conducted a case study by analysing the data from anonymous interviews. The analysis was done to explore learning opportunities in maritime traffic management. The study identified different interesting areas, such as different perspectives on the term Intelligent transport system, adoption barriers for learning, and learning methods. The thesis contributes to identifying similarities, comparisons, challenges, and solutions that can be helpful to have a perspective on the current situation and limitations of the transportation system.

Acknowledgment

I want to thank my supervisor, Marius Imset, from the bottom of my heart. He has been a reliable guide and supporter, guiding me even before I arrived in Norway and overseeing each aspect of my thesis. I genuinely appreciate his valuable input, feedback, and motivation that helped me along this journey.

I want to thank the University of South-eastern Norway for allowing me to study here and supporting me when needed. I am thankful to the professors who helped me to complete my journey toward my master's.

Special thanks go to ITS Norway's Managing Director for helping me conduct the interview and providing helpful information. I want to acknowledge each of the participants for participating.

I want to thank my friends in Norway who were always there and patient enough to listen to my ideas and provide me with feedback.

Last but not least, I would like to thank my family, who have motivated me and supported me overseas to complete my thesis.

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Abbreviation

TMS- Traffic management system

VTS- Vessel traffic service

ITS- Intelligent transport system

RTMS- Road traffic management system

MTMS- Maritime traffic management system

ATMS-Advanced Traffic management system

HS- Hub and Spoke

CFWM-Congestion flow waiting model

CFRM- Congestion flow redistribution model

1. Introduction

Managing traffic in maritime areas is challenging and crucial, particularly as the volume of traffic increases. Over the past decade, a significant surge in global trade and demand has resulted in a higher need for maritime transportation services. As a result, cargo ships and tankers have become more extensive, and fleet capacity has increased to transport goods more efficiently and quickly (Stopford, 2009); nevertheless, this growth also presents potential challenges such as busier ports, including congestion, navigation safety concerns, and an increased risk of collisions. (AAMAS'20, 2020).

These challenges increase costs, fuel consumption, and carbon emissions(Song & Panayides, 2012). According to the international transport forum, the capacity of ships has become less effective due to congestion (Performance of Maritime Logistics, n.d.) Moreover, delay costs due to congestion crossed 228 billion euros (EU Strategy,2020, n.d.). Effective traffic management is important to mitigate maritime transportation costs and environmental impacts.

However, effective traffic management involves managing and monitoring vessel movements, ensuring safe navigation, minimizing the risk of collisions or other accidents, managing cargo flow, coordinating with other vessels, and ensuring compliance with international legislation (Lind et al., 2016) (Singh et al., 2020). To establish an effective traffic management system, valuable learnings needed to be gained from various transportation systems in the context of intelligent transport systems.

The European Union is committed to creating a sustainable transport system that improves traffic management and traffic flow by reducing waiting times and congestion in ports, terminals, hubs, and transfer nodes. Regulations are needed to reduce congestion and waiting time, which can lead to increased fuel consumption and emissions. (EU Strategy,2020, n.d.). Considering this goal of the EU, ITS Norway has developed three strategic objectives, which focus on industrialization, collaboration, and competence. 'ITS Norway' is an active member association that works strategically with ITS for all transport modes. ITS Norway aims to ensure a more intelligent, sustainable, and safer transport system. ITS has several projects to ensure more competent maritime traffic management. For example: To monitor and track, a combination of AIS, radar, and Vessel traffic systems is implemented in the traffic management system of Rotterdam Port. However, this thesis is aligned with the strategy of

industrialization, which focuses on providing sustainable multimodal, seamless, and holistic ITS solutions. (ITS Strategy, n.d.).

While the road is advancing toward improved traffic management regarding congestion, navigation, and safety, maritime still follows the traditional approach in this area (Van & Praetorius, 2014). Moreover, a discussion with the managing director of ITS Norway shows that the road sector is the segment where ITS has implemented most of its solutions. However, when it comes to road transport modes, the notable advancement of ITS cannot be denied. Considering the statement, maritime traffic management needs to increase the implementation of ITS to increase the safety of navigation, avoid collisions and reduce congestion and focus on acquiring the learnings from road traffic management. The ITS framework offers several opportunities to optimize maritime operations and promote a seamless multimodal transport network. (ITS NORWAY, 2011).

Previously, many articles were published on the intelligent system on Maritime and roads. Different technologies adopted by maritime are analyzed in papers such as (Pietrzykowski 2010a), tools for extracting vessel traffic patterns in Taiwan (Chang et al., 2010), and wireless vehicular networks (Coronado Mondragon et al., 2012). Different technologies adopted by road and rail, such as various applications (Zear et al., 2016) and cloud-based traffic systems (Ashokkumar et al., 2015), express the potential and benefits of implementing the ITS in the different transportation systems. This literature agrees that it is working to ensure effective traffic management regarding traffic control, navigation, prediction, and safety.

Although there are several research on the implementation of intelligent transport systems and multimodal transportation systems, the application of different technologies of ITS, and their potential benefits and advantages on different transportation systems, there are no research and empirical study on the lessons learned from each other specifically on what maritime can learn from other modes of transportation.

However, as these modes have similarities and transferability (check table 1), and it is possible for maritime to learn from road traffic management to overcome the shortcomings (Papadimitriou et al., 2020). The thesis searches for critical lessons possible to learn from road modes to improve maritime traffic management within an Intelligent transport system.

1.1 Goal of the thesis

The thesis aims to investigate the learning opportunities of maritime transportation from road modes of transportation within ITS, such as road, and rail transportation, to improve traffic management. The thesis outcome aims to explore a better understanding of the challenges and learning opportunities and recommend potential solutions to overcome challenges and establish a way of learning.

The information presented in this thesis will benefit individuals involved in the maritime industry. Port authorities can take advantage of new technologies while shipping companies and ITS can make informed strategic decisions about collaboration and standardization. Policymakers can also use this information to develop regulations that utilize ITS technologies and practices to enhance traffic management. Considering the goal of the thesis, the following research question is developed.

Research question

- What are the learning opportunities of the maritime transport system from the road transport system for enhancing traffic management within the context of Intelligent Transportation Systems (ITS)?

To answer this research question, three sub research questions are developed.

Sub research questions:

- What are the challenges of the road traffic management system within ITS?
- How were the challenges addressed?
- What are the barriers for maritime traffic management to adapt the lessons?

The research question investigates potential lessons maritime can adopt from the road. The research question does not imply that road transport is better than maritime but aims to identify the possible practices and strategies to adapt. Moreover, it is relevant to find out the challenges faced by ground transportation and their actions to mitigate them to answer this question. However, conditions like weather and regulations vary from one mode to another. Considering that, it is crucial to find out the barriers faced by maritime to adapt the lesson. Also, the sub-research question to identify barriers to adopting learning is answered because

it is important to identify potential barriers to develop strategies for mitigating them to ensure a smooth process of transferring knowledge.

The hurdles to answering these questions are the unavailability of updated data, information, and academic literature on maritime traffic management within the context of ITS, limiting the possibility of comparing them.

However, a comprehensive analysis of literature and opinions from industry experts provide solutions to the challenges of answering these questions.

1.2 Thesis structure

This thesis contains seven chapters, starting with the introduction in Chapter 1. Chapter 2 reviews relevant literature to this thesis with keywords, definitions, summary, and theoretical framework. In Chapter 3 research method is presented along with the method of data collection. The result of the research is discussed in Chapter 4, followed by a discussion and conclusion and a reference list in Chapters 5,6 & 7 accordingly. The chapters are divided into sub-chapters according to the requirements.

2. Literature review

2.1 Goals for review

A literature search involves a methodical and comprehensive investigation of all published literature to discover a diverse range of high-quality references pertinent to a particular topic (Librarians, 2012). This literature review aims to investigate existing knowledge and the current situation of different modes of transportation and understand the challenges of traffic management in maritime and road in light of literature. The literature review intends to identify how they address challenges and the extent of technology adoption rather than the understanding of technology in relevant published literature. However, more elaboration on different solutions to mitigate challenges is presented in the following chapters.
This literature review analyses existing literature to find definitions, similarities, and differences between the different aspects of traffic management of different modes and compares.

The goal is to cover topics that answer the research questions and formulate a theoretical framework. Overall, the goal is to cover topics that answer the research questions and formulate theoretical framework.

2.2 Methods for finding and selecting literature:

For finding and searching literatures following stages were followed:

Figure 1: Steps in searching literature (Author)

Background reading and analysis

Firstly, the topic is selected by conducting research on relevant textbooks and websites, as well as seeking advice from an appropriate individual for the thesis.

Specifying search term

The research begins with a thorough background investigation of the topic. Then a comprehensive set of keywords is developed, and an exhaustive search for pertinent articles in top-tier databases such as Google Scholar, Scopus, ScienceDirect, and USN Bibliotic is conducted. To ensure proper citation in the APA style, the thesis relies on Zotero's highly efficient management capabilities for all source materials.

Keyword:	Search term
Traffic management	Traffic management systems, effective traffic management in transport, traffic management definition, maritime traffic management, road traffic

Traffic management	management, traffic management in transport
Multimodal transport	Intermodal transport
Transfer node	Transfer hub in transportation, hub to spoke, point to point, transfer network
Learning	Learning opportunity, cross domain learning, multi domain learning, multitask learning, domain adaption
Barrier to adopt learning	Adoption barrier, barrier for learning

Table 1: Keyword and search term

Reading, analysis, and summary

After searching keywords in the databases, a thorough study was initiated by reading the literature and finding the information to formulate the plot for the research problem. he following topics were deemed relevant for investigation after reviewing the literature. Traffic management in maritime and road.

- Intelligent transport system
- Integration of different transport modes
- Learning across different domain
- Areas that have learning opportunities for maritime
- Barriers to adopting the learning.

The criterion for selection includes:

- Year range for selecting literature are not considered as the literature is required fundamental theories, but the literature ranging from 2010-2023 are prioritized.
- The articles selected includes learning within other domain of transport industry.

- All articles chosen are focused on traffic management and learning rather than the technology tested and used.
- To ensure that important findings don’t get skipped, thorough analysis of full body of literatures is conducted.

However, the literature review is done by following a narrative review approach. A narrative review focuses on providing a narrative description and summary of the key findings and themes in the literature without a predefined protocol for searching and selecting studies. The approach involves a less structured approach, and the reviewer searches for and synthesizes relevant studies without a predefined protocol. This method was appropriate for "Learning opportunities of maritime operations from different modes of transportation within ITS," as it allowed for a broad and exploratory review of the literature to identify key themes and learning opportunities (Diana Papaioannou, 2010).

2.3 Reviewed literature

The literature review aims to clarify certain definitions that are found in existing literature. This section presents those definitions in addition to the review.

2.3.1 Traffic management in road and maritime

Traffic management is a system that includes tools, applications, information, and monitoring to ensure safety and efficiency. Traffic management aims to ensure effective and efficient movement of transport, goods, and people (de Souza et al., 2017). However (Dresner & Stone, 2004) and (Avatefipour & Sadry 2018) have identified traffic congestion as the current challenge of all modes of transportation in their literature, and (Avatefipour & Sadry 2018) describe that efficient traffic management can solve this issue. Efficient traffic management involves the movement of people and freight without delay and safely.

While these articles focus on traffic management on a general sense, several works of literature focused specifically on the maritime and road traffic management.

Maritime

Various literary works have delved into the subject of MTM, covering aspects such as control (Praetorius & Hollnagel, 2014), advanced AI techniques (Singh et al., 2020), coordination and cooperation (Van & Praetorius, 2014), and information sharing and collaboration (Lind et al., 2016). Regulatory bodies such as IMO, MARPOL, and COLREG oversee the maritime transport system. According to (Singh et al., 2020), (Van & Praetorius, 2014), (Praetorius & Hollnagel, 2014), MTM is currently operated through VTS, which provides guidance, navigation, and traffic information to operators and COLREG is responsible for ensuring navigation safety and regulating the duties of Vessel Traffic Service, as highlighted by Van & Praetorius in 2014. However, VTS has its limitations, as it is only effective in limited geographic areas and lacks a global regulatory framework. Despite the abundance of digital data in the maritime industry, there is still a need for more standardization and control, as noted by Lind et al. (2016).

Apart from the control, congestion is a major challenge in the maritime industry. Based on the findings of (Zear et al., 2016), (Van & Praetorius, 2014), it is evident that the absence of proper standards, control measures, and limitations in Vessel Traffic Services (VTS) presents a significant challenge to Maritime Traffic Management (MTM). This challenge has a ripple effect on the economy, leading to substantial economic losses and delays. Although existing literature sheds light on this problem, it only provides a superficial understanding, needing a comprehensive analysis. However, all sources agree that improving MTM is crucial to alleviate congestion and address the challenges that come with it. Therefore, it is imperative to set up an efficient MTM system that accounts for all the factors affecting maritime traffic to ensure smooth and safe navigation.

Road

(Dongare et al., 2023) define RTM as the combination of regulation and coordination of static and dynamic traffic. Traffic engineering, traffic control service, and intelligent transport system are the three aspects of traffic management. Traffic engineering aims to optimize network performance (Wang, 2001); traffic controls operate and monitor traffic signals and message symbols, and it provides solutions like automation and real-time information to reduce the significant challenge (Papageorgiou et al., 2003).

One of the main issues in RTM is traffic congestion caused by traffic demand, unexpected situations like bad weather or accidents, and traffic infrastructure. A way to tackle this challenge is to regulate traffic flow through a traffic management system that works alongside various applications (de Souza et al., 2017). According to research, it has been observed that utilizing multiple applications simultaneously reduce waiting periods. This finding highlights the potential benefits of collaborating different software programs in order to optimize overall efficiency and productivity (Salkham et al., 2008).

Similarities and differences between the two modes

Both traffic modes aim to ensure navigation safety and reduced collision. The European Commission is the regulatory body for both modes. EU's shipping policy and road transport policy create the ambition for reduced carbon emissions by 2050 (A Review of the European Union Shipping Policy, n.d.) (Wolf et al., 2021). Hence, currently, road transport follows TRB 2000 and FGSV 2015. These two guidelines are used to record the traffic flow and density (Rudolph & Mátrai, 2018a).

Moreover, there are several challenges in these two domains, and among them, congestion is a common problem (Mandhare et al., 2018) (Praetorius & Hollnagel, 2014) (Liachovičius & Skrickij, 2020). Although congestion is a common problem, it has been defined differently in many literatures in the light of maritime and road. (Rudolph & Mátrai, 2018b, p. 217) Defines congestion in RTM as 'a condition from traffic delay, from the ratio of high density and low speed and incremental cost resulting from interference among traffic users.'

On the other hand, (Hilde Meersman, n.d., pp. 49–68) defines congestion in MTM as a result of overcapacity. The literature investigates the place of congestion occurrence. Generally, the places are nodes, terminals, and hinterlands. The author of this literature also describes that congestion means the vessels are in the queue, waiting for a berth.

Although VTS controls maritime traffic, there is no specific management for RTM. Local and National authorities control RTM (Grote et al., 2021). The authorities are a combination of traffic police and transportation departments. On the other hand, VTS is responsible for managing traffic flows in ports, harbours, and water channels (Papadimitriou et al., 2020).

The road transport industry utilizes advanced technologies like travel information systems, connected vehicle technology, ramp metering, adaptive traffic control system, and variable message signs. These technologies are implemented by building new infrastructure, retrofitting existing infrastructure, and partnerships between the public and private sectors (Shahgholian & Gharavian, 2018). On the other hand, in terms of the adaption of new technology, (Pazouki et al., 2018) argues that the maritime industry is in a lower position compared to other industry. After comparing both modes, it is needless to say that the maritime needs to learn more to improve traffic management.

Considering this aspect of RTM, maritime is in the initial stage in terms of automation. Highly automated, fully remote-controlled, and autonomous ships are yet to be practiced to ensure maritime traffic management safety (Ehlers et al., 2022).

From the literature, a table of similarities and differences is drawn as it is significant to draw similarities and differences to identify opportunities, challenges, and areas for learning and improvement.

Topic	**Road traffic management**	**Maritime traffic management**
Objective	Ensuring safety and reduced congestion	Ensuring navigation safety and reduced congestion
Challenge	Congestion	Congestion
Definition of congestion	Demand exceeds the capacity, traffic delay which results from high density and low speed.	Demand exceeds capacity and longer waiting time in ques for berth.
Place of occurrence	Transfer nodes, hinterland, and terminals	Transfer nodes, hinterland, and terminals
Traffic control management and authorities	Government and local authorities. No specific management. EU is the international regulatory body.	Vessel traffic services control the traffic flow. EU is the international regulatory body.

Technology adoption	In an advance position to adapt and implement quickly	Comparatively in a lower position
Level of automation	Highly automated	Initial stage of automation

Table 2: Similarities and differences between the two mode

Furthermore, a table is presented below to show the perspective and findings of several academic sources and institutional reports discussing the same aspects of the two modes.

Aspect	**Reference**	**RTM**	**MTM**
Congestion	(Mandhare et al., 2018b),(Praetorius & Hollnagel, 2014), (Liachovičius & Skrickij, 2020)	✓	✓
Definition of Congestion	(Anja Estel & Pedersen, n.d.), (Rudolph & Mátrai, 2018a)	✓	
Location of Congestion	(Hilde Meersman et al., n.d.)	✓	
Traffic Control	(Papadimitriou et al., 2020), (Grote et al., 2021)	✓	
Technology Adoption	(Shahgholian & Gharavian, 2018)	✓	
Technology Adoption	(Pazouki et al., 2018)		✓
Regulation	(European Commission)	✓	✓
Automation	(Singh et al., 2019)	✓	
Automation	(Van & Praetorius, 2014)		✓

Table 3: Similarities and differences between the two modes from literature

The scope of this table is to focus on the aspects of congestion, the extent of technology adoption, regulation, and policy.

2.3.2 Intelligent transport system

Intelligent Transport Systems (ITS) have become increasingly important due to their potential to enhance the efficiency and safety of the transport industry. The combination of information technology is used to control traffic and navigation systems (Zear et al., 2016). ITS is a system that contains information, advanced technology, and communication, drawing the attention of transport industry experts to automation and regulatory bodies. In Europe, ITS has had a significant role in road transportation deployment and usage since 2008. ITS has several projects ongoing with public and private authorities regarding driving based on connected automation, intelligent and autonomous safety, and deployment (Mandhare et al., 2018).

