WORLD MARITIME UNIVERSITY

# DISSERTATION

# SYNCHROMODALITY:

## Acknowledging Logistics Service Provider Views of The Practicability, Transformation, and Decision-Maker Role.

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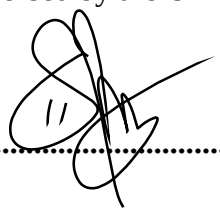
A dissertation submitted to the World Maritime University in partial fulfillment of the requirements for the award of the degree of Master of Science in Maritime Affairs 2023.

# Declaration

I certify that all the material in this dissertation that is not my own work has been identified and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views and are not necessarily endorsed by the University.

(Signature):  **.....**

(Date): **26 September 2023**

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## Acknowledgments

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And lastly, I thank the participant and maritime expert who helped me with the data collection and interviews.

# Abstract

Title of Dissertation:

**Synchromodality: Acknowledging Logistics Service Provider Views of The Practicability, Transformation, and Decision-Maker Role.**

Degree: **Master of Science**

To acknowledge and examine the views regarding the practicability, transformation, and decision-maker role within synchromodality is the highlight of this study, explicitly withing logistics service providers' context as the possible actors for the concept. This includes the views relating to constraints, enablers, barriers, drivers, prerequisites, and new features based on the current conditions of the logistics service providers.

The study combines a systematic literature review to analyze the final sample of 92 publications related to synchromodality, transformation, and decision-making and semi-structured interviews to gain logistics service providers' views as written in the objectives. It identifies that the shift from intermodality into synchromodality is practically possible with the adoption of advanced technologies, collaboration of involved parties, and the physical internet as an enabler. This study contributes to the body knowledge of this field by examining the views of logistics service providers towards the practicability, transformation, and decision-maker role of the concept.

As there has been minimal practical implementation in the business so far, and as there is also very little literature on the subject, the study emphasizes applicable limits when exploring a developing idea like synchromodality. In its conclusion, the report suggests various topics for more investigation in this area.

**KEYWORDS**: Synchromodality, Synchromodal Transport, Intermodality, Logistics Service Provider, Decision-Maker, Transformation, Practicability, Operational.

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# List of Abbreviation

| | |
|---|---|
| ALICE | : Alliance for Logistics Innovations Through Collaboration in Europe |
| ANP | : Analytic Network Process |
| CIMO | : Context, Intervention, Mechanism, Outcome |
| CSCMP | : Council of Supply Chain Management Professionals |
| DINALOG | : Dutch Institute for Advanced Logistics Information |
| ECT | : European Container Terminal |
| EGS | : European Gateway Services |
| EGT | : European Gateway Terminal |
| ETP | : European Technology Platform |
| ISO | : International Organization for Standardization |
| IT | : Information Technology |
| KPI | : Key Performance Indicators |
| LSP | : Logistics Service Provider |
| PI | : Physical Internet |
| RQ | : Research Questions |

# Chapter 1: Introduction

## 1.1 Background and Problem Statement

Synchromodality is considered a future upgrade of the intermodal transport system, which offers flexibility in transport mode booking and shifting supported by real-time information (Zhang & Pel, 2016; Brümmerstedt et al., 2017; Duin et al., 2019). To a logistic extent, synchromodality is also defined as a concept that expects to improve the share of rail and waterway services in near real-time shifts (Putz et al., 2015).

This concept has a promising chance of addressing some supply chain activities with more options in transportation modes, which is supported by new features, such as real-time information, flexibility, cooperation and coordination, and synchronization (Dong et al., 2017; Giusti et al., 2019).

Another flexibility term is highlighted by Verweij (2011) in changing transport modes, which can shift from one transport mode to another in a particular schedule when the consignment is in transit. This change can be held while still meeting the service and cost requirements (Dong et al., 2017). The utilization of several transport modes detailed by Behdani et al. (2016) and Tavasszy et al. (2015), where freight has a particular route in a possibility of fulfilling a similar order but then departed different modes.

In its infancy, this concept aims to integrate transport services and modes and develop cooperation among them to add the possibilities of service operators in providing better transport alternatives to the shippers by utilizing multiple services of multiple modes. The Dutch logistics sector has had a theory about this system's beneficial purpose in decreasing delivery costs, providing better capacity utilization of each method, and creating a more reliable transport system that considers the impacts of buffering between the various modes (Zhang & Pel, 2016).