(Kwiatkowska-Sienkiewicz, 2011) Delve into the modern navigation and communication technologies being used in the industry. By providing accurate and timely information, technologies like Global Navigation Satellite System and E-navigation system help ships avoid collisions, optimize routes, and reduce fuel consumption, vessel traffic, monitoring, management, and weather conditions, which leads to significant cost savings and environmental benefits. The following diagram presents the development of ITS

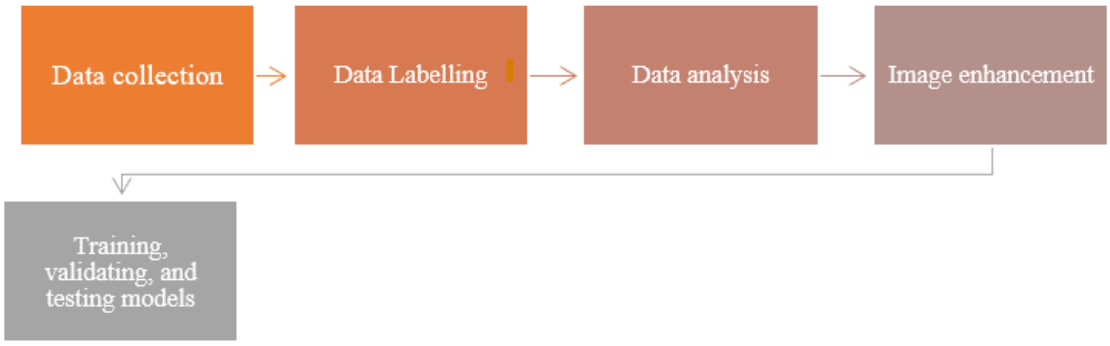

Figure 2: Development of ITS (Zear et al., 2016)

Figure 2 illustrates how an intelligent transport system works. The technologies used in ITS are data collection technologies, communication technologies, and database management. The primary goal of Intelligent Transportation Systems (ITS) is to gather accurate data and furnish up-to-the-minute information. Overall, ITS aims to reduce emissions by introducing and implementing autonomous solutions (Zear et al., 2016).

ITS framework in RTM

The Intelligent Transportation System (ITS) framework is a comprehensive solution that offers various approaches to the Real-Time Monitoring (RTM) of transportation. Its capabilities include collecting and analysing vast amounts of data from sensors and other sources, such as improved GPS systems that rely on image processing, vanets, cloud computing, agent-based computing, and real-time information systems. By leveraging these technologies, operators can predict and manage traffic more efficiently, resulting in a better transportation experience for everyone.

The ITS framework is designed to examine data from different transportation modes, collecting a vast amount of transportation data that can be used to make informed decisions. RTM collaborates with different transportation methods to ensure successful data sharing, enabling transportation operators to share information more effectively. This framework also includes various applications, such as traffic control, disaster management, vehicle information and navigation systems, driver assistance systems, and air pollution control, all currently used in the RTM.

Overall, the ITS framework is a powerful tool for transportation operators. It enables them to gather and analyse data from different sources, collaborate with other transportation modes, and use various applications to improve transportation safety, efficiency, and sustainability. Its capabilities are essential for maintaining a smooth transportation system that benefits everyone (Zear et al., 2016) .

ITS framework in MTM

The use of technology has become increasingly important in the maritime industry, providing solutions like GPS tracking and wireless mobile communication to monitor vessels and optimize ship operations effectively (Pietrzykowski, 2010b).However, it should be noted that implementing Intelligent Transport Systems (ITS) can be a costly process and may present legal challenges like standardization and interoperability, which in turn can result in a lower adoption rate of these solutions in maritime operations (Kwiatkowska-Sienkiewicz, 2011).

Despite the extensive literature on the implementation of ITS in road and maritime traffic management, there still needs to be more information regarding the potential adverse effects

of ITS on RTM and the overall success of implementing ITS solutions. More empirical studies must be conducted to provide accurate data and statistics that reflect the benefits of implementing ITS in the maritime industry. By doing so, we can better understand the full potential of ITS and its impact on the maritime industry.

2.3.3 Integration of different transportation modes

Multimodal transportation integrates different modes of transport, such as rail, truck, and ship, to move goods from one point to another or the transfer of goods by a minimum of two or more transport modes based on multimodal transport contract from a country of origin to the destination country (Caris et al., 2014) (Reis et al., 2013) (Butta & Abegaz, n.d.).

Although multimodal transportation is cited with different names in different works of literature, namely, intermodal and co-modal, the commonality between all three modes is that at least two different transport models are used in transportation (Seifi et al., 2014). The author argues that intermodal and multimodal terms refer to a similar transportation system, and many authors have stated them in the literature without having a strict definition and differentiation (Seifi et al., 2014).

An illustration (Figure 3) is presented below to show the operation of a general multimodal transport system where (Nikola, 2021) describes operations in multimodal transportation, such as the operation of road transport, rail, and ship. The illustration is an example of using two or more transport modes. The literature highlights the reason to prioritize multimodal transport as it combines and offers the services of different modes of transportation where transports are selected by considering the geographic location. Another reason is that multimodal transportation enables transport and transfer of freights from one country to another. Finally, quick decision-making in an emergency is possible as a single operator is responsible for the complete operation (Nikola, 2021).

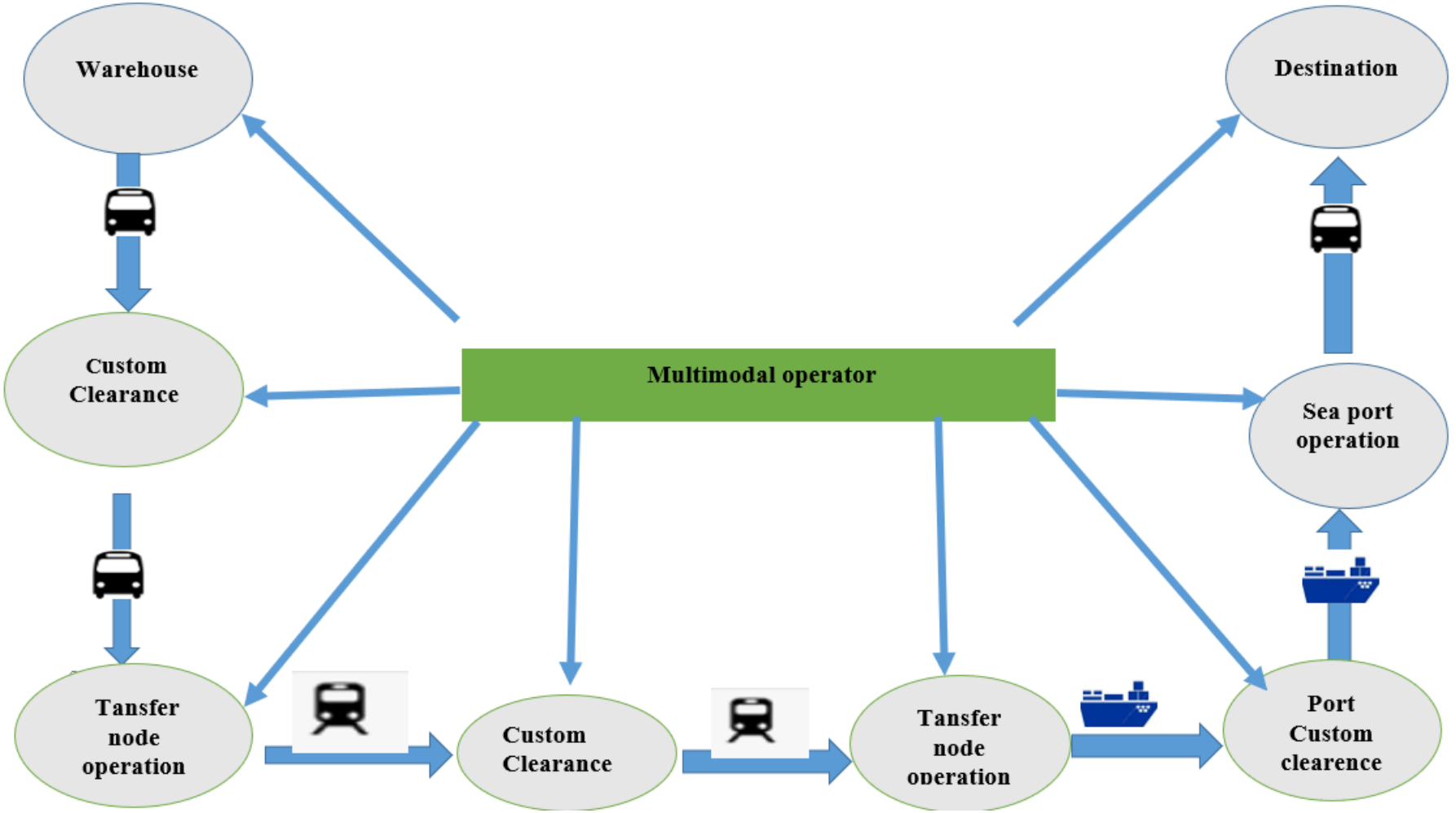

Figure 3: Operation of multimodal transport system (Nikola, 2021)

A drawback of the multimodal transportation system is the need for standard conventions. For example, regarding property loss during road or maritime transportation, the CMR and Hague-Visby rule conventions provide coverage. However, in the case of multimodal transportation systems, there is currently no convention to address any loss or damage to the freight (Shakil & Mostafa, n.d.).

However, several studies have explored the benefits of multimodal transportation. (Dua & Sinha, 2015) & (Kordnejad, 2014) analyzed the impact of intermodal transportation or integration on traffic management, showing that using multimodal transportation lead to a competitive advantage in the global economy as it saves time, makes it cheaper to move internally faster, moves goods from origin to destination seamlessly and contributes to environmental benefits which result in reduced congestion and provide more options for ship owners and charterers.

While describing the importance of integration and intermodal transportation, the transfer node in RTM and MTM is vital to highlight.

Transfer nodes

Several works of literature have cited transfer nodes as terminals, hubs, and points integral to transport networks. A transfer node is a point described where the change of one mode of transport to another or a similar mode occurs (Vojtek et al., 2018). The efficiency of transfer nodes depends on the waiting time for the transfer. Less waiting time brings the benefits of reduced congestion and less emission. Significant areas of transfer nodes are the coastline, courtyard, and inland. These areas are responsible for the loading and unloading the vessels of both areas. (Azab et al., 2017)

Two standard terms used in these areas are *hinterland and hub and spoke*.

The hub and spoke system is a crucial network used in RTM and MTM. It is responsible for moving goods and people by distributing them through different spokes that lead to a central hub, a terminal, or a major transportation centre. The spokes are the peripheral destinations that connect to the hub (Hsu & Hsieh, 2007).

There are benefits when using a hub-and-spoke (HS) network due to the economies of scale from connecting destinations with fewer shipping services (O'Kelly & Miller, 1994). For instance, a shipowner can gather cargo from various origins and consolidate them into one shipment. However, a hub's effectiveness depends on its hinterland's efficiency, which is the geographic area that connects the hub with trade routes and the origin or termination points of spokes. Initially, the hinterland was restricted to one dominant port, making it captive. Over time, the hinterland has become more contestable as it is now connected to multiple ports, providing transportation with more options to select less congested ports (Wan & Luan, 2022).

Figure 4 (Claes et al., 2010) presents a hub and spoke model hierarchy. Hubs are the transfer node denoted as 1. On the other hand, spokes, or hinterland, as 2 and 3 accordingly. For example, The Port of Rotterdam is a hub for shipping. The surroundings of the port are inland waterways which are hinterlands from where freight and transport are transferred to smaller ports or spokes.

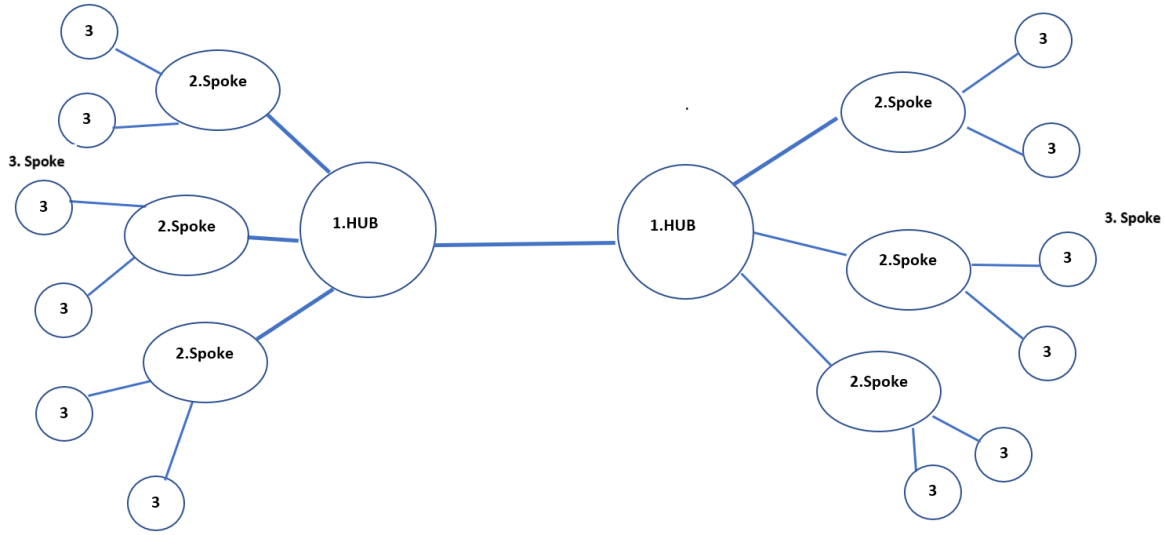

Figure 4: Hub and Spoke (Claes et al., 2010)

Transfer Nodes in Road

Transfer nodes are important locations where major transportation routes intersect with other modes of transportation, like truck yards or ports. They play a critical role in multimodal transportation systems by providing a central location for transferring transportation, improving connectivity, and accessing different destinations. Regarding road transportation, transfer at these nodes can occur in the same or different modes (Rodrigue, 2020). An illustration is drawn to show the process of transfer in the transfer nodes of road transportation:

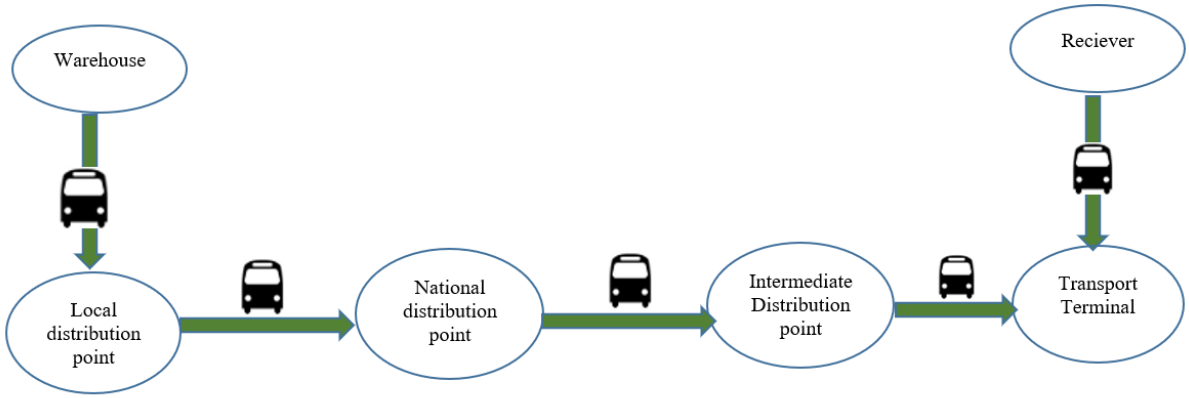

Figure 5: Transfer Nodes in Road (Rodrigue, 2020)

Figure 5 (Rodrigue, 2020) shows a series of transfer nodes and transfer of transportation to move freight from origin to destination. Transfer of goods starts from the warehouse and ends up at the receiver. The warehouse, local distribution point, national distribution point, Intermediate distribution point, and transport terminal are all the transfer nodes where freights or transport transfer occurs.

(Naumov & Samchuk, 2017) The efficiency of a transfer node can be analyzed based on the waiting time it incurs. In order to ensure an efficient transfer node, it is necessary to minimize the waiting time. One effective way to achieve this is by reducing congestion at the transfer node. By doing so, the transfer node can function smoothly and efficiently, ensuring minimal user waiting time.

To reduce the waiting time in transfer nodes, collaboration with the application and implementation of ITS in the transfer nodes is increasing consistently, and the role of ITS in reducing the challenges in nodes is undeniable. ITS provides solutions such as Transfer information service, Multimodal traffic information service, and Multimodal navigation service, which provide real-time information that helps to plan trips, choose less congested, alternate routes resulting in a more distributed traffic system, monitor, and management of traffic flow, making a decision based on observation. (Kwiatkowska-Sienkiewicz, 2011) (Mandhare et al., 2018).

Transfer nodes in Maritime

During the second half of 1950, the maritime industry witnessed a revolutionary innovation and transformation through the introduction of containerization. It enabled efficiency from

autonomous handling of cargo to multimodal transport resulting in remarkable economic benefits (Coşar & Demir, 2018) (Hamilton, 2006).

According to (Hu & Zhu, 2009), seventy percent of sea trade occurs with containers. Considering the significance, the role of transfer nodes has changed. The nodes in maritime are responsible for ensuring flawless freight transfer from one mode to another, these freights are cargo, containers, and trailers (Kozan, 2000).

Generally, the ports are the location where transfer nodes are located, and they are the main hubs for shipping and transporting freight. Cargoes are unloaded from one mode and transferred to onward transportation in the nodes. For example: Containers arriving at the Port of Oslo from a container ship from China may be transferred onto a barge to be transported to the Port of Stavanger. This cargo transfer between the two ports involves multiple modes of transportation and is an example of a combined transfer node approach. Here is an illustration presenting transfer nodes of maritime:

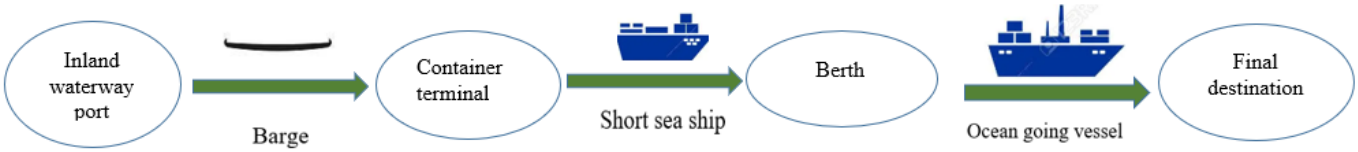

Figure 6: Transfer Nodes in Maritime (US EPA, 2016)

Figure 6 (US EPA, 2016) describes a series of transfer nodes. The series starts with an inland waterway port, which facilitates loading or unloading in a river or canal. The goods are loaded in barges by cargo handling equipment and transported to intermodal container terminals. From there, freight is loaded into short sea ships and transported to the berth area of a given port. From the berth area, containers are loaded into ocean-going vessels and transported to their destination or final port.

Like the nodes on the road, congestion and waiting time are the challenges in maritime transfer nodes as well. When the port and cargo handling equipment is inefficient, it causes delays and congestion, leading to longer waiting times. Some models, such as CFWM and CFRM, are proposed to improvise the operations in transfer nodes (Xu et al., 2021). However, ITS solution, such as technologies adopted by roads that help to reduce congestion in RTM, still needs to be implemented in MTM.

This literature review section on 'integration of transport modes' explores how maritime traffic management benefits from integrating different transportation modes within the ITS framework. The literature review examines existing literature stating the benefits of multimodal transportation within ITS. It defines the multimodal system and transfers nodes aspect of traffic management as these aspects are correlated. The findings help to understand the multimodal system and transfer nodes, their challenges, and their method of operations.

2.3.4 learning across different transportation modes

Before focusing on the learning between domains, the term learning needs to be defined. Initially, learning was referred to as the change in a performance led by experience. Over time, the term is defined as acquiring knowledge to identify the problem and rebuilding the process to solve the problem. Learning is a systematic and structured process containing sub-processes such as creating, retaining, and transferring knowledge (Argote, 2011) (Fiol & Lyles, 2018).

Learning arises in industries with specific characteristics, such as Shared Culture, which contains shared beliefs, values, attitudes, and behaviour where the people in the industry are interested to learn and collaborate. Secondly, structure, a decentralized structure where people from all levels are encouraged to share ideas and participate in decision-making, is necessary for learning. After that, if the environment of an industry is simple and does not change constantly, the industry can adapt knowledge. Finally, strategies focusing on improvement and the importance of learning can ensure learning all over the sector (Fiol & Lyles, 2018) (Lipshitz et al., 2002).

Identifying different mechanisms for learning

Learning arises in industries with specific characteristics, such as Shared Culture, which contains shared beliefs, values, attitudes, and behaviour where the people in the industry are interested to learn and collaborate. Secondly, structure, a decentralized structure where people from all levels are encouraged to share ideas and participate in decision-making, is necessary for learning. After that, if the environment of an industry is simple and does not change constantly, the industry can adapt knowledge. Finally, strategies focusing on improvement and the importance of learning can ensure learning all over the sector (Fiol & Lyles, 2018) (Lipshitz et al., 2002).

Identifying different mechanisms for learning

Training, management development, and organizational development are organizational learning approaches. The benefit of the new process increases through managers' training, knowledge, and skills. Additionally, managers identify their potential through management development and are encouraged to be creative. Counselling and providing feedback on different tests are management development. Finally, organizational development is the process that changes, updates, and improves the entire system for increased effectiveness. (Reilly, 1998)

While these are the traditional approaches, the industry can improve by learning from others or cross-domain learning. This is particularly relevant to a transportation system that combines various types of transport modes, and those modes are correlated. Due to consistent increases in demand, there is an urge to have cross-domain learning. Transfer of learning or cross-domain learning improves knowledge for a given mode (Hua et al., 2022).

Additionally, (Zhuang et al., 2010) learning across different domains or cross-domain learning refers to the transfer of knowledge to enhance the performance of a domain. Learning is practical or beneficial if it comes from a different industry. It is a crucial drawback for cross-domain learning if the data for learning is obtained from sources with similar features. Learning from other domains provides enormous benefits such as:

Enable access to a wide variety of information

Learning across different modes enables us to acquire knowledge and information from various sources, such as communication technologies. Through learning, a better understanding of a given topic develops, new perspective to address challenges develops (Mahajan & Sarjit Singh, 2017).

Opportunities to exchange ideas

Experts from both modes are brought together in cross-domain learning where they can exchange ideas, inspire, and promote creative challenges to improve effectiveness. Learning across different modes or adoption of learning encourages cross-fertilize ideas and inspires innovative solutions. One example can be drawn: automotive companies may share the ideas

of applying autonomous driving and operating technologies to MTM to improve safety and reduce congestion (Mahajan & Sarjit Singh, 2017).

Cross-domain learning helps to analyse the complementary capabilities and knowledge that help to understand a topic. In the case of MTM, learning enables one to understand the challenges from different perspectives and explore the capabilities to solve the challenge (Mahajan & Sarjit Singh, 2017).

Chances to cover the gap

Learning across different modes is beneficial as it fills the knowledge gap that emerges when there is a need for more expertise or knowledge in certain areas. By learning from other modes, an industry lacking knowledge can fill the gap by acquiring the needed knowledge (Mahajan & Sarjit Singh, 2017).

Cross-domain learning in other industries

Although there are research gaps on maritime learning opportunities from the road transportation system, there are studies on the learning opportunities across different industries. (Praetorius et al., 2012) Discusses how the aviation industry can provide valuable learning opportunities for those interested in the maritime industry. The finding is about the learnings obtained from the study visit. The literature addresses the similarities and differences. The author compares Maritime Traffic Management (MTM) and aviation to identify key learnings. MTM is typically managed by local Vessel Traffic Services (VTS), which better understand the local territory and can provide more effective training to operators. However, they may need more expertise to understand and comply with international regulations. Compliance with international regulations is crucial for the maritime industry, and in this respect, maritime can learn from aviation, which has a more centralized approach to regulation. The author also argues that maritime can learn from aviation to anticipate, respond to, and monitor potential risks and hazards (Praetorius et al., 2012).

This literature suggests that the maritime industry can benefit from the practices of the aviation industry. Specifically, this article compares aspects of maritime transportation

management, like regulatory challenges, with those of aviation to identify opportunities for improvement.

2.3.5 Areas that have learning opportunities

In previous sections several aspects of road traffic management and maritime traffic management are analysed. Factors in road traffic management such as: extent of adopting solutions of ITS, regular update of these technologies, benefits of effective multimodal system and transfer nodes and the relationship with stakeholders are drawn from analysis which are considered as learning opportunities for maritime. Theories from the published academics on these areas are drawn as follow:

Continuous improvement

Continuous improvement is a process containing the improvement of people or processes continuously monitored and sought. In a word, it is sustaining the improvement (Dale, 1996).

Figure 7: Continuous improvement cycle (Sokovic et al., 2009)

Figure 7 (Sokovic et al., 2009) illustrates an improvement cycle that helps the industry to identify the area to improve, plan the improvement process, implement the process, and provide continuous feedback based on the monitoring.

Road Traffic Management (RTM) is a suitable example of continuous improvement, inspiring Maritime Traffic Management (MTM). In the realm of Road Traffic Management (RTM), numerous research projects are currently focused on improving the efficacy and efficiency of traffic management. With the constant evolution of technology, implementing new technological advances in RTM requires the development of additional procedures to ensure that these technologies are being used appropriately. Therefore, ongoing research and development are necessary to keep pace with the latest technological advancements and

continuously improve RTM's operation. Therefore, the RTM sector is in a constant state of learning and improvement. The literature suggests that an industry's ability to improve continuously is a key success factor for transformation, and RTM provides an excellent example of making this achievable. By learning from RTM's continuous improvement process, it is possible for MTM to enhance its capacity to adapt to new technologies and evolving regulations, ultimately leading to a more efficient and sustainable maritime transport system (Yuen et al., 2016).

Industries that prioritize improvement find it easy to implement continuous improvement. However, continuous improvement is crucial for the advancement of RTM and presents learning opportunities for the MTM.

Adoption of new technologies

Due to dynamic changes in the demand for effective traffic management, the need for new technology is increasing. Considering the requirements, the maritime needs to invest in new technology to make the operation more efficient in terms of reduced cost and congestion (Fonseca et al., 2021).

However, technology adoption is a system that requires learning and understanding of a new process which is often challenging and expensive because when there is a new technology, the extent of acceptance varies according to the adoptive culture of industry to industry. To make the technology received by an industry, it should be prepared by considering the needs of the industry. For instance: road transport mode is prepared to adapt and implement new technology like ITS to reduce pollution and congestion (Straub, 2009). Considering the technological advances in RTM, the mechanism of adopting new technology by RTM is a learning opportunity of RTM. For example, ITS in RTM facilitates real-time information and an advanced traffic management system that ensures traffic monitoring and routing. RTM has adopted these technologies through research and development, pilot test, and training. Similarly, adopting new technology is a learning opportunity for maritime.

However, MTM is comparatively more complex and more enormous than RTM. The environment and legislation are different from Maritime traffic management. Investment in new technology and pilot test training and development might cause huge money costs. That is why, before adopting technology, MTM should consider its unique characteristics and requirements of the industry by doing research, training, collaborating with experts who

provide technologies, exploring funding options, conducting forecasting and cost-benefit analysis (Arumugam et al., 2022)

Prioritization of Multimodal transportation

Considering the importance of multimodal transportation, RTM has increased its focus on multimodal transportation as it brings economic benefits. Due to overload on the roads and colossal congestion road transport systems, they have improved policies and regulations regarding multimodal transportation. They are in the leading position to develop and implement strategies prioritizing multimodal system. For that they have developed a model named synchro modal, which integrates different transport modes and gives the best combination to operator and alternative routes to choose the better option (Pamucar et al., 2022). (Coronado Mondragon et al., 2012) presents the significance of prioritizing multimodal transportation. The multimodal system has resulted into faster, reliable and flexible transportation systems that allows various kinds of transportation. The multimodal transportation system is getting more popular for this flexibility ranges, which is why it a priority in RTM.

Considering the increased demand for sea trade, prioritizing a multimodal system is a learning opportunity for MTM that is possible to achieve by studying the experience of RTM on their prioritization of multimodal transportation and developing strategies to prioritize and improve monitoring, policies, and information flow of multimodal transportation.

Improvement of transfer nodes

Effective transfer nodes result in an efficient transport system. A congestion-free effective transfer node depends on the design and function. That is why it is essential to improve the operations of transfer nodes. Keeping this in mind, RTM focuses on improving the transfer mode. One such transfer node is a truck terminal with advanced logistics and information technology such as GPS, real-time information systems, and automated storage and retrieval system. These facilitate seamless cargo transfer between different modes of transportation, monitoring, and tracking cargo (Shakil & Mostafa, n.d.).

An important learning opportunity of the MTM is the study of the use of advanced logistics, and information technology, the design and implementation of these technologies of road

transportation, and the implementation of the study to optimize the layout of the transfer node to improve the use of technology and automation, and to streamline the logistics and supply chain processes of hub, port, and port terminal (O'Kelly & Miller, 1994). For example, these technologies, such as GPS and automated cargo handling equipment, are proven helpful for transferring nodes. By GPS transfer, nodes can get real-time information on cargo arrival and departure and plan berths accordingly. On the other hand, automated cranes ensure container handling quickly and without human error. That is why it is significant to improve transfer nodes, and MTM has the opportunity to learn the strategies to improve the transfer nodes from RTM.

Stakeholders' collaboration

The road transport system is an example of a transport system that heavily relies on the coordination of stakeholders. Transfer nodes are operated based on the information flow obtained from traffic monitoring. Traffic route planning, monitoring, scheduling, and departure work effectively due to coordination. RTM is in a favorable position in terms of coordination. RTM often plans by coordinating with other transport modes such as rail and aviation. Road transport mode has coordination with authorities, shippers, public transport, the European Commission, and national and local government (Jagienka, 2018). Several strategies of collaboration between transport modes are implemented by RTM, such as intermodal transport, infrastructure sharing, standardization, joint planning, and public-private partnership, which help to reduce operation costs and congestion (Li & Nguyen, 2017).

These coordination strategies are learning opportunities for maritime as it has unique challenges such as congestion and longer waiting times for loading and unloading in transfer nodes which need collaboration between stakeholders. It is possible to acquire strategies through learning. Increased collaboration and coordination between port operators, terminal operators, shipping lines, and authorities are crucial for managing congestion and improving the efficiency of port operations.

2.3.6 The barriers to adopt learning

Learning and implementing the lessons learned in a specific industry is a transformation. The aim of transformation through learning is to improve economic performance. The maritime industry requires much more focus compared to other modes, such as road, rail, and aviation

(Raza et al., 2023). Although the maritime needs to learn much, there is a reluctance to adopt the learning (Sanchez-Gonzalez et al., 2019).

Barriers to adopting learning are categorized as operational, organizational, managerial, and technological (Raza et al., 2023) and (Harris et al., 2015)., The literature explores and investigates the barriers from the interview of the employees from the linear shipping segment.

Governmental and organization

These barriers relate to the industry's people, culture, beliefs, and structure. Workforces only sometimes welcome changes and learning. There is often a reluctance to learn new things. Adapting to learning is only possible if the industry practices shared culture and beliefs. Moreover, a centralized structure focusing on cost-benefit rather than improvement and development often block learning. These barriers are challenging to overcome factors such as motivation, training, and development help to overcome these barriers.

Operational barriers

These are the barriers industry faces if there is a need for more resources and standardization. Limited resources and tools limit the learning capacity. If an industry wants to learn but needs more equipment and tools, learning will not occur. Similarly, the need for established policies and guidelines hinders learning. The industry must be standardized to access progress and measure success to learn and adapt. There are solutions to overcome these barriers, such as investment in hiring expertise, participation in workshops, collaboration between industries, and working for standardization throughout the industry.

Technical barriers

Factors like outdated and complexity of the system are technological barriers to adopting learning. Complex systems are difficult to understand and need special knowledge and expertise to adapt. On the other hand, outdated systems often fail to cope with changing demands. In both cases simplifying the system or designing the system according to the nature of the industry might help. Moreover, regular system updates and maintenance may overcome these barriers (Raza et al., 2023).

Summary

The first concept***, traffic management in road and maritime***, describes traffic management characteristics, the status of road and maritime traffic management, and similarities and differences. This analysis provides the ground to explore the learning opportunities, challenges, and how both modes solve challenges. The international authority regulates Maritime, but national or local authorities provide the traffic management system VTS.

The second concept, ***intelligent transport system***, describes the importance of ITS in enhancing the efficiency of the operation of both modes. Discussion from the framework presents the differences in technology used between RTM and MTM. This comparison gives ground for exploring learning opportunities.

The third concept, ***integrating different transport modes***, describes multimodal transportation, its importance, shortcomings, transfer node, and differences in technology used to increase efficiency. There is an elaboration of transfer nodes as they are critical elements in multimodal.

One important finding is the possibility of combining maritime and road transfer nodes. The combination might result in a more seamless transport system, less and reduced waiting time, effective infrastructure utilization, and greater flexibility in choosing routes. To make a combination successful, shared culture or knowledge is a crucial basis for learning, as discussed earlier. Shared culture enables us to have a common understanding and integration; it is essential to have a common goal between stakeholders with different perspectives and objectives, such as transport operators, port authorities, logistics companies, and government agencies. The shared culture enables industries to learn and implement effective strategies, and learning is important because it ensures the transfer of knowledge and best practices from one system to another. Here is an illustration of a combined transfer node.

Figure 8 presents a series where two modes are included, and there are transfer nodes for both modes. The container terminal is the transfer node or port where the ocean-going vessel reaches and unloads the container, freights are transferred to a barge and move towards the

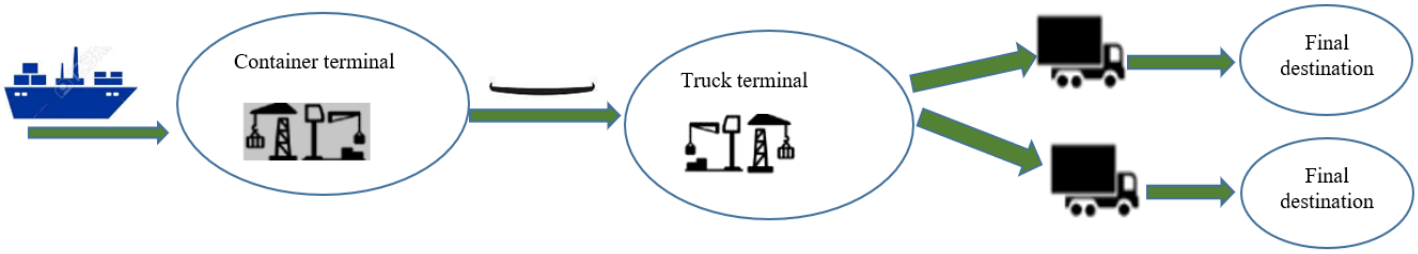

Figure 8: Combination of the transfer node of road and maritime (author)

terminal, the truck terminal is the initial transfer node for road, freights are distributed to road transport and move toward the final destination. The transfer time in both transfer nodes is significant. The less the transfer time, the more efficient the transfer node. This efficiency of transfer nodes depends on the extent of technology implementation discussed earlier.

However, the fourth concept, ***learning across different domains***, provides the importance and necessity of cross-domain learning. The framework elaborates on the benefit of cross-domain learning. This framework helps to formulate interview questions and helps to understand that knowledge for improvement can be shared. The framework also shows the cross-domain learning between aviation and maritime, confirming that cross-domain learning is possible and significant.

The concept, areas with learning opportunities identify the lessons or transferable areas. However, more research needs to be conducted on maritime learning opportunities from the road. The framework has aimed to fill that research gap. This framework addresses the research topic and provides a foundation for forming interview questions.

The final and fifth concept ***is barriers to adopting the learning***. Although learning is necessary, some obstacles refrain MTM from learning. These barriers were identified so maritime can adapt the learning by eliminating them.

Overall, the literature review provides a foundation and boundaries by investigating and analysing the literature.