However, to the best of the author's knowledge, the view of the practicability of the concept in general, the view regarding transformation from intermodality to synchromodality, and the decision-maker role for this concept from the logistics service provider, port, and terminal operator in an intermodal logistics network are still in no possession of literature. Therefore, the author would like to fill this knowledge gap by researching this matter with the aim, objectives, and research questions explained in the following points.

Thus, future research related to knowledge span, transformation factors, and decision-maker role may be extended along with the popularity of this concept.

## 1.2 Research questions, aim, and objectives

The research aims to examine the practicability of the synchromodality concept in general, the challenges of transforming from intermodality to synchromodality, and the likelihood of a logistics service provider being appointed/supported to be the decision-maker by the other logistics service providers in an intermodal logistics network. The research questions are proposed as follows:

1. What are the views of logistics service providers in an intermodal logistics network about the practicability of the synchromodality concept in general?

   This RQ will be handled by interviewing logistics service providers in an intermodal logistics network to acknowledge their views on the practicability of the synchromodality concept in general.

2. What are the views of logistics service providers in an intermodal logistics network about the possibility of transformation from intermodality to synchromodality concept?

   This RQ will be handled by interviewing logistics service providers in an intermodal logistics network to understand their views about the transformation from intermodality to synchromodality. A thorough explanation will be given before the interview to provide a comprehensive and clear understanding of the synchromodality concept.

3. Given the need for a decision-maker role, how likely can logistics service providers in an intermodal logistics network be the decision-makers in the synchromodality concept? Please provide the reasoning.

   Continuing the previous RQ, this will be handled by interviewing logistics service providers and port and terminal operators to understand the likelihood of a logistics service provider/port/terminal being appointed as a decision-maker.

The objectives are proposed as follows:

1. To acknowledge the views of logistics service providers, port, and terminal operators in an intermodal logistics network about the practicability of the synchromodality concept in general.
2. To acknowledge the views of logistics service providers, port, and terminal operators in an intermodal logistics network about the possibility of transformation from intermodality to synchromodality based on the current condition in their logistics company/port/terminal.
3. To acknowledge the likelihood of logistics service providers/port/terminal operators in an intermodal logistics network being appointed decision-makers.

## 1.3 Research Scope and Limitations

Since synchromodality is still in its infancy and has no full implementation, this study will measure the views from logistics service providers in an intermodal logistics network within countries where synchromodality was first pilot-studied and implemented: Belgium and the Netherlands.

## 1.4 Dissertation Structure

The remainder of this dissertation is structured as Chapter 2 presents the literature review, Chapter 3 discusses the research methods, Chapter 4 contains data analysis and findings, and Chapter 5 concludes the study along with future research recommendations.

# Chapter 2: Literature Review

## 2.1 Intermodality

Intermodalism refers to the movement of goods or materials via several transport modes with prior integration (Jaffee, 2010).

It is an innovative technology in revolutionizing spatial distribution activities, the economic role of transport nodes, and the functioning of the logistics chain; intermodality is also expected to enlarge the economies scale in transport industries is expected to be expanded through this transport system (Roson & Soriani, 2000).

Song and Panayides (2022) mentioned that there are two sides of intermodality development:

a. Supply

   The greatest movement in intermodal transport history was containerization. The two significant subjects affected by this movement are transshipment costs and time, both of which were decreased in numbers by the standardization of transport devices. Additionally, intermodal development has benefited from the increasing size of container ships and improved port facilities.

b. Demand

   The spread of shippers' locations has contributed to the development of intermodal by extending their inland areas and transport demand. These subjects have widened from port-to-port to door-to-door.

Another to add, to ease the comprehensive understanding of intermodality growth, Goletz et al. (2020) defined some supporting factors clustered into three as follows:

a. Societal changes and trends
b. New mobility forms and services

c. Individual motives related to the use of intermodal transport

According to Song and Panayides (2022), as a modal split, intermodality consists of the following components:

1. Collection
2. Trunk line
3. Distribution using standardized containers

The general components are clustered into sea-road transport modes and sea-road-another mode transport modes, depicted as follows:

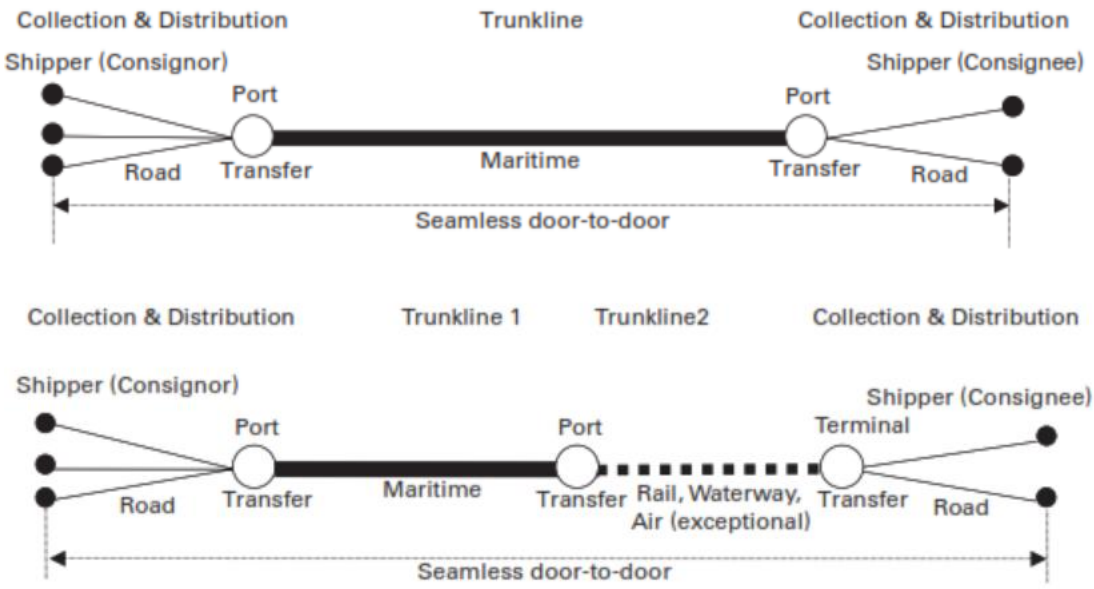


*Figure 1 Components of intermodal transport by sea, road, and other modes (Song & Panayides, 2022).*

The trunkline is usually dedicated to maritime transport, and both collection and distribution are done by road transport. In terms of long-distance delivery, road transport is generally replaced by rail and inland waterways.

From time to time, intermodality has caught quite the attention of players within this network; the advantages of this modal split range from an environmental-friendly format to balancing transport ways, overall transportation cost reduction,

improved efficiency in transport operations, faster and more flexible door-to-door delivery (Roson & Soriani, 2000; Bohács et al., 2013; Lee, 2016; Goletz et al., 2020). In addition, the advantages of intermodality are divided into benefited parties (Song & Panayides, 2022) :

a) Shippers, it is easier for them to arrange seamless door-to-door transportation and
b) In intermodal transport, the operator will handle accident risk regardless of the transport modes. Intermodality also offers consolidation, leading to economies of scale and transport cost reduction.

In the future, backed up by the features, advantages, and reasonings related to vehicle ownership and mobility patterns, the share of intermodal mobility usage will likely increase (Goletz, 2020). Other than in development matters, the demand and supply sides are defined as well (Song & Panayides, 2022) :

a) Supply

   The growth of ISO containers is likely to rise in the future of intermodal transport. The service quality improvement of intermodal infrastructure in the United States and Europe is expected to be enhanced. Intermodal infrastructure, in this term, refers to the transshipment facilities and tackling missing transport links.

b) Demand

   On the demand side, the future of intermodal transport is backed by the variations in shippers' needs that vary from time to time. It then directs the alternative intermodal transport routes, leading to costs and various modes of transport.

## 2.2 Intermodal Logistics Network

An intermodal logistics network is a network that consists of goods transportation utilizing multiple transport modes from the origin to the destination in a seamless manner using an intermodal container (Warsing et al., 2001).

Besides utilizing various transport modes, Guilbault (2016) mentioned that this network allows for the efficient movement of goods across geographically dispersed locations while minimizing cost and maximizing speed and reliability. The fundamental focus of this network is to handle global-scale shipments with sensible time and reasonable prices within limited transportation infrastructure, transfer points, and cost structure.

Ishfaq and Sox (2010) defined the difference between this transport system and the traditional road-based transportation system lies in the number of transport modes used and the location of the hub-spoke network structures. The hub positioning depends on consideration factors, such as flows between origins and destinations within the network's service, the transportation cost, economies-of-scale, service time performance, modal connectivity, and fixed costs.
Additionally, the sensitivity change level from both networks is different. An intermodal logistics network is more sensitive to changes in service requirements and costs than the traditional transportation system due to its hub and spoke network structure and several transport modes. On the other hand, conventional transport modes deliver goods right from the origin to the destination.