Theoretical framework:

Based on the literature review and concepts, an interview guide is developed and divided into four themes. Each of the themes is connected to the concepts. The themes are:

T1 Introduction-Traffic management and Intelligent transport system

T2 Implementation of ITS: Challenges and strategies

T3 Learnings from ITS of road traffic management for maritime

T4 Barriers for learning and strategies

The categories are connected to the frameworks found in the literature review. Below is table representing the theoretical framework:

Concept	Themes			
	T1	T2	T3	T4
· Traffic management in maritime and road				
· Intelligent transport system				
· Integration of different transport modes				
· Learning across different domain				
· Learning opportunities for maritime				
· Barriers to adopt the learning				

Table 4: Theoretical framework

The thesis further develops coding from the literature review. Details on coding is discussed in the methodology chapter. The section for coding is selected from literature review as follows:

- Introduction
- Challenges and solution
- Adoption barriers
- Learning opportunities

The thesis follows a deductive content analysis system to conduct coding from the literature and related topics to the research problem. The codes are used to build an interview guide further. Deductive content analysis is a technique that involves examining existing data in a new context. It requires testing categories and concepts. To do this, a categorization matrix of related topics, literature, and the source is created, and data is then coded based on the related topic. The analysis can be either structured or unconstrained, depending on the goal of the study. The structured analysis focuses only on aspects that fit the categorization frame, while unconstrained analysis creates new categories based on the principles of inductive content analysis (Elo & Kyngäs, 2008). So, in the case of this thesis, the study's goal is to focus on the aspects that fit with the related topic. Here is an illustration of the coding.

Literatures	Related topic	Source	Code
(Zear et al., 2016)	Defining ITS	Indian Journal of Science and Technology	ITS
(Kwiatkowska-Sienkiewicz, 2011)	Process in ITS	Taylor & Francis	ITS
(Straub, 2009)	Adoption of learning	SAGE Journals	Challenge
(Zear et al., 2016) (Van & Praetorius, 2014)	Congestion	Indian Journal of Science and Technology Springer Link	Challenge
(Rahman et al., 2014)	Congestion	IEEE Xplore	Solution
(Zhuang et al., 2010) (Mahajan & Sarjit Singh, 2017)	Benefits of learning	IEEE Xplore Journal of Humanities and Social Science	Solution
(Raza et al., 2023) (Harris et al., 2015) (Sanchez-Gonzalez et al., 2019)	Barriers for adopting learning	ScienceDirect	Barriers for adopting learning
(Dale, 1996)	Area for improvement	Emerald Insight	Continuous improvement
(Shahgholian & Gharavian, 2018)	Road traffic management	Arxiv	Continuous improvement
(Fonseca et al., 2021)	Investment	ScienceDirect	Adaption of new technology
(Straub, 2009)	Area for improvement	SAGE Journals	Adaption of new technology
(Caris et al., 2014) (Reis et al., 2013) (Butta & Abegaz, n.d.) (Seifi et al., 2014) (Nikola, 2021) (Dua & Sinha, 2015) (Kordnejad, 2014)	Integration of different transport mode	Elsevier SSRN Academia Elsevier Pedagogika-Pedagogy, 21(Special Issue), 31-38 SSRN Elsevier	Prioritization of multimodal
(Pamucar et al., 2022)	Multimodality of road transport	ScienceDirect	Prioritization of multimodal
(Rodrigue, 2020) (Mandhare et al., 2018)	Transfer nodes in road and maritime	Routledge International Journal of Computer Sciences and Engineering	Improvement of transfer nodes

Literatures	Related topic	Source	Code
(Naumov & Samchuk, 2017) (Xu et al., 2021)	Area for improvement	Elsevier ScienceDirect	Improvement of transfer nodes
(Rodrigue, 2020)	Integration of different transport mode	Routledge	Increased collaboration
(Li & Nguyen, 2017)	Importance of collaboration	IEEE Xplore	Increased collaboration
(Praetorius et al., 2012)	Cross domain learning	Diva-portal	Learning from others
(Reilly, 1998)	Learning methods	The Pfeiffer Library	Learning from others
(Shahgholian & Gharavian, 2018)	Technological advances	Arxiv	Experiment
(Reilly, 1998)	Learning methods	The Pfeiffer Library	Experiment
(Vijayaraman & Jayarin, 2019)	Traffic management of road	IEEE Xplore	Experience
(Argote, 2011) (Fiol & Lyles, 2018)	Change in the way of performance	SAGE Journals Annual review of sociology	Experience

Table 5: Codes related to literatures

3. Research method

The objective of this research method is to explore a procedure or specific tools to answer the research questions. The methodology helps to find reliable and valid results that answer the questions. Some research methods are surveys, experiments, interviews, semi-structured interviews, and case studies (Blumberg et al., 2014, p. 45).

The research method has significance because it specifies the approach required for carrying on the study for this thesis. The data quality, findings, results, and discussion depend on the method. Different methods give different outcomes, and choosing the appropriate procedure research method is essential. In this methodology, several attributes are considered while choosing the research method as follows:

Defining and analysing the research question

When initiating the research, it is essential to thoroughly analyse the research question to determine which areas require further clarification, how these areas should be defined, and what results are expected to be achieved. This elaboration ensured that the research was conducted accurately and effectively, ultimately leading to successful outcomes.

Conducting literature review

While conducting a literature review, it is imperative to examine existing literature that has addressed similar questions thoroughly. Additionally, cross-domain learning from various industries was scrutinized to identify relevant research material. This is especially important in cases where literature is limited.

Assessing the pros and cons of different methods

A variety of methods are subjected to rigorous analysis, with careful evaluation of their strengths and weaknesses. The most effective one was selected. Furthermore, a thorough pilot test was conducted with an industry expert to confirm the choice and ensure optimal results.

After considering all these attributes, it was found that the method of interview suits to answer the research question because the interview collects data by recording participants' experiences, thinking, attitudes, and beliefs toward the thesis topic of learning opportunities.

An interview is suitable for this thesis, as it allows exploring a different perspective of the participants about the topic, which may not be achieved through a survey or experiment. As the interview is the chosen research method, an interview guide with the questionnaire is developed, which is answered in the interview (Bryman & Harley, 2022).

3.1 Research design

While a research method is the identifying tools or technique to answer the research questions, a research design contains a refined research question, population and sample, the description of data sources, data collection method, and ethical considerations. This research design is a plan and structure to carry out the research for this thesis (Bryman & Harley, 2022, p. 45).

As the method is determined as an interview, the thesis follows qualitative research. The research topics of this topic require nonnumerical data such as observation and experience. In contrast, quantitative research is centred around collecting numerical data. In the research questions, there are topics like challenges, barriers, and learning opportunities that are not possible to express an answer in numerical data. That is why qualitative research is chosen for the interview (Bryman & Harley, 2022, pp. 353-361,435).

In addition, it is important to define and clarify the approach. The inductive approach is often used in qualitative research. This thesis follows an inductive approach, which involves commencing the research process with observations, where the research starts with observations. As the thesis aims to explore learning opportunities which are new insights based on the data collected, an inductive approach is appropriate (Bryman & Harley, 2022, pp. 20–24).

3.2 Population and sample

In research, a population is the units or broader set on which the research is conducted. The groups in a population have the same characteristics and attributes. While conducting research, it is important to define the population initially. On the other hand, the sample is the smaller portion of the population that represents the population fully.

Selecting samples is significant as it makes the research procedure convenient, and the proper selection of samples makes the result reliable.

In this thesis, the population is different projects of ITS related to road traffic management and maritime traffic management. The sample is the people working on different projects. Here is a figure showing the population, sample and transfer of learning from road traffic management to maritime traffic.

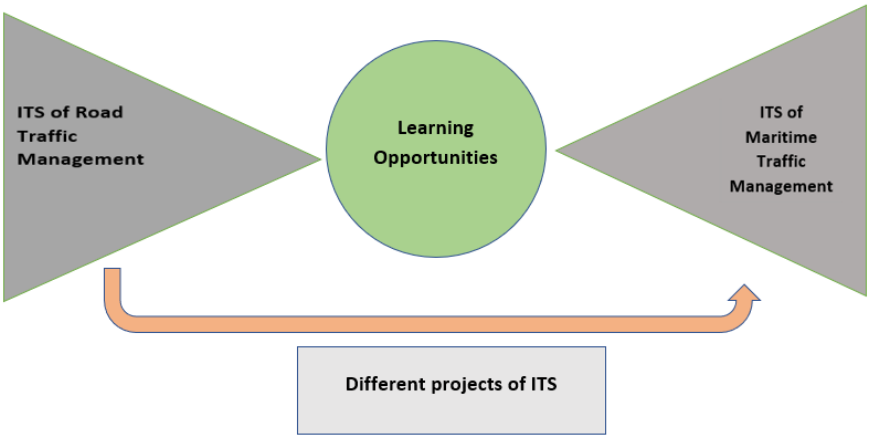

Figure 9: Population and sample (Author)

While determining the population and sample, it was ensured that projects were chosen without any bias and that recording data from participants was convenient (Shukla, 2020, pp. 69–78). The study focused on R&D projects since they are closely linked to current trends, innovation, opportunities, and challenges. Selecting and studying R&D projects as the population can help identify critical improvement areas.

A sample size of 8 participants, selected from the different projects of ITS, was interviewed. As qualitative research often uses purposive sampling, and this thesis includes a group from a particular industry, the sampling is purposive. The sample is selected randomly without any bias based on their characteristics similar to the maritime and road industry (Bryman & Harley, 2022, p. 388).

3.3 Data collection method

Data collection is obtaining relevant and reliable data in systematic techniques and processes for a research project. In this thesis, data collection is the key point as it determines the quality and reliability of the data collected (Bryman & Harley, 2022, p. 11).

Data collection methods can be divided into two groups. One is primary data collection, and the other is secondary data collection. As mentioned earlier, the thesis is qualitative research,

and the primary data was collected from the semi-structured interview, and secondary data was collected from the literature review.

Initially, an online meeting was held with a relevant person from ITS and the supervisor to address and inform them about the objective and goal of the thesis. The purpose of the meeting was to have a depth understanding of ITS and the implications for the RTM and MTM.

The participants were the department heads of the projects dealing with daily opportunities and challenges. As previously stated, this is a semi-structured interview. This format allows for an interview guide to be used for a specific topic while also allowing for questions outside of the guide to be asked. Interviewees can freely share their experiences and perspectives beyond the topic at hand. The same set of questions was asked in each interview, but interviewees had the flexibility to answer in their own way. This approach was suitable for this thesis to explore and get the answers to the research question as this method collects more information, scrutinizes the information and gives a comprehensive understanding, and enables one to make informed decisions based on the evidence found in the interview. However, as the interview was never done by the researcher before, the tutorial was taken from YouTube videos on how to conduct semi-structured interviews (Bryman & Harley, 2022, pp. 436, 438).

The interviews were conducted in Microsoft Teams, and the language of the interview was English. All the interviews were recorded entirely from the first minute to the last so that there was no chance of losing any information, and at the same time, notes were taken to ask more profound questions if anything needed to be clarified. The usage of Microsoft Teams in qualitative interviews are appreciated positively by some researcher as they provide enormous benefit such as access to experts from different geographic locations, cost saving from travel, flexibility in scheduling time such as last-minute adjustment to the schedule due to any unavoidable circumstance (Bryman & Harley, 2022, p. 453).

The challenge of the technology to hold online video meeting is that it can be disrupted by poor internet connection. But in the case of this thesis, the connection from both ends was excellent.

The scheduling of the interviews was done in advance. A mail was sent to each interviewee for scheduling and to inform them about the topics. Then invitation links were sent to the interviewees according to their preferences. The interview was scheduled to be one-to-one. The duration of the interview was a maximum of 2 hours, and a minimum was 45 minutes.

3.4 Interview guide

The scope of developing this interview guide (Appendix A) was to gain insights into the potential areas of learning and development of the ITS of maritime traffic management. To develop the interview guide at first, a literature review was conducted to pinpoint areas of learning and development for Intelligent Transportation Systems (ITS) in maritime traffic management. From the review, codes were extracted that highlighted the main themes and concepts associated with ITS.

Afterward, the theoretical framework was utilized to create the interview guide. This framework helped to arrange the codes and formulate questions that would gather information about each theme. The interview guide was then separated into four categories, with each category focusing on a specific theme that was identified in the literature review.

In summary, the interview guide was developed systematically and rigorously, considering a theoretical framework and empirical evidence from the literature review.

Professionals with experience working on Intelligent Transportation Systems (ITS) projects were interviewed to gain insights into potential areas of learning and development in maritime traffic management. The interviews aimed to gather personal and professional experiences and insights on ITS-related terms and concepts. Carefully crafted questions were used to elicit detailed and meaningful responses. The goal was to explore the perspectives of professionals with first-hand experience working on ITS projects to identify potential learning opportunities and relevant aspects of ITS.

3.5 Data analysis method

Data analysis is a method to examine, filter, reduce, and manage the collected data to address the research topic. The data analysis method of this thesis is a grounded theory analysis, as ground theory analysis is the most suitable framework for analysing qualitative research and contains tools such as coding, theoretical saturation, and constant comparison. Considering the

tool containing coding and outcomes containing theory and categories, grounded theory was convenient for this thesis (Bryman & Harley, 2022, p. 522).

In this thesis, each of the interviews was recorded in Microsoft Teams. One of the principal advantages of the team is the ability to transcribe the data gathered from the interview immediately and automatically. Transcription is an easy way as it is difficult to write down every word from an interview, and transcribing the data from recorded interviews is a time-consuming process, but meetings in teams make it comparatively easier and quicker than transcribing manually. One of the limitations is the transcribing may vary from the original statement in some places, recorded during the interview. To make the transcribing accurate and reliable, transcribes were checked several times according to the recorded interview before analysing, and scripts were corrected according to the recording.

Once the transcription was done, each transcript was analyzed according to the code, as this thesis follows a deductive coding approach. The coding process breaks down the data into component parts (Bryman & Harley, 2022). All this coding was done in the software named Vivo. NVivo is used in qualitative research as it has the capability to organize, code and analyse vast amounts of data. Codes were divided into subcodes. The codes are then analyzed, linked to the relevant literature, and presented in the result. The codes and sub-codes are as follows:

Code	**Subcode**
Definition	ITS
	Concept
	Example
Challenge	Non-technical Challenge
	Technical challenges
Solution	Non-technical challenge
	Technical challenges
Barriers for adopting learning	Organizational
	Operational
	Technical
	Legal
Area	Continuous improvement
	Adaption of new technology
	Prioritization of multimodal
	Improvement of transfer nodes
	Increased collaboration
Method of learning	Learning from others
	Experiment
	Experience

Table 6: Codes and subcodes

3.6 Ethical considerations

Ethical consideration refers to the values and principles that an interviewer follows during the research and ensures that the procedure is morally valued. While doing research, a researcher should consider factors such as informed consent, confidentiality, minimum harm, and deception (Bryman & Harley, 2022, p. 109). While conducting the research for this thesis, all factors were considered.

Norsk senter for forskningsdata (NSD) has viewed and approved this thesis's data management and research project. The form is attached in the appendix section. Permission was obtained from ITS Norway to use the association's name in the thesis. However, as the requirement of NSD is to take consent from participants, a copy of the confidentiality and informed consent template prepared by USN were sent to the participants. Each of the participants was asked for their consent to record the interview. Participants were informed about their right to withdraw from the interview. All the recordings and transcriptions were only available to the author and were deleted after the research process.

4. Result

This chapter presents the study results based on the interview guide. The results are the analysis of answers drawn from interview questions. These results are structured according to the coding used to analyse the transcripts and the interview guide categories, such as introduction, challenges, solution, learning opportunity, and barrier to adopting learning.

4.1 Overall description of the examined demographic

The studied population worked on different ITS projects and is generally in the top position of the project. Most of the population belong to the position of CEO and senior position. A significant percentage of the population belongs to CEO (2) and scientist (2), followed by a specialist (1), captain (1), managing director (1), and senior advisor (1) (Figure 9).

Regarding the experience of working with ITS, 2 of the population worked between 25 years to 28 years (2), 20 years, and between 9 to 11 years (2). 1 of the participants worked less than 20 years, and 1 worked more than 40 years (Figure 10). 6 belong to men, and 2 are women (Figure 10).

Figure 9: Job position of the participants

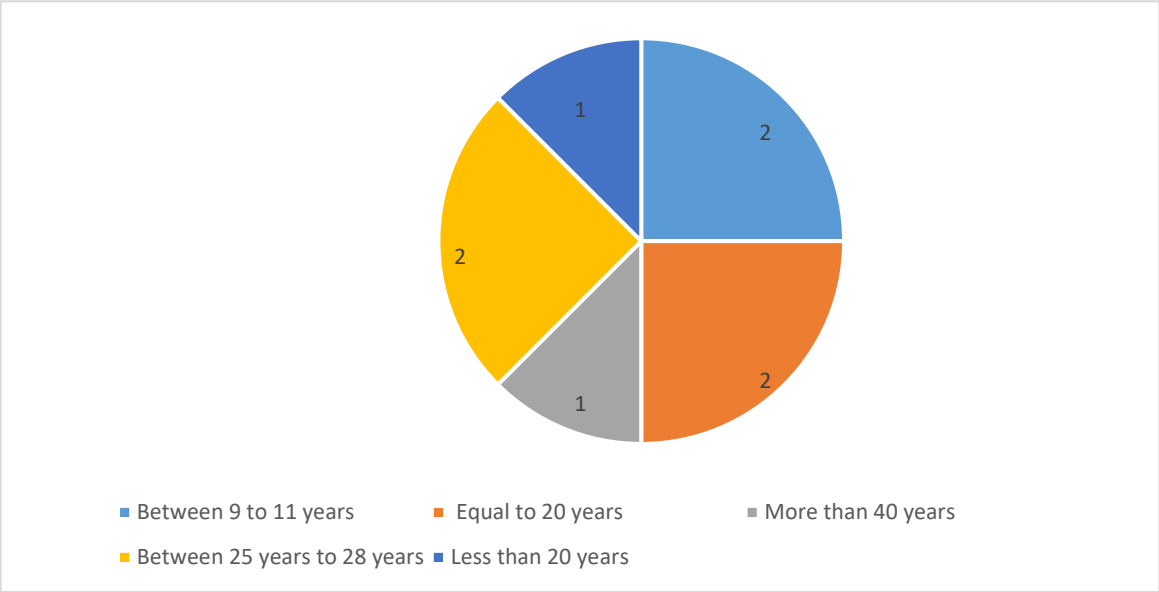

Figure 10:Number of years working with ITS

Regarding the experience of working with ITS, 2 of the population worked between 25 years to 28 years (2), 20 years and between 9 to 11 years (2). 1 of the participants worked less than 20 years and 1 worked more than 40 years (Figure,10). 6 of the participants belong to men and 2 is women (Figure,11).

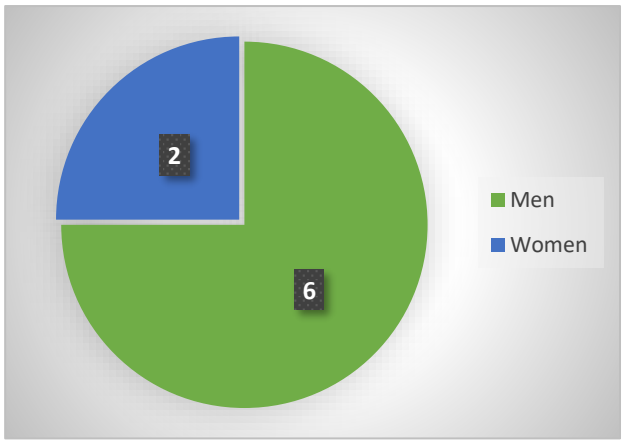

Figure 11: Number of Men and women working with ITS

Additionally, Individuals who participated in the study were involved in various ITS projects. Here is an illustration (figure 12) showing the number of people working in different departments. 2 of them are from public road administration, 2 of them are from top management, 1 of the informants is from a standard development organization,1 of the participants is from a mapping authority, 1 of the informants is from maritime management, and 1 participant is from information and communication technology.

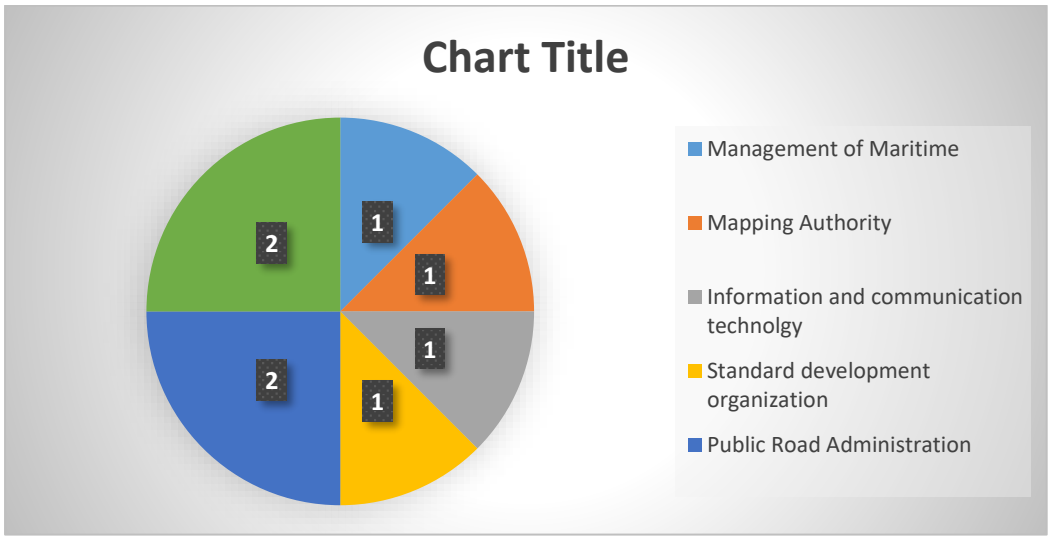

Figure 12: Individuals representing different departments

From Theory to Practice: ITS through participant perspective

The term ITS is defined from different points of view. 4 of the participants have a common understanding of ITS. According to them, ITS is not just limited to the road. The area is broad and complex. The term is wide enough that it can be used for operating a pizza delivery robot

to control vessels. '*Some people think that ITS is limited to road transport, but I think it has a wider perspective than road transport*.' Even though they share a common viewpoint, they define "ITS" from different perspectives, as outlined below.

3 of the informants stated that it is the system to control vessels. It is a solution that can give a signal to avoid a route where there is trouble.2 participant said that it is the automation of everything, such as automatic tolling, system, or application. 'It's an automated vehicle or any kind is of course one part of it, yes. But it's also about controlling traffic.' 1 stated that the goal of ITS has variations such as reduction of emissions, enhancement of traffic safety, integration of all transport modes, and optimization of the flow of vehicles from all domains. 1 stated that it is information communication technology, and 1 said it is all about ensuring safety.

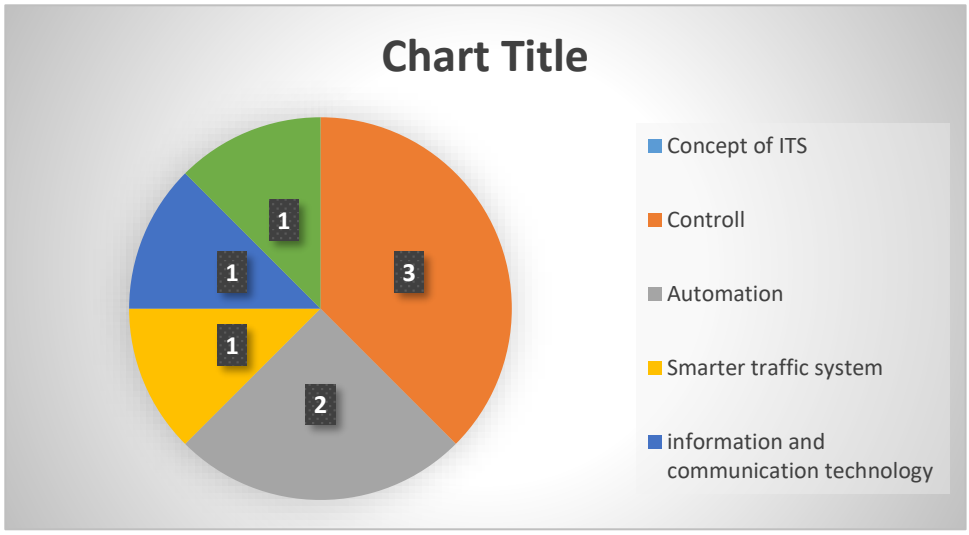

Figure 12: View on the concept of ITS

4.2 Challenges and Solution

Challenges

Participants were asked to share the most significant challenge that they faced in the project. 4 of the respondents said they face several challenges. However, among them, the challenges with legislation are the most difficult to deal with as it has stopped a lot of development in the traffic management sector. The legal challenges are often associated with politicians, and it needs a lot of data to explain. '*That is very hard to overcome because you have to deal with politicians.'*

According to a participant, out of these 4-participants, maritime must deal with international law, which is a challenge. *'Then international shipping has restrictions on what we are allowed to do.'*

1 of the population stated that political decisions are difficult to deal with. The participants stated how political decisions might hinder the technologies from proceeding, especially in the maritime sector. The decision-making process of regulatory bodies is slow, and it takes longer to grant any proposal. The challenge was discussed by drawing an example of a user-friendly app that collects information from various transport providers developed by the MAAS company in Finland. Users can receive suggestions of different travel options based on speed and cost by entering their destination. This simplifies comparing and selecting the most suitable option for the user.

'So, company in Finland they put in a lot of effort to build this platform, but then the Finnish government figured out this is a great idea. So, they may want themselves and of course that's filled this company that had been betting on this technology for like 5 or 10 years. Previously, I mentioned that we require decisions from the government. That maybe never came. That was a problem. Now we have a problem with these examples that the government sees this as a great idea and opportunity, and then they take the market from the private actors.'

1 of the participants stated that getting awareness globally is a challenge. More specifically, it is the challenge of implementing traffic regulations globally. '*Getting the organizations and the institutions to realize this and to start working on the problem that is by far the biggest challenge we have.'* This participant also agrees with the slow and conservative nature of government systems.

'It is really settled culture and not wanting to risk things it it's these are government, huge government systems. And they are extremely conservative in nature. They are extremely hard to get moving. And yeah, So it's'.

2 of the population said that it is the lack of cooperation. Cooperation between different actors and authors, containing authority and industry, is essential for the success of a project. *'I think that would be the cooperation between the different actors, different stakeholders and between the authorities and the industry.'*

Apart from the above non-technical challenges, 4 of the participants also discussed technical challenges that are significant and relevant at the same time.

1 of the 4-participants stated that standardization is a difficult challenge, and it is tough and expensive to adapt. Standardization is the development of technical standards regarding the manufacturing, performance, and operation of computer networks. Even if every country has the same standard with the same name, they vary because they are implemented differently.

'*You have to deal with standardization. That is very expensive to change or to adapt to.'*

Another 1 of the participants of this 4 stated that resilience-related challenges are significant. Prediction or forecasting unwanted interruptions and situations is impossible in today's traffic system. Predicting and taking measures in advance is a great challenge. '*This resilience to be aware of things at an early stage, even before they happen and to take measures to limit the negative consequences is a big challenge.'*

1 of the participants stated that the lack of infrastructure is a challenge. Today's vessels must be equipped or advanced to participate in a dynamic industry. *'Many ships don't have the infrastructure to really participate. You need equipment, stuff like that, more advanced than minimum requirements for ships.'*

1 of the attendants stated lack of human intervention in automated driving is a challenge. In a situation like a slippery road, no one can decide to avoid the road. *'You have to have a human driver that intervenes and takes all the control of the vehicle because you run into a situation that automated system cannot handle.'*

Solution

3 of the participants stated that communication, collaboration, and cooperation are the keys to solving the challenges faced by legal decisions.
'So, we try to do both to set up meetings with the politicians and the Parliament, but also in the government to start project start processes to overcome especially the challenges from the legal.'

'You have to work with the big or the most significant operators, the interest organizations. You also have to link this to the intergovernmental organization. It's the International Maritime

organization in our case.'

1 of the participants stated that the continuous development of technology and mandatory implementation could overcome political challenges. *'We try to continue develop the technology'.*

1 of the attendance said that, to ensure global awareness, it is important to establish cooperation and harmonization. Many countries are currently in the process of digitizing their government operations. As part of this process, electronic traffic regulations are becoming increasingly important. The use of technology in traffic management can greatly improve efficiency and reduce the need for manual intervention. Countries must coordinate and harmonize their efforts to ensure the successful implementation of these regulations. '*Thing that needs, coordination and that needs harmonization.'*

This participant also stated that they try to convince people and make people understand the benefits of technology. '*With the correct people, try to make them understand what that this is needed and to get them moving in the right direction. So, it's a multifaceted program of convincing people and doing what can only be described as marketing.'*

1 of the informants said that to solve the problem related to cooperation, they put all the relevant people together and identified the reasons and factors that cause challenges to discuss them. '*Is mainly putting people in the same room. Getting people to talk with each other.'*

Additionally, to overcome the challenges regarding the need for more cooperation between the stakeholders, 1 of the participants stated that projects are working with the same goal to solve this challenge. Research projects are an excellent platform to bring stakeholders together. *'Well, I think that's what the European research projects all is about because through this project you get the cooperation between a lot of different stakeholders.'*

The solution to technical challenges

1 of the participants agrees that the discussion with government and legislative bodies helps overcome standardization challenges. '*We address both the upper level, like Parliament and government, the government is quicker, the Parliament is slower because of the situation.'*

To overcome the challenge regarding resilience, 1 of the participants stated that there should be a shared understanding of a concept model and reference architecture to achieve a common goal. They plan to implement automation in a gradual process by connecting all necessary components first and then adding more advanced features until it is fully automated.
'*First of all, we try to establish a common understanding of what this is about.'*

To address the issue of managing infrastructure, two solutions can be implemented suggested by 1 of the participants. Firstly, a safety regime can be put in place to regulate traffic and prevent hazardous incidents. Secondly, a coordinated and cooperative timetable for ship arrivals at the terminal can be established.
'What is done today is that we have a safety regime.'

To facilitate the safety and decision-making ability of autonomous driving, 1 the participants said to develop communication technology and an information-sharing system that can provide less dependency on human intervention.
'*Basically, it's the communication technology and it is the information that you shared through that communication technology that is what we call the enablers that solve or overcome the challenges.'*
The participants identified a range of technical and non-technical challenges and proposed solutions to address them presented in the table below. Regarding non-technical challenges, the main issues were legislation, lack of global awareness, political issues, and lack of cooperation. The participants suggested that solutions could involve cooperation, collaboration, meetings, harmonization, convincing, improvement of technology, putting people in one room, and development of research projects.
For technical challenges, the participants identified standardization, resilience, lack of infrastructure, and lack of human intervention in automated driving as significant issues. The suggested solutions included discussing with the government, developing a shared understanding, establishing safety regimes, collaborating, and developing communication technology.

Non-Technical challenge			
Challenge	Participant (8)	Solution	Participant (8)
Legislation	4	Cooperation, collaboration	3
		Meeting	1
Getting global awareness	1	Cooperation, harmonization and convincing	1
Political	1	Improvement of technology	1
Lack of co operation	2	Putting people in one room	1
		Development of research project	1
Technical challenge			
Challenge	Participant (4)	Solution	Participant (4)
Standardization	1	Discussion with Government	1
Resilience	1	Development of common understanding	1
Lack of infrastructure	1	Safety regime and collaboration	1
Lack of human intervention in automated driving	1	Development of communication technology	1

Table 7: Summary of Challenges and solutions

From the table it is evident that majority of the participant put emphasize on the cooperation, collaboration, and meeting to solve the most significant challenge.

4.3 Area with learning opportunity

Continuous improvement

2 of the participants stated that continuous improvement is essential to proceed, and it should be done by learning from previous projects. The focus should be given to ongoing projects and updating the system continuously. *'Continuous improvement is that, would say really important to keep on moving forward.'*

Moreover, 2 of the informants informed that they focus on deployment of the industry, legal and standard barriers. To survive and teach their members, a framework of continuous improvement is significant. They agree on improvement through learning from others. *'We have made a system for that and make sure that we can use that kind of framework of continuous improvement as a business model, but also to teach our members.'*

2 of the participants stated that for continuous improvement, collaboration and partnership is required. Continuous improvement enables us to share knowledge and resource. The discussions also focus on the necessity of efficient business models to facilitate the execution of continuous improvement and the challenges of expanding pilot projects without a viable market.

'We are building up a portfolio of project. And if you agree to be a partner in lab, then you agree to share the knowledge, the solutions and in your project with and the partners that you have and so others can build on that knowledge. So that way you get a continuous improvement and also you get, uh, projects which have been developed for several years but with different kinds of finance financial sources.'

Although continuous improvement was not explicitly mentioned by 1 of participants, they discussed their viewpoint on continuous improvement by emphasize the significance of making systems adaptable, practical and adaptable to future changes and compatible with previous versions. *'They focused on making it future- proof and compatible with previous projects.'*

Furthermore, 1 of the participants stated the role of ISO and the Norwegian coast guard as a driver for innovation and continuous improvement. They offer a structure for organizations to create and execute systems that help them reach their objectives. However, It should be noted that the maritime industry is primarily dominated by global players, making it challenging to alter regulations and establish uniform standards. *'So continuously improvements. Yes, it's possible within some limitations.'*

Here is a table suggested various methods for achieving continuous improvement. Two of the informants emphasized the value of learning from past projects, another two informants mentioned learning from peers, one participant suggested developing strategies based on previous experiences, two participants highlighted the importance of collaboration and partnerships, and one person highlighted the role of regulatory bodies.

Area	Result	Participant
Continuous improvement	Learning from previous projects	2
	Learning from others	2
	Strategies for future by considering previous	1
	Collaboration and partnership	2
	Role of regulatory bodies	1

Table 8: Summary of the result of analysis

From table 8, it is evident that most of the participants said that they improve continuously by learning from previous projects and others.

Adoption of new technology

2 of the participants stated that technology adoption depends on the client's preferences. Adoption then depends on how it can convince people to adopt and needs collaboration between developer and client.

'If you really can prove that technology is useful, then it will be taken up quite fast in some cases, so new technology has to be proven to have
Significant benefits.'

1 of the participants stressed the significance of embracing new technology, specifically within Intelligent Transport Systems. They acknowledge the rapid advancements in technology, particularly in artificial intelligence, and explain how these innovations can tackle challenges connected to automated driving.

'The core of ISTS is to adapt new technology because things are happening really fast and it's always a lot of new technology coming up and especially now with the with the artificial intelligence and development happening there.'

1 of the participants stated that adopting new technology is essential specifically for maritime, and for adopting new technology, government support is necessary. According to the attendant, the adoption of technology has two steps, one is development, and another is adoption.

'So, we kind of create a possibility for innovation to develop new technology, and then we work with the clients, those who are going to buy it to make sure they are aware of this and can buy it afterward.'

1 participant stated that operators and other parties had embraced new technologies, but their primary aim was improving their operations.

'Adoption of new technologies, yes, there has been a lot of adoption of new technologies but it might help them self. The focus is to help themself for their own operation.'

1 participant stated that new technology could be expensive to implement, so a convincing reason is needed to justify it. However, if it proves valuable, it can be adopted quickly. '*I think people are very open to new technology when it's out there. Maybe the thought of technology is scary before you see it before you know what it is. But everything new is scary before you can see it and know what it is. So, I think that people adapt quite easily.'*

Additionally, 1 participant did not provide their input regarding the learning opportunities associated with adopting new technology.

Here is a table summarizing the results,

Area	Result	Participant
Adoption of new technology	Preferences and collaboration	2
	Advancement of technology	1
	Government support	1
	Self-development	1
	Ability to convince	1

Table 9: Driving factors to adopt new technology

From table 9 it is evident that participants had different views on drivers for adopting new technology. However, 2 participants agreed that preferences and collaboration are essential factors for the adoption of new technology. 1 participant emphasized the advancement of technology, while another participant mentioned the importance of government support. Additionally, self-development and the ability to convince others were mentioned by one participant each.

Prioritization of multimodal

2 participants emphasized the importance of giving priority to multimodal transportation in order to achieve traffic safety and improve the quality of traffic. They expressed that there is only no alternative of prioritizing multimodal transport. *'If you want to reach any targets of and the and the climate or Traffic Safety or making the transportation smarter, we need to we really need to prioritize the multimodal. There is no way around it and even in Norway where you don't have that many roads.'*

Additionally,2 participants suggested that to optimize the entire transport system, it is crucial to prioritize multimodal transport. This involves coordination among various actors, such as truck drivers, sea cargo operators, and senders/receivers of goods. However, each actor may prioritize their operations instead of considering the entire value chain. '*So, I think if you're going to utilize the whole transport system, in an optimal way, you must also coordinate between the modes.'*

Furthermore, 1 participant pointed out that the road and maritime sectors give little attention to multimodal transport. This is because maritime transport mainly involves transporting goods from one port to another, while road transport provides door-to-door service. Therefore, there may be limited opportunities to learn about multimodal transportation.
'Multimodal is not really high on the agenda for the maritime sector. Maritime is very much about port-to-port transport.'