In maximizing the function of the intermodal logistics network, some of the challenges are faced by the involved parties, such as the performance of individual elements and interaction quality among involved parties regarding operations, information, and decisions (Bektas & Crainic, 2007).
To tackle the abovementioned issues, knowledge exchange between players within the network is encouraged; one of the goals is to avoid documentation duplication and maximize data processing procedures, resulting in better logistics network integration (Lee, 2016).

Related to socioeconomic and environmental sustainability, this logistics network has contributed by optimizing the use of several-mode-based transport systems in providing cost-efficient and effective transport systems through customer-oriented and door-to-door services in favor of competition among transport operators (Kayikci, 2010).

## 2.3 Logistics Service Provider

As quoted by Akman & Baynal (2014), defined by the Council of Logistics Management, logistics is a chain of processes including planning, implementing, and controlling of raw materials, in-process inventory, finished goods, and related information starting from origin-destination to consumption to satisfy the customers' needs in a way that considers efficiency, cost-effectiveness flow, and storage.

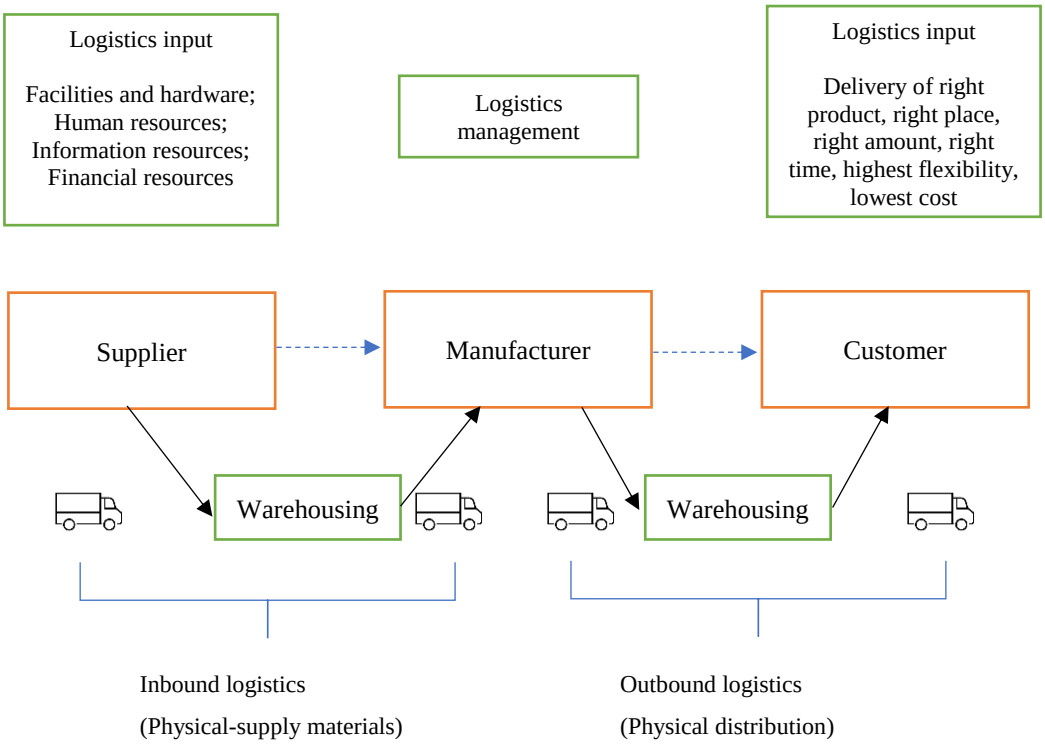


*Figure 2 Logistics management (CSCMP, 2006)*

Within logistics, a logistics service provider provides logistics functions on behalf of the clients, ranging from transportation, warehousing, inventory management,

and supply chain coordination (Song & Panayides, 2005). They also play a crucial role in improving supply chain performance by ensuring the timely and efficient flow of goods and information. They are increasingly influential in supply chains as businesses outsource their logistics to specialized providers.

Logistics service providers can act as intermediaries in sustainable development by mobilizing skills in planning, organizing, and relating to one another while considering stakeholders and coordinating the supply chain management (Monnet, 2008).

Selecting the right logistics service provider is a crucial and meticulous step in developing logistics in a maximized manner. A comparative study by Jharkharia and Shankar (2007) determined four determinants clustered from the overall weighted index in the selection process of logistics service providers through an analytic network process (ANP) :

1. Compatibility
2. Cost
3. Quality
4. Reputation

These determinants are then classified into four dimensions as consideration factors to examine the quality of a logistics service provider:

1. Information sharing
2. IT capability
3. Size and quality of fixed assets
4. Experience in similar products

In the selection process itself, it is vital to notice that the process includes qualitative and quantitative methods, which can potentially conflict with each other regardless of their significance in supporting the competitiveness growth at the company level (Akman & Baynal, 2014).

Suitable selection of logistics services provider will favor the quality of logistics services provided, as Ercan & Çelik (2021) mentioned that the quality of logistics services is one of the enablers of a company's in reaching their goals.

Another to add, is that logistics services quality is frequently linked to the quality of information, order processes, timelines, and accuracy of order (Karadeniz & Başaran, 2014).

To answer order processes and achieve high accuracy in fulfilling orders, logistics flexibility is a vital factor in having a dynamic move in a multidimensional and difficult-to-handle term to quickly adapt to consumers' needs in terms of supply, support, and operations (Zhang et al., 2002; Ercan & Çelik, 2021).

In addition, as consumer demands keep evolving in shipping, assistance, and services in both inbound and outbound terms, it is essential to properly manage the loop by building good coordination between incoming and outcoming packages, manufacturing assistance, and information (Zhang et al., 2005).

Thus, it can be concluded that flexibility is a supporting factor for a logistics service provider in coping with future demands and innovation in transport systems in a logistical manner. This circumstance is also supported by Gil Saura et al. (2008), who said that logistics flexibility may increase customer service and operational efficiency.

## 2.4 Synchromodality

### 2.4.1 Definition

Synchromodality is considered the future upgrade of the intermodal transport system, which offers flexibility in transport mode booking and shifting supported by real-time information (Zhang & Pel, 2016; Brümmerstedt et al., 2017; van Duin et al., 2019). It is also regarded as the problem-solver of congestion and declining reliability of services and environmental concerns prompted by international trade and cargo demand (ETP-ALICE, 2018).

The flexibility in this concept supports the transport chain to be adjusted according to infrastructure capacity and condition (Brümmerstedt et al., 2017). Compared to intermodality and co-modality, this concept is one step further as it brings the network to adjust the dynamics environment (Acero et al., 2021).

Dutch Institute for Advanced Logistics (DINALOG) gave a proposed definition of synchromodality as a transportation modal with the term where shippers and service operators have an agreement on product delivery with a set of cost, quality, and sustainability specified in advance and freedom of delivery mode according to agreed upon specifications (Dinalog, 2015).

This concept is predicted to be a center of interest to improve transport modalities sustainability and modal shift, giving more efficiency in cost and resource, reliability, and resilience in transports (Rentschler et al., 2022).

### 2.4.2 Development

Piloted in 2010 in the Port of Rotterdam with the European Container Terminal as the terminal operator, synchromodality aims to integrate transport services and modes and develop cooperation among them to add the possibilities of service operators in providing better transport alternatives to the shippers by utilizing multiple services of multiple methods. The Dutch logistics sector has had a theory about this system's beneficial purpose in decreasing delivery costs, providing better capacity utilization of each mode, and creating a more reliable transport system that considers the impacts of buffering between the various modes (Zhang & Pel, 2016).

Two years after Dinalog proposed a definition of synchromodality, Brümmerstedt et al. (2017) arranged some realization aims as follows:

1. Decreasing total costs of handling, transport, storage, capital commitment, and charges
2. Decreasing logistics costs other than the ones mentioned above through:
    a. Enhanced resilience in the maritime pre and post – haul
    b. Enhanced reliability in the maritime pre and post – haul
    c. Improved flexibility in the maritime pre and post – haul
    d. Enhanced responsiveness in the maritime pre and post – haul
    e. Enhanced service quality in the whole maritime transport chain
3. Increasing sustainability in the entire maritime transport chain
4. Coping in the growth of transport volumes through improving the use of infrastructure.

Brümmerstedt et al. (2017) also used the Port of Rotterdam as one of its case study subjects; they mentioned that the Port of Rotterdam did a self-brand as a synchromodality port with European Gateway Services (EGS) acting as the hinterland transport organizer. Extended Gateway Terminals (EGT) and the adapted customs legislation made it possible to pass customs audits for container transport.

Nevertheless, their network was considered too small since not all hinterlands could be organized in a synchromodal way. Furthermore, the logistics service provider was a subsidiary of ECT, which meant neither collaboration nor competition existed between the different logistics service providers. Thus, for the Port of Rotterdam, synchromodality was only for some geographic areas with a solo organizational entity. These circumstances made the Port of Rotterdam adaptable to future changes.

### 2.4.3 Prerequisites

Some system prerequisites also mentioned by Brümmerstedt et al. (2017) in a similar study, based on several kinds of research related to the synchromodality concept:

1. Physical network/connections: This prerequisite is a dense and reliable network of nodes consisting of seaports, multimodal hinterland terminals, and inland ports. Also, transport links such as roads, railways, and inland waterways are considered part of physical prerequisites (Douma et al., 2012; Tavasszy et al., 2017).
2. Real-time data/(partly) automated transport planning, due to the uncertainty of traffic at terminals or en route, resource limitations, and modal capacities (SteadieSeifi et al., 2014, p.14), real-time data is considered a significant prerequisite for synchromodality. Real-time data can also share up-to-date information and communication (ECT, 2011; van Wijk et al., 2011; Pleszko, 2012; Behdani et al., 2014; Tavasszy et al., 2017).
3. Collaborative networks/trust, in supporting synchromodality, require that involved parties have the willingness to share real-time data and collaboration between shippers and logistics service providers (Verweij, 2011; Douma et al., 2012; Pleszko, 2012; Behdani et al., 2014; Tavasszy et al., 2017).

   The mechanism in information exchange may help actors within the concept to build trust with each other (Mason et al., 2007; Pleszko, 2012; Pomponi et al., 2015). Another prerequisite related to this aspect is that synchromodality has different business initiation since the organization of the transport chain is not determined in advance (van Wijk et al., 2011; Douma et al., 2012; Reis, 2015; Tavasszy et al., 2017).
4. Legal and political network conditions to support the system working, existing transportation rules must be compatible with the system's requirements, and interfering regulations and laws must be minimized. Another to add is that a legal framework in liability and

liability transfer must be renewed (van Wijk et al., 2011; Pleszko, 2012; Tavasszy et al., 2017).

### 2.4.4 Enablers and Barriers

During its development, the synchromodality concept caught quite the attention. Tavassy et al. (2017) studied some of the possible enablers and barriers to this concept:

1. Transaction

   The fundamental change from intermodality to synchromodality is that shippers are not required to fix the transport mode. This shifting prompted changes in contractual matters, and they are expected to be the enablers in the transaction process. Barriers in this section are mainly related to business models and the adaptation towards data access, processing, and sharing.

2. Governance

   Intervention from the government to benefit the system can emerge through data and message standardization and harmonization in information systems. The difficulty in orchestrating different operations within the concept is a form of challenge in synchromodality; this will lead to another problem in the transport chain performance in case failure in coordinating happens.

3. Institutional

   The conventional cultures of small businesses involved in the service sector, which do not welcome innovative applications, and a lack of enthusiasm for sharing information, seen as a crucial component in this concept, are institutional-related concerns that significantly impact synchromodality. These barriers can become institutional enablers using distributed information brokerage with peer-to-peer information systems.

4. Cultural

   The mental shift from mode-based to service-based transport services must be familiarized between shippers and transport service providers in different modes. Without this mental Shift, one modality to another will only see each other as a competitor, and this culture will be another barrier to the system. On the contrary, this mental form will be a significant cultural enabler for synchromodality.

### 2.4.5 Benefits and Challenges

An infant concept always comes with benefits and challenges; Shang et al. (2010) classified them into business and public challenges. It needs to be noted that the following challenges are not threats to this concept's advantages.

a. Business Challenge
   i. In network design organizations, this challenge relates to bundling volumes, adjusting business models, and sharing the benefits and costs.
   ii. Control tower organizations, this issue requires intensive cooperation, information that is available comprehensively, developing decision models, and prime communication.
   iii. Bookings and planning are required to tackle this challenge, jointly booking and planning by all involved parties.
   iv. Creation of flexibility: Despite improvement in the transport modes' utility, flexibility remains a problem in this concept.

b. Public