Additionally, another participant agreed that using multimodal transportation can help achieve shared mobility and reduce traffic congestion, which has a negative impact on sustainability. '*Having multi modal journeys for example, I think that it's good as long as it is shared mobility. As long as you have as much transport that you can have with as less traffic as possible.*'

The global perspective on handling logistics is that multimodal should be prioritized according to one participant. *'Prioritization of multiple multimodalities that's really important for from a well what you say a global perspective perhaps for handling the logistics.'*

Based on feedback from the participants, the table highlights the main factors to consider when prioritizing multimodal transportation. Out of the 8 participants, 4 suggested that intelligent traffic and optimization are the most important drivers. 1 participant mentioned limited opportunities as a factor not to prioritize multimodality in maritime, while two emphasized the significance of shared mobility and a global perspective. The general consensus among the participants is that prioritizing multimodal transportation is crucial for achieving more intelligent and optimized traffic. Additionally, there are ample opportunities for learning and improvement in this area.

Finally, 1 participant did not add any input to Prioritization of multimodal.

Area	Result	Participant
Prioritization of multimodal	Smarter traffic	2
	Optimization	2
	Limited opportunity	1
	Shared mobility	1
	Global perspective	1

Table 10: Key drivers to prioritize multimodal

Improvement of transfer nodes

2 participants emphasized the importance of improving transfer nodes to create a sustainable transportation system.1 of the two participants talked about mobility as a service platform of the Norwegian government, which positively impacts improving transfer nodes.

Additionally, 2 participants expressed that collaboration between different stakeholders is needed to improve transfer nodes or reduce waiting time. Transfer nodes play a vital role in optimizing traffic management across various networks. However, one of the participants pointed out that transfer nodes will only work with a common language. Therefore, cooperation should be prioritized before optimizing individual networks. '*Then you need to improve the transfer nodes, and someone needs to be responsible for the transfer nodes now and. And that's, uh, sort of. Back to where I started because transfer nodes, they will not work if you don't have a common language, if you put cooperation uh at the top of your list. Maybe before optimizing your own network. So, if the transfer nodes are sort of the key to multiple model Traffic management.'*

Furthermore, 1 participant stressed the need for a standardized framework for transfer nodes. This framework should define the minimum information required to facilitate any combination of travels available in that node. The participant highlighted that the inefficiency of transfer nodes could lead to economic and environmental losses.

1 participant emphasized the importance of introducing tracking and tracing in transfer nodes to prevent property loss. They suggested that there is still much room for improvement in this area. '*There is, still, much to do in the track. Trace in in the transfer nodes.'*

1 participant pointed out the potential for enhancing transfer nodes by providing more detailed information and connections between different modes of transportation. They also suggested that automation could improve transfer nodes by implementing automated traffic signals, vehicles, and ticketing systems.

Finally, 1 participant did not respond to the learning opportunities in transfer nodes.

This table shows that most of the participants indicate that the operation of transfer nodes needs to be improved, and it can improve by introducing and updating tracking, tracing, and collaboration.

Area	Result	Participant
Improvement of transfer nodes	Tracking and tracing system	2
	Collaboration	2
	Standardized framework	1
	Government support	1
	Automation and detail information providing system	1

Table 11: Summary of finding for improving transfer nodes

Increased collaboration

2 participants discussed the significance of collaboration among various transport modes like air, rail, and road to enhance the priority intersection system. One of the participants emphasizes that collaboration must be more than just a name, but an actual agreement. They stress the need to increase collaboration between transport modes. '*So, you should take collaboration seriously, not only in name. You should do it. And the way we learn, and ITS*

Norway is that if you if you want to collaborate, you should have an agreement that kind of lays out the basic principle of that collaboration. Otherwise, it's only a name.'

2 participants said about the significant role of collaboration. The participant highlighted that the transportation industry needs more collaboration to overcome challenges and achieve the organizational goal.

1 informant highlighted the importance of collaboration to have an optimal system.
'So of course, collaboration is important. If you're going to have an optimal system, the different actors and systems and actions must be coordinated, and then you need collaboration.'

1 participant stated that communication and coordination today are manual. To improve this communication, better collaboration is needed, especially in the more oversized ports. *'And this has to be done by telephone. So, it's very complicated and a lot of things can go wrong so that you have more delays and stuff like that. So, there's really a need for better coordination and collaboration in the big ports.'*

1 participant talked about the positivity of stakeholders toward collaboration. According to him, collaboration is not an issue in the system, and stakeholders are interested in collaboration. '*Stakeholders are interested in addressing it. So, collaboration is a is not a problem I would say.*'
Lastly, 1 participant did not comment on increased collaboration. Here is a table summarizing the result.

Area	Result	Participant
Increased collaboration	Enhancing the operation of intersection	2
	Overcoming challenge	2
	Optimal system	1
	Digitalization	1
	Interest	1

Table 12:Summary of finding drivers for collaboration.

The table summarizes the participants' results on the factors that contribute to increased collaboration in improving intersection operations. The majority of participants identified the need to overcome challenges and improve intersection operations as the primary drivers for collaboration. Other drivers included implementing an optimal system, digitalization, and interest. These results indicate that collaboration can be an effective solution for addressing challenges and enhancing the overall functionality of intersections.

The most significant area that has learning opportunities

Table 13 indicates the areas and number of participants that have chosen the most significant area with learning opportunities.

3 out of 8 participants have indicated that the collaboration area has much potential to improve, followed by the area that prioritizes multimodal system. 2 out of 8 participants indicate that there is much to learn in the multimodal system. Apart from that, 1 participant felt that area of continuous improvement could be improved with the adoption of new technologies, 1 participant indicated that there are learning opportunities regarding the improvement of transfer nodes with increased collaboration, and 1 participant did not choose any of the area given but expressed that collaborative implementation is an area which has learning opportunity. Areas that are chosen by a majority of the participant are discussed in the discussion chapter.

Areas	Participant
Continuous Improvement	0
Adoption of new technology	0
Prioritization of multimodal	2
Improvement of transfer nodes	0
Increased collaboration	3
Continuous improvements with adoption of new technologies by increased collaboration	1

Improvement of transfer nodes with increased collaboration	1
Collaborative implementation	1

Table 13: The most significant area having learning opportunity

4.4 Learning method

The participants were asked to express their views on various learning methods, and they provided their feedback accordingly. This questions in this section, aimed to gain insights into the different learning method and preferences of participants, and to identify the most effective and efficient methods of learning for optimized operations.

Learning from others

1 participant stated that they learn from others in private and public workshops on private and public levels, and it is a way of engaging themselves in ongoing research and development. *'Learning from others. So that means you are engaged in in ongoing research and development in Europe*.'

1 participant stated that learning from others is a process where learners can choose what to pick from a lecture or presentation. '*They can pick up on uh on things that is valuable for them in that in that kind of presentation or lecture or whatever, you don't need to be try too hard to try to think what will be helpful if you concentrate on saying what do we do then the other kind of party that needs to learn.'*

1 participant stated that it is important to learn from others when a project is new for someone. *'If it is a new area for you, it is important to learn from others.*

1 participant stated that learning from others is not applicable when no one has done anything related to that project before. However, if someone did something in that field, particularly in maritime, then it is certain that the learning will be transferred. Sometimes you cannot learn from others because this is the first time anyone has done it.
'If somebody has done something in the maritime field, it will typically be transferred, it will

be transferred relatively rapidly.'

Furthermore, 1 participant stated that when someone has to decide on which direction to go, they should always start with learning from others. '*You know which direction you have to go. So, you use learning from others to decide where we should go.'*

1partuicipant expressed this method as learning with others rather than learning from others. It depends on the mindset of people regarding the openness to learn and share something. The participants highlight learning together. *'I think I would say that I learn with others.'*

1 participant expressed that learning from others is extremely important in the case of optimizing organizational things, which involves motivating and discussing with people to learn. *'It's a very good way to find out how to optimize organizational things and it involves how to motivate people, how to discuss, to get the truth out.'*

Finally, 1 participant stated that they are following this method currently by studying and researching ongoing projects. '*…. Building a knowledge base that we can build further on. So that's basically what we're doing by learning from others.*'

Experiment

1 of the participants stated that to test and implement new standards experiment is needed. '*The experiment is very important to take a look at all these new standards and develop solutions that matches the standards.'*

1 participant stated that they do many experiments, which is the quickest way to get results. *'If you can do an experiment, you will gain quickest.'*

2 participants stated that it is a part of the evaluation. When someone intends to do something new, they must undergo several evaluations, and an experiment should be one of them.
'*When you have done projects and don't proper evaluations, you can also summarize the lessons learned, the experience and also recommend what to do next.'*

1 participant stated that experiment is the way to gain experience. '*We have to do experiment and to gain experience you have to do experiments.'*

1 participant stated that experiments are important in cases where nobody has done the same thing before although experiments are sometimes expensive. So, for the experiment it has to be tested first.

'Sometimes you cannot learn from others because there is nobody has done it before.'

'..... Solving the problem on paper 1st and then if you think this will work then you have to prove that it works with experiment.'

1 participant stated that experiment is needed to see how things will work, how it will meet the goal and how it will meet the need of people.
'So, I think you need to experiment, but you need to do it smart, and you need to have a clear vision of your goal. What do you want to achieve with the experience, experiment, or the pilot thing.'

1 participant stated that the experiment is the demonstration of how a project will work out and to succeed, preparation and adequate infrastructure are needed. '*Experiments, it's most likely about the demonstrations, in order to succeed with those demonstrations, you need to do all of these preparations with making sure that you have the physical infrastructure that works for them.'*

Experience

3 participants stated that experience is the learnings people get from the demonstration. Experience is dependent on the experiment. By experimenting, one can get experience. '*When you have done projects and done proper evaluations, you can also summarize the lessons learned, the experience and recommend what to do next.'*

1 participant stated that it depends on the capability to relate it to the next project. If someone gets a project and does not know how to connect experience, then the experience will not work. *'You have an experience that you don't know how that relate to the next domain.*'

2 participants stated that experience is the documentation of an experiment from which others can learn to do things. *'They have paperwork that details how to do things, how to test things.'*

1 participant stated that having the experience to decide whether something is better or worse is important. '*You have to decide that this is a good way to do it, and then you can test it so experience….'*

1 participant said that experiments and experience are interrelated and expressed the same perception about the experience. '*We have to do experiment and to gain experience you have to do experiments.'*

The most significant learning method

According to the responses gathered from most participants, it was agreed that the learning methods related to optimizing operational processes, which include improvement, collaboration, and technological development, are interconnected. The order in which these learning methods were presented in the interview guide was also deemed correct by most of the participants. Here is a table presenting the feedback of participants. Here is a table to present the feedback of participants on learning method

Area	Result	Participant
Learning Method	Learning from others	1
	Experiment	2
	Experience	1
	Learning from others, Experiment and Experience	4

Table 14: The most significant learning method

From the table, it is evident that, 4 out of 8 participants stated that, all methods of learning are significant.

'So, I think all these three are important.'

'I would never choose just one then I don't think you'll get a good project, so I think all three, learning with others through experiment and experience.'

'You shouldn't start to do experiments on something that you do not have any knowledge about. So, get some learning from others, do some experiments, and find out why. Get some experience.'

2 out of 8 participants stated that, experiment is the most significant learning method. '*I think the most efficient is to do an experiment if it's possible.'*

4.5 Barriers to adopt learning

Organizational barrier

6 participants stated that organizational barriers are related to culture. The culture should be ready to accept learning if it does not accept that it is a crucial barrier.1 participant stated that the barrier is so strong in some cases that they have to quit the project.
'Some transport modes think they are best, or they think they are so different from others that there is no point in listening to others. So that is as a culture that may limit the learning.'
'Well, it's much about the culture, about the size of the organizations that they it's take, it takes a long time to change the way you're working, accept the new technologies and so on.'

1 participant indicated that organizational barriers are becoming more prominent where digitalization comes more. *'When digitalization comes more and more and then it becomes more and more important to sort out these sorts of barriers, so it's a huge barrier.'*

1 participant stated that this barrier creates a dilemma where government regulation is on one end, and corporations are on one end. *'All the regulations that make provides a predictable market for big investments. So that was a big problem. So, you had the big corporations for sitting on one fence and the governments were sitting on the other fence and nobody wanted to jump down the middle and make this thing work*.'

Operational barrier

4 participants stated that the barrier always exists as there is always a lack of resources and capabilities such as finance, but these barriers are easy to overcome. *'Every single time they will point to, no we don't have the money. We don't have the resources, we don't have the people with knowledge and there are no standards we can use and what we have here is so outdated and so on, all excuses to not do anything.'*
2 participants stated that this kind of barrier, like a lack of resources, can limit the capability of the industry to learn and develop. *'Someone does not get resources. Someone never gets the opportunity to actually develop their department because there is always a lack of capability. And that is a real barrier for, learning and developing your organization.'*

1 participant stated that operational barriers to the legal system are challenging to overcome.

For example, Manufacturing plants may need to invest in new equipment to comply with legal safety standards.

1 participant stated that operational barriers become more significant when people do not want to share or are scared to share the resource. *'That would be an operational challenge, getting people to share their data and also connecting different kind of systems that is operating today.'*

Technical barriers

4 participants stated that it is the easiest to solve technical barrier by adjusting the standard according to their convenience, or everyone agrees to do the same thing.

'The easiest thing is usually to solve the technical problems. That's the easy thing. To make things work. Yeah, that's the easy part. The problem is you make the solution works great, but you didn't complete the follow the standard, so the standards were not. The standards were a bit loose. So, we ended up with your own version of the standard. So now you're not compatible with any other systems. But so, to make things work, that's the easiest part.'

1 participant stated the operational and technical barriers with the same example and highlighted that this barrier always exists.

1 participant stated that their projects face these barriers, and they work a lot to fix the barriers related to standardization.

'*That's one of the areas I have been working a lot with standardization and that's an obviously a significant challenge.'*

1 participant stated that, because of lack of standard and due to technical difficulties, it is always hard to implement solutions.

'If you are not able to implement things due to technical difficulties or due to lack of standardizations. So, you're not able to learn because you cannot. Test or do things. You will be just theoretical.'

1 participant stated that barriers such as outdated systems may hamper the reliability and validity of data. However, they are possible to overcome by risk assessment system, and it depends on the existing knowledge and willingness to overcome.

'*You need to have, risk assessment systems in place also so that you know what to do if you*

have unforeseen incidents.'

The Most significant barrier to adopting learning

After conducting interviews with the participants and analysing their responses regarding the different barriers to adopting learning, they were asked to identify the most significant barrier they faced. Of the 8 participants, 4 stated that governance and organizational barriers were the most significant barriers to adopting learning.

'*Technical is also an issue for digital, for cooperation mostly, but organizational is the big barrier. 'If your organizational going as barriers, then you're stuck.'*

1 participant explained that technical issues are also a concern for digital cooperation, but organizational barriers pose the biggest challenge. An organization must face barriers to make progress.

2 participants stated that operational barriers are significant, while 2 others believed all barriers are significant.

Based on their answers, a table is created to summarize the most significant barrier to adopting learning. The table showed 4 participants identified organizational and governance barriers as the most significant, 2 informants identified operational barriers, and none identified technical barriers. 2 participants believed all three barriers (organizational, operational, and technical) were equally significant.

Barriers	**Participants**
Organizational and Governance	4
Operational	2
Technical	0
Organizational, operational, technical	2

Table 15: The most significant barrier to adopt learning

5. Discussion

This chapter will thoroughly examine the findings presented in the previous chapter and draw connections to the reviewed literature to see if the study results agree with or contradict the theory. The topics considered significant in analysis and those the author deems essential will be focused. Sub-research questions are answered first as the answers provide information to address the main research question. Sub-research questions were built to see the different perspectives of studies to identify the potential hurdles, strategies, and solutions that can affect learning opportunities. Identifying challenges and barriers and building a strategy to solve challenges is essential to get a depth analysis of the main research question.

Sub-research question no .1

- What are the challenges of the road traffic management system within ITS?

The study shows that one of the main challenges is related to legislation. According to the participants, legislation becomes a challenge for reasons such as: when it includes complex and unfavourable regulations for industries to implement new solutions, legal constraints that set boundaries for what can be done or what not, and policy decisions that limit the capability of access to resources needed.

Additionally, the study shows that legislation can be difficult to navigate due to the complexity of laws that often need to be updated and written convolutedly. Updating or adjusting laws that have been in place for a long time can be slow, even, when necessary, to meet current demands.

When legislation requires the involvement of politicians, challenges become more prominent. Meeting with politicians is a lengthy and cumbersome process, especially when trying to make them understand the necessity and benefits of new solutions. Conversations and negotiations with politicians typically require considerable data and technical expertise.

Apart from national law, complying with international law is also a significant challenge. Some industries must adhere to international law. International laws are sometimes designed in a way that does not consider different states' requirements and strategies. The conflict between international and local laws often makes it difficult to implement solutions.

In addition to national laws, compliance with international laws is a significant challenge for specific industries. International laws may only sometimes consider individual states' specific needs and nuances, making it difficult to implement solutions and resulting in conflicts between local and international laws. This conflict between national law and international law often hinders the potential of new solutions.

Apart from legislation, legal decisions also impede data sharing. Reliable and accurate data are crucial for efficient traffic management. Legal decisions restrict the data collection, usage, and disclosure, which makes gathering necessary information challenging.

However, the findings from the literature review show that the challenge of both domains is congestion which causes significant loss economically. Several pieces of literature have identified and justified the reasons behind considering congestion a significant challenge, such as growing demand, inadequate infrastructure, lack of collaboration, and lack of automation(Praetorius & Hollnagel, 2014) (Liachovičius & Skrickij, 2020) .

It is interesting to see the different results from the two studies. The reason for the variation lies in the methodology. The primary data analysis of this thesis is from an interview, and the secondary data analysis was from published journals and literature. The interviews identified the challenge based on the perspective and practical experience, whereas the published literature identified the challenge from a broader perspective. Another reason is that the study from the interview covers specific projects and unique challenges, whereas the literature review covers a wide range of traffic management issues (Bryman & Harley, 2022).

So, according to the interview and literature review, the challenges are related to legislation and congestion.

Sub- research question no .2

- How were the challenges addressed?

Based on the literature review, the challenge of congestion in road traffic management has been successfully addressed through the implementation of ITS. This has been achieved through quick technology adaptation, various applications, extensive research and development, and the completion of different projects road (Mandhare et al., 2018).

Government agencies, transportation operators, and technology providers must work together to implement the ITS solution successfully. This collaboration ensures that the appropriate technologies are utilized, adequate infrastructure is available, and the necessary policies and regulations are implemented, as emphasized in the literature (Li & Nguyen, 2017).

On the other hand, according to the study of interviews, cooperation and collaboration are needed to overcome legal challenges. Cooperation, collaboration and communication are effective to convince people and to spread knowledge and learnings. According to the participants, to overcome legal challenges, they arrange meetings and discussions with politicians, Parliament, and government officials because they are responsible for drafting policies and regulation. Communication enables the related authority to realize and identify the several perspectives from both ends. Thus, the approval and necessary legal procedures become convenient for the industries.

Additionally, the participants emphasized the significance of collaborating with major operators such as port authorities, container terminal authorities, cargo owners, truck terminal authority, truck owners and different interest groups. Collaboration ensures effective communication and clarifies respective job responsibilities. To overcome the legal challenges, it is required to have a common and shared understanding of challenges and solution.

Furthermore, collaboration with intergovernmental organizations like the International Maritime Organization, International organization for standardization and EU is required for effective communication and to overcome the legal restrictions imposed by them. On a global scale. Collaboration with international regulatory bodies enables us to advocated new standards and guidelines convenient to local needs, limitations and strategies.

After the discussion, it was determined that the obstacles to successful project implementation or operation are many and intricate, including factors like legislation and congestion. To overcome these hurdles, it is crucial to have productive collaboration among stakeholders at all levels.

Sub- research question no.3

- What are the barriers for maritime traffic management to adapt the lessons?

Through analysing the statements of participants, it was discovered that organizational barriers pose a significant challenge in the learning and transfer of knowledge in traffic management within the ITS.

One major hindrance is the organizational culture, the mindset of industry where some transport modes believe they are superior, lack of realization in the importance of learning, lack of knowledge sharing mentality and do not value the opinions of others. These are cultural barriers which and results from the structure of the industry are extremely difficult to overcome. If the structure is centralized, people working there have lack of interest in adopting learning. This cultural barrier limits learning and obstructs the transfer of knowledge from another domain.

Participants also highlighted, resistance to change and the time it takes for organizations to accept new technologies and adapt to them another barrier. Some industries are often scared of adopting new learning and people often resist. Apart from that some industries wait for the learning to be proven beneficial to other industry or domain which makes them late in adopting learning. These are organizational barriers to adopt learning related to people.

The size of an organization is a factor that contributes to this obstacle. According to the participants, larger organizations take more time to change as decision-making processes and implementing changes can be slowed down in larger organizations due to complex structures and hierarchies. This can be further complicated by specialized departments and teams, leading to communication barriers and siloed thinking. As a result, employees may resist change and prefer to stick to the status quo. To successfully implement ITS and adapt to the changing landscape of transportation management, organizations must identify and address these barriers. With the rise of digitalization, the resistance to change becomes more prominent, as technology continues to develop and expand, businesses must adjust and incorporate new technological advancements into their operations. However, some companies may be hesitant to embrace change, particularly when it comes to digitalization, resulting in obstacles to implementing new technologies and processes.

Another organizational barrier is the dilemma where government regulations provide a predictable market for significant investments, while corporations face uncertainty when investing in new technologies. Businesses may nevertheless experience uncertainty when investing in new technology, even though government laws can create a reliable market for significant investments. Regulations create a stable market with unambiguous norms and standards, but it can be difficult for businesses to invest in cutting-edge Technologies that are burdened with danger and uncertainty. This is a conundrum because while the government can guarantee a stable market, businesses would need more assurance and willingness to take risks with their investments. These uncertainties within the business create barriers to adopt learning.

The reasons for the barrier are fear of losing job, lack of confidence and lack of knowledge about the importance and benefit learning. Participation in workshops, training and development and motivational activities from the industry are needed to overcome the barrier(Raza et al., 2023).

While the study result presents people, culture, and governance as organizational barriers, the literature review also identifies people, culture, and governance as organizational barriers. These barriers arise within industry. Reluctance to change, cultural beliefs, and attitudes toward learning are the causes of these barriers. Additionally, the bureaucratic or centralized culture with strict job descriptions and a focus on profit causes an adoption barrier(Harris et al., 2015),(Raza et al., 2023).

So, to conclude it can be said that organizational barriers such as people, culture, and structures are the factors that contribute to the barriers to adopting learning.

Research question

- What are the learnings opportunities of maritime transport system from road transport system for enhancing traffic management within the context of Intelligent Transportation Systems (ITS)?

According to the result of the interview, there are opportunities for learning in the maritime industry through collaboration and coordination with other transportation modes like air, rail, and road. The analysis of finding challenges and solutions also shows that collaboration and cooperation are vital to overcoming significant challenges like congestion and legislation.

Increasing collaboration is a learning opportunity. According to interviews collaboration has been good and stakeholders are interested in collaboration. But collaboration should occur between all stakeholders, not just by name but also by agreement. When there is collaboration in the form of an agreement, all the stakeholders are accountable for collaborating. To implement projects and new solutions, collaboration starts with the government, parliament, and authorities like police, and public administration.

As in the previous chapter, learning is defined as acquiring and sharing knowledge. Increased collaboration is an excellent platform to learn in that sense(Argote, 2011). Even if the technology is ready and there is willingness to accept it, in that case also collaboration is required, which should not be mix with cooperation. Collaboration with different stakeholders can facilitate learning as it widens the opportunity to exchange ideas. People with different backgrounds and expertise work together, share their experiences, facilitate enough resources for experimenting with different solutions, and, most importantly, people learn with each other instead of learning from others(Argote, 2011).

Increased collaboration is also needed to overcome the silo thinking of the industry by breaking down barriers between departments or teams, fostering a culture of knowledge sharing, and encouraging interdisciplinary approaches to problem-solving (de Waal et al., 2019). For example, it was observed in the answers where respondents thought that multimodality is not an agenda for maritime, even though most cargo vessels use different modes of transportation to reach their destinations. A system of collaboration between all the actors is required to avoid any unexpected situation, such as congestion. Collaboration between all actors results in an effective communication system. For instance, the existing communication system is manual such as paperwork and messaging system. These systems can be improved by digitizing paperwork and advanced messaging systems, which is possible to learn from collaboration with ITS solutions.

In addition, some participants chose not to answer all the questions. Additionally, others noted that there may be opportunities to learn from aviation in the maritime industry, which has already been documented in literature(Praetorius et al., 2012). This highlights the need for more openness to new ideas and exploration of potential areas. To facilitate learning, greater collaboration is necessary so that individuals can share expertise and knowledge to uncover the possibilities within their respective fields.

Furthermore, improving collaboration is crucial for addressing a wide range of areas, including prioritizing multimodal transportation, adopting new technology, and enhancing transfer nodes. Without collaboration, it becomes difficult to tackle these issues effectively. For instance, the introduction of updated technology for operating cranes or cargo tracking and tracing can help improve transfer nodes. However, implementing such technology requires increased collaboration between the responsible authorities and technical experts. Another example could be the goal of achieving sustainable transport which needs the collaboration of all transport modes. Similarly, adapting new technology, continuously improving, and prioritizing multimodal transportation also require increased collaboration among all involved parties.

Apart from the interviews, the literature review also identifies the area of increased collaboration as learning opportunity. The literature review highlighted the essential role of collaboration to reduce delay, waiting time and congestion (Jagienka, 2018) (Li & Nguyen, 2017).

5.1 Reflection from the interview

Some interviewees answer some of the questions. One explanation for not answering all questions is that they may need more knowledge or experience to provide a meaningful response to specific questions, so they skipped them.

Additionally, respondents may have skipped questions because maybe the question did not align with their personal preferences or biases. They might have felt more comfortable answering questions about their experiences or views.

Some respondents may have hesitated to provide their opinions on specific topics due to their concerns about confidentiality, fear of judgment, or lack of confidence.

Some respondents were too technical while answering the questions. If someone needs help explaining business concepts in a way that is easy to understand, it can make it easier to work with people who are not as knowledgeable in that field. This could lead to communication and collaboration issues.

Moreover, questions related to challenges and solutions received more attention than those questions about areas of learning opportunity. The individuals who were interviewed for this

study might have felt more at ease discussing how they overcame obstacles, as this could be seen as a sign of proficiency and capability. On the other hand, recognizing learning opportunities might be perceived as admitting a deficiency in knowledge or skills, which some people may find less desirable, related to the barrier of cultural beliefs and attitudes towards learning in the industry. Putting more emphasis on challenges and solutions indicates a preference for dealing with immediate issues instead of taking a proactive approach to learning and innovation.

Interestingly, some respondents were more willing to express their opinions on multiple areas beyond the given options. Some individuals may have a wide-ranging interest and possess knowledge across various field areas. This indicates their curiosity and willingness to learn beyond their specific domain, which is positive. However, some respondents may have felt compelled to share opinions on topics outside their primary focus to appear knowledgeable.

5.2 Limitations

One of the limitations was the availability of respondents. Initially, it took much work for the author to reach the contacts of relevant and required people. There could be a chance of the detection of the origin of the information because the sample size was small. Considering that some information was not disclosed. The challenge was maintaining the interviewees' anonymity because some answers were related to job positions.

One limitation is credibility. The thesis presents a case study of an association. The areas of learning opportunities for maritime could vary according to the other industry or company.

Furthermore, another area for improvement is the unavailability of published literature on learning opportunities. To overcome this limitation, learning opportunities in different sectors and the areas with the most learning opportunities were investigated separately.

All the interviews were in English, although neither the participants nor the interviewer were native speakers. Nevertheless, both interviewer and participants have proficiency in English.

6. Conclusion

The study has identified that legalization and congestion are two main challenges in managing transport within ITS. Regulations that are complex and ***unfavourable***, legal

restrictions, inconvenient policies, and conflicts between national and international law significantly hinder data sharing and maintaining an uninterrupted transportation system. On the other hand, congestion was identified as a primary challenge caused by the lack of infrastructure, rising demand, and minimal use of automation in works of literature. The variation in the result was due to the methodology, such as the interview is focused on specific associations. At the same time, the literature review covered a wide range of traffic management issues.

Collaboration was identified as a solution for addressing challenges. Collaboration and communication with legislative bodies at the national and international levels are the strategies that help to overcome the challenges. Besides, putting all stakeholders in the same room and identifying common drivers and barriers, collaborating with the technology to implement ITS solution, coordinating schedules for controlling systems, and establishing a safety regime were highlighted as collaboration strategies to deal with complex and multifaceted problems and challenges.

Additionally, the thesis finds out resistance to change, lack of interest in exploring new areas, and uncertainty regarding government regulations are the organizational and governance barrier. The barrier contributes to factors such as silo thinking and reluctance to adopt new technology, and less capability to think of potentiality.

Finally, these sub-research questions were analysed to answer the main research question, and the study found the importance and role of increasing collaboration. The study found that maritime has learning opportunities in collaboration within ITS. The increased collaboration covers areas such as multimodal, transfer node, and adaption of new technology. More learning and improvement in collaboration is required for a transportation system that prioritizes multimodality, has improved transfer node, improve continuously and adopt new technology.

To conclude, the thesis aims to explore learning opportunities in maritime operations. Therefore, it found the areas, such as ITS, barriers to learning and explored different perspectives of people with different backgrounds and learning methods. The result of this study will help to make ITS and maritime traffic about the importance of increasing collaboration.

6.1 Recommendation

From the study, observation, and literature review, there is a knowledge gap, and a lot can be done to overcome it and increase collaboration.

From the interviews, it is found that most of the participants are interested in technical developments and in sharing experiences from the technical point of view. From another interview, it was found that when there is a need to develop technology, the first thing that needs to be done is to experiment with the readiness level of people and the impact of introducing the new technology to society.

To increase interest and engagement in non-technical aspects, it is crucial to collaborate with social organizations. These organizations deeply understand the needs and challenges of specific communities. They can provide valuable insights into how technology can be designed and implemented in a way that benefits everyone. By partnering with social organizations, project owners can also ensure that the impact of their technology is optimistic and equitable and that any potential risks or negative consequences are identified and mitigated. In addition, social organizations can help communicate the technology's benefits to the wider community and encourage adoption and participation. Therefore, building strong relationships and partnerships with social organizations should be a key priority for anyone involved in technology development.

However, in addition to understanding the intended audience's needs, conducting a thorough legal analysis of the technology is important to ensure compliance with all applicable laws and regulations. This may involve seeking guidance from legal experts or regulatory agencies to ensure adherence to intellectual property laws, data privacy regulations, and other legal requirements.

To increase collaboration, it is crucial to shift the mindset of individuals working in the industry. This can be achieved by providing training and development opportunities, engaging with end-users to document their experiences, recruiting individuals from diverse cultural backgrounds to increase understanding of different perspectives, highlighting success stories of industries that have embraced learning and development, and investing in practical research and development.

By offering training and development programs, individuals can acquire new skills and knowledge to broaden their understanding and perspective. Engaging with end-users is also essential to gain insight into their needs and challenges and to ensure that technology solutions are designed with their needs in mind. Hiring individuals from diverse backgrounds can increase cultural awareness, promote inclusivity, and make people out of the box. At the same time, investment in practical research and development can lead to more innovative solutions that address real-world challenges.

Overall, changing the mindset of individuals working in the industry is essential for fostering collaboration and promoting innovation. By investing in training, engaging with end-users, promoting diversity, and investing in practical research and development, organizations can create a culture of collaboration and innovation that benefits the industry and society.

6.2 Issues for further research

The identified challenges had different outcomes, and it would be interesting to investigate whether the discrepancies were due to technology changes, policy changes, or contextual changes. Another effective avenue of investigation would be to compare the challenges identified in the study with those published in documents. The discrepancies suggest more project-specific research to identify and compare unique challenges.

The study focused on ITS with a relatively small sample of individuals working on different projects, and it would be valuable to conduct interviews in similar associations. The thesis also highlighted the need for research on learning opportunities, specifically cross-domain learning opportunities in the maritime industry, methods of learning, and adoption barriers for learning.

Reference

A review of the European Union shipping policy. (n.d.). https://doi.org/10.1080/03088830118389

AAMAS'20: Proceedings of the 19th International Conference on Autonomous Agents and MultiAgent Systems : May 9-13, 2020, Auckland, New Zealand. (2020). International Foundation for Autonomous Agents and Multiagent Systems (IFAAMAS).

Argote, L. (2011). Organizational learning research: Past, present and future. Management Learning, 42(4), 439–446. https://doi.org/10.1177/1350507611408217

Arumugam, A., Khazaei, H., Bhaumik, A., & Kanesan, T. (2022). Analysing the Factors Influencing Digital Technology Adoption in Manufacturing Sectors: Leadership Effectiveness as a Mediator. WSEAS TRANSACTIONS ON BUSINESS AND ECONOMICS, 19, 1764–1787. https://doi.org/10.37394/23207.2022.19.159

Ashokkumar, K., Sam, B., Arshadprabhu, R., & Britto. (2015). Cloud Based Intelligent Transport System. Procedia Computer Science, 50, 58–63. https://doi.org/10.1016/j.procs.2015.04.061

Avatefipour, O., & Sadry, F. (2018). Traffic Management System Using IoT Technology—A Comparative Review. 2018 IEEE International Conference on Electro/Information Technology (EIT), 1041–1047. https://doi.org/10.1109/EIT.2018.8500246

Azab, A., Karam, A., & Eltawil, A. (2017). A Dynamic and Collaborative Truck Appointment Management System in Container Terminals: Proceedings of the 6th International Conference on Operations Research and Enterprise Systems, 85–95. https://doi.org/10.5220/0006188100850095

Blumberg, B., Cooper, D., & Schindler, P. (2014). EBOOK: Business Research Methods. McGraw Hill.

Bryman, & Harley, B. (2022). Business research methods (Sixth edition). Oxford University Press.

Butta, T. L., & Abegaz, M. B. (n.d.). Challenges in the operation of multimodal transport system: The case of Ethiopian shipping and logistics services enterprise.

Caris, A., Limbourg, S., Macharis, C., van Lier, T., & Cools, M. (2014). Integration of inland waterway transport in the intermodal supply chain: A taxonomy of research challenges. Journal of Transport Geography, 41, 126–136. https://doi.org/10.1016/j.jtrangeo.2014.08.022

Chang, S.-J., Hsu, G.-Y., Yang, J.-A., Chen, K.-N., Chiu, Y.-F., & Chang, F.-T. (2010). Vessel Traffic Analysis for Maritime Intelligent Transportation System. 2010 IEEE 71st Vehicular Technology Conference, 1–4. https://doi.org/10.1109/VETECS.2010.5493942

Claes, R., Holvoet, T., & Gompel, J. V. (2010, September 1). Coordination in hierarchical pickup and delivery problems using delegate multi-agent systems.

https://www.semanticscholar.org/paper/Coordination-in-hierarchical-pickup-and-delivery-Claes-Holvoet/0ac6877d8d5202496e4363d3e065023668d70660

Coronado Mondragon, A. E., Lalwani, C. S., Coronado Mondragon, E. S., Coronado Mondragon, C. E., & Pawar, K. S. (2012). Intelligent transport systems in multimodal logistics: A case of role and contribution through wireless vehicular networks in a sea port location. International Journal of Production Economics, 137(1), 165–175. https://doi.org/10.1016/j.ijpe.2011.11.006

Coşar, A. K., & Demir, B. (2018). Shipping inside the box: Containerization and trade. Journal of International Economics, 114, 331–345. https://doi.org/10.1016/j.jinteco.2018.07.008

Dale, B. G. (1996). Sustaining a process of continuous improvement: Definition and key factors. The TQM Magazine, 8(2), 49–51. https://doi.org/10.1108/09544789610114867

de Souza, A. M., Brennand, C. A., Yokoyama, R. S., Donato, E. A., Madeira, E. R., & Villas, L. A. (2017). Traffic management systems: A classification, review, challenges, and future perspectives. International Journal of Distributed Sensor Networks, 13(4), 155014771668361. https://doi.org/10.1177/1550147716683612

de Waal, A., Weaver, M., Day, T., & van der Heijden, B. (2019). Silo-Busting: Overcoming the Greatest Threat to Organizational Performance. Sustainability, 11(23), Article 23. https://doi.org/10.3390/su11236860

Dongare, T., Huljute, D., Jadhav, P., Lad, A., & Marawar, Prof. S. (2023). A Review on Traffic Management and Road Analysis of Porwal Road. International Journal for Research in Applied Science and Engineering Technology, 11(1), 881–884. https://doi.org/10.22214/ijraset.2023.48508

Dresner, K., & Stone, P. (2004). Multiagent traffic management: A reservation-based intersection control mechanism. Proceedings of the Third International Joint Conference on Autonomous Agents and Multiagent Systems, 2004. AAMAS 2004., 530–537.

Dua, A., & Sinha, D. (2015). The Multimodal Transportation: Research Trend and Literature Review. Udyog Pragati, 39.

Ehlers, T., Portier, M., & Thoma, D. (2022). Automation of maritime shipping for more safety and environmental protection. At - Automatisierungstechnik, 70(5), 406–410. https://doi.org/10.1515/auto-2022-0003

Elo, S., & Kyngäs, H. (2008). The qualitative content analysis process. Journal of Advanced Nursing, 62(1), 107–115. https://doi.org/10.1111/j.1365-2648.2007.04569.x

EU stratetegy,2020. (n.d.). Retrieved May 10, 2023, from https://transport.ec.europa.eu/system/files/2021-04/2021-mobility-strategy-and-action-plan.pdf

Fiol, C. M., & Lyles, M. A. (2018). Organizational Learning.

Fonseca, T., Lagdami, K., & Schröder-Hinrichs, J.-U. (2021). Assessing innovation in transport: An application of the Technology Adoption (TechAdo) model to Maritime Autonomous Surface Ships (MASS). Transport Policy, 114, 182–195. https://doi.org/10.1016/j.tranpol.2021.09.005

Grote, M., Waterson, B., & Rudolph, F. (2021). The impact of strategic transport policies on future urban traffic management systems. Transport Policy, 110, 402–414. https://doi.org/10.1016/j.tranpol.2021.06.017

Hamilton, S. (2006). The Box: How the Shipping Container Made the World Smaller and the World Economy Bigger. By Marc Levinson. Princeton, N.J.: Princeton University Press, 2006. xii + 376 pp. Index, notes, bibliography, tables. Cloth, $24.95. ISBN: 0-691-12324-1. Business History Review, 80(4), 775–778. https://doi.org/10.2307/25097271

Harris, I., Wang, Y., & Wang, H. (2015). ICT in multimodal transport and technological trends: Unleashing potential for the future. International Journal of Production Economics, 159, 88–103. https://doi.org/10.1016/j.ijpe.2014.09.005

Hilde Meersman. (n.d.). Maritime Logistics: Contemporary Issues. Retrieved March 24, 2023, from https://web-p-ebscohost-com.ezproxy2.usn.no/ehost/ebookviewer/ebook/bmxlYmtfXzQzMjY3M19fQU41?sid=0b469060-4714-4372-9a0f-fe4aabc72a69@redis&vid=1&format=EB&rid=1

Hsu, C.-I., & Hsieh, Y.-P. (2007). Routing, ship size, and sailing frequency decision-making for a maritime hub-and-spoke container network. Mathematical and Computer Modelling, 45(7), 899–916. https://doi.org/10.1016/j.mcm.2006.08.012

Hu, Y., & Zhu, D. (2009). Empirical analysis of the worldwide maritime transportation network. Physica A: Statistical Mechanics and Its Applications, 388(10), 2061–2071. https://doi.org/10.1016/j.physa.2008.12.016

Hua, M., Pereira, F. C., Jiang, Y., & Chen, X. (2022). Transfer learning for cross-modal demand prediction of bike-share and public transit. https://doi.org/10.48550/ARXIV.2203.09279

Jagienka, R.-C. (2018). Stakeholders' Contribution in Coordination of Passengers' and Goods' Flows within the Urban Areas. European Journal of Sustainable Development, 7(4). https://doi.org/10.14207/ejsd.2018.v7n4p402

Kordnejad, B. (2014). Intermodal Transport Cost Model and Intermodal Distribution in Urban Freight. Procedia - Social and Behavioral Sciences, 125, 358–372. https://doi.org/10.1016/j.sbspro.2014.01.1480

Kozan, E. (2000). Optimising container transfers at multimodal terminals. Mathematical and Computer Modelling, 31(10–12), 235–243. https://doi.org/10.1016/S0895-7177(00)00092-3

Kwiatkowska-Sienkiewicz, K. (2011). Development and Standardization of Intelligent Transport Systems. In Transport Systems and Processes. CRC Press.

Li, M., & Nguyen, B. (2017). When will firms share information and collaborate to achieve innovation? A review of collaboration strategies. The Bottom Line, 30(1), 65–86. https://doi.org/10.1108/BL-12-2016-0039

Liachovičius, E., & Skrickij, V. (2020). The Challenges and Opportunities for Road Freight Transport. In K. Gopalakrishnan, O. Prentkovskis, I. Jackiva, & R. Junevičius (Eds.), TRANSBALTICA XI: Transportation Science and Technology (pp. 455–465). Springer International Publishing. https://doi.org/10.1007/978-3-030-38666-5_48

Lind, M., Hägg, M., Siwe, U., & Haraldson, S. (2016). Sea Traffic Management – Beneficial for All Maritime Stakeholders. Transportation Research Procedia, 14, 183–192. https://doi.org/10.1016/j.trpro.2016.05.054

Lipshitz, R., Popper, M., & Friedman, V. J. (2002). A Multifacet Model of Organizational Learning. The Journal of Applied Behavioral Science, 38(1), 78–98. https://doi.org/10.1177/0021886302381005

Mahajan, M., & Sarjit Singh, M. K. (2017). Importance and Benefits of Learning Outcomes. IOSR Journal of Humanities and Social Science, 22, 65–67. https://doi.org/10.9790/0837-2203056567

Mandhare, P., Kharat, V., & Patil, C. Y. (2018). Intelligent Road Traffic Control System for Traffic Congestion A Perspective. International Journal of Computer Sciences and Engineering, 6, 908–915. https://doi.org/10.26438/ijcse/v6i7.908915

Naumov, V., & Samchuk, G. (2017). Class Library for Simulations of Passenger Transfer Nodes as Elements of the Public Transport System. Procedia Engineering, 187, 77–81. https://doi.org/10.1016/j.proeng.2017.04.352

Nikola. (2021). Challenges To The Multimodal Transport Networks Based On Sustainable Growth In The Volume Of Containerized Cargoes. Pedagogika-Pedagogy, 93(7s), 53–64. https://doi.org/10.53656/ped21-7s.04chal

O'Kelly, M. E., & Miller, H. J. (1994). The hub network design problem. Journal of Transport Geography, 2(1), 31–40. https://doi.org/10.1016/0966-6923(94)90032-9

Pamucar, D., Deveci, M., Gokasar, I., Martínez, L., & Köppen, M. (2022). Prioritizing transport planning strategies for freight companies towards zero carbon emission using ordinal priority approach. Computers & Industrial Engineering, 169, 108259. https://doi.org/10.1016/j.cie.2022.108259

Papadimitriou, E., Schneider, C., Aguinaga Tello, J., Damen, W., Lomba Vrouenraets, M., & ten Broeke, A. (2020). Transport safety and human factors in the era of automation: What can transport modes learn from each other? Accident Analysis & Prevention, 144, 105656. https://doi.org/10.1016/j.aap.2020.105656

Papageorgiou, M., Diakaki, C., Dinopoulou, V., Kotsialos, A., & Wang, Y. (2003). Review of road traffic control strategies. Proceedings of the IEEE, 91(12), 2043–2067. https://doi.org/10.1109/JPROC.2003.819610

Pazouki, K., Forbes, N., Norman, R. A., & Woodward, M. D. (2018). Investigation on the impact of human-automation interaction in maritime operations. Ocean Engineering, 153, 297–304. https://doi.org/10.1016/j.oceaneng.2018.01.103

Performance of Maritime Logistics. (n.d.). Retrieved March 15, 2023, from https://www.itf-oecd.org/sites/default/files/docs/performance-maritime-logistics.pdf

Pietrzykowski, Z. (2010a). Maritime Intelligent Transport Systems. In J. Mikulski (Ed.), Transport Systems Telematics (Vol. 104, pp. 455–462). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-16472-9_50

Pietrzykowski, Z. (2010b). Maritime Intelligent Transport Systems. In J. Mikulski (Ed.), Transport Systems Telematics (pp. 455–462). Springer. https://doi.org/10.1007/978-3-642-16472-9_50

Praetorius, G., & Hollnagel, E. (2014). Control and Resilience Within the Maritime Traffic Management Domain. Journal of Cognitive Engineering and Decision Making, 8(4), 303–317. https://doi.org/10.1177/1555343414560022

Praetorius, G., van Westrenen, F., Mitchell, D. L., & Hollnagel, E. (2012). Learning lessons in resilient traffic management: A cross-domain study of Vessel Traffic Service and Air Traffic Control. https://lnu.diva-portal.org/smash/record.jsf?dswid=1008 & pid=diva2%3A1084977.

Raza, Z., Woxenius, J., Vural, C. A., & Lind, M. (2023). Digital transformation of maritime logistics: Exploring trends in the liner shipping segment. Computers in Industry, 145, 103811. https://doi.org/10.1016/j.compind.2022.103811

Reilly, A. J. (1998). „ , THREE APPROACHES TO. 16.

Reis, V., Fabian Meier, J., Pace, G., & Palacin, R. (2013). Rail and multi-modal transport. Research in Transportation Economics, 41(1), 17–30. https://doi.org/10.1016/j.retrec.2012.10.005

Rodrigue, J.-P. (2020). The Geography of Transport Systems. Routledge.

Rudolph, F., & Mátrai, T. (2018a). Congestion from a Multimodal Perspective. Periodica Polytechnica Transportation Engineering. https://doi.org/10.3311/PPtr.12048

Rudolph, F., & Mátrai, T. (2018b). Congestion from a Multimodal Perspective. Periodica Polytechnica Transportation Engineering. https://doi.org/10.3311/PPtr.12048

Salkham, A., Cunningham, R., Garg, A., & Cahill, V. (2008). A Collaborative Reinforcement Learning Approach to Urban Traffic Control Optimization. 2008 IEEE/WIC/ACM International Conference on Web Intelligence and Intelligent Agent Technology, 2, 560–566. https://doi.org/10.1109/WIIAT.2008.88

Sanchez-Gonzalez, P.-L., Díaz-Gutiérrez, D., Leo, T., & Núñez-Rivas, L. (2019). Toward Digitalization of Maritime Transport? Sensors, 19(4), 926. https://doi.org/10.3390/s19040926

Seifi, M., Dellaert, N. P., Nuijten, W., Van Woensel, T., & Raoufi, R. (2014). Multimodal freight transportation planning: A literature review. European Journal of Operational Research, 233(1), 1–15. https://doi.org/10.1016/j.ejor.2013.06.055

Shahgholian, & Gharavian. (2018). Advanced Traffic Management Systems: An Overview and A Development Strategy. https://arxiv.org/ftp/arxiv/papers/1810/1810.02530.pdf

Shakil, S. M., & Mostafa, K. A. (n.d.). An Analysis of the Advantages and Disadvantages of Using a Multimodal Transport System in the Carriage of Goods.

Shukla, S. (2020, June 25). CONCEPT OF POPULATION AND SAMPLE.

Singh, A. J., Kumar, A., & Lau, H. C. (2020). Hierarchical multiagent reinforcement learning for maritime traffic management. New Zealand.

Sokovic, M., Šaković Jovanović, J., Krivokapic, Z., & Vujovic, A. (2009). Basic Quality Tools in Continuous Improvement Process. Strojniski Vestnik, 55, 333–341.

Song, D.-W., & Panayides, P. (2012). Maritime Logistics: A Complete Guide to Effective Shipping and Port Management. Kogan Page Publishers.

Straub, E. T. (2009). Understanding Technology Adoption: Theory and Future Directions for Informal Learning. Review of Educational Research, 79(2), 625–649. https://doi.org/10.3102/0034654308325896

US EPA, O. (2016, September 18). Ports Primer: 2.1 The Role of Ports [Overviews and Factsheets]. https://www.epa.gov/community-port-collaboration/ports-primer-21-role-ports

Van, F., & Praetorius, G. (2014). Maritime Traffic Management: A Need for Central Coordination? Cognition, Technology & Work, 16(1), 59–70. https://doi.org/10.1007/s10111-012-0244-5

Vojtek, M., Skrucany, T., Kendra, M., & Ponicky, J. (2018). Methodology for calculation of minimum transfer time in the transport hub. MATEC Web of Conferences, 235, 00015. https://doi.org/10.1051/matecconf/201823500015

Wan, S., & Luan, W. (2022). Hinterland evolution and port growth decomposition: The case of Shanghai. Journal of Transport Geography, 100, 103334. https://doi.org/10.1016/j.jtrangeo.2022.103334

Wang, Z. (2001). Internet Traffic Engineering. In Internet QoS (pp. 179–208). Elsevier. https://doi.org/10.1016/B978-155860608-1/50005-3

Wolf, S., Teitge, J., Mielke, J., Schütze, F., & Jaeger, C. (2021). The European Green Deal—More Than Climate Neutrality. Intereconomics, 56(2), 99–107. https://doi.org/10.1007/s10272-021-0963-z

Xu, W., Huang, J., & Qiu, Y. (2021). Study on the Optimization of Hub-and-Spoke Logistics Network regarding Traffic Congestion. Journal of Advanced Transportation, 2021, 1–16. https://doi.org/10.1155/2021/8711964

Yuen, K. F., Thai, V. V., & Wong, Y. D. (2016). The effect of continuous improvement capacity on the relationship between of corporate social performance and business performance in maritime transport in Singapore. Transportation Research Part E: Logistics and Transportation Review, 95, 62–75. https://doi.org/10.1016/j.tre.2016.09.003

Zear, A., Kumar Singh, P., & Singh, Y. (2016). Intelligent Transport System: A Progressive Review. Indian Journal of Science and Technology, 9(32). https://doi.org/10.17485/ijst/2016/v9i32/100713

Zhuang, F., Luo, P., Xiong, H., Xiong, Y., He, Q., & Shi, Z. (2010). Cross-Domain Learning from Multiple Sources: A Consensus Regularization Perspective. IEEE Transactions on Knowledge and Data Engineering, 22(12), 1664–1678. https://doi.org/10.1109/TKDE.2009.205

Appendix A

Interview guide

1. Introduction – Traffic management and Intelligent transport system

(a) Could you please briefly introduce yourself and your current position?

(b) What is your personal and professional experience with ITS?

(c) What does ITS mean to you? Please name a few concepts that come to mind when you hear "ITS"?

2. Challenges and strategies.

(a) What was the challenge in your project?

(b) What are your most common solutions to overcome these challenges?

3. Learnings opportunities

(a) What do you think about the following areas as learning opportunities?

- Continuous improvement
- Adaption of new technology
- Prioritization of multimodal
- Improvement of transfer nodes
- Increased collaboration.

(b) In your expert view, which of the above areas presents the most significant learning opportunity?

(c) What do you think about following learning methods in the projects

- Learning from other
- Experiment

- Experience

(d) In your expert opinion, which learning method do you consider to be the most suitable for learning?

4. Barriers to learning and strategies

Could you kindly elaborate on how the following barriers can potentially impede the adoption of learning within an organization:

- Organizational/Governance barriers, such as people and culture and a centralized structure
- Operational barriers, including a lack of resources and capabilities and the complexity of systems.
- Technical barriers, such as a lack of standardization and outdated systems.

Appendix B

Sikt

Notification form / Learning opportunities of maritime operations from different modes o... / Export

Notification form

Reference number

534828

What personal data will you process?

- Name (also with signature/consent)
- Email address, IP address or other online identifier
- Pictures or video recordings of people
- Audio recordings of people

Project information

87

Project title

Learning opportunities of maritime operations from different modes of transportation within ITS.

Project description

The thesis aims to investigate how maritime transportation can learn from other modes of transportation within ITS, such as road, and rail transportation, to improve operation in terms of congestion, safety, and sustainability.

Justify why it is necessary to process the personal data

The personal data is for the project

External financing

Not completed

Type of project

Student project, master's study

Contact information, student

Farzana Akter, akterfarzana223@gmail.com, tel: +4746572692

Processing responsibility

Institution responsible for processing

The University of Southeast Norway / Faculty of Technology, Natural Sciences and Maritime Studies / Department of Maritime Operations

Project manager (scientific employee/supervisor or research fellow)

Marius Imset, Marius.Imset@usn.no, tel: 97145212

Should processing responsibility be shared with other institutions (joint processors)? No

Selection 1

Describe the selection

Online meeting

Describe how recruitment or selection of the selection takes place

Online meetings in teams should be held for discussion

Age

35 - 45

Personal information for selection 1

How do you collect data from sample 1?

Personal interview

Attachments

Interview guide.docx

Basis for processing general categories of personal data Consent (Privacy Regulation art. 6 no. 1 letter a)

Information for selection 1

Do you inform the committee about the processing of personal data? Yes

How?

Written information (paper or electronic)

89

Information letter

Confidentiality and NDA form.docx

Third parties

Are you going to process personal data about third parties? No

Documentation

How is the consent documented?

- Electronic (email, e-form, digital signature)

How can consent be withdrawn?

By email

How can the data subjects access, correct or delete personal data about themselves?

By email

Total number registered in the project

1-99

Permissions

Do you need to obtain the following approvals or permits for the project?

Not completed

Treatment

90

Where is the personal data processed?

- Private devices

Who processes/has access to the personal data?

- Student (student project)

Are the personal data made available outside the EU/EEA to a third country or international organisation?

No

Safety

Is the personal data stored separately from other data (connection key)?

Yes

What technical and physical measures secure the personal data?

- The personal information is continuously anonymised
-
- The information is encrypted during shipment

The information is encrypted during storage

Duration

Project period

01.01.2023 - 17.05.2023

What happens to the data at the end of the project?

Data is deleted (deletes the raw data)

Will the registered people be able to be identified (directly or indirectly) in the thesis/dissertation/other publications from the project? No

Additional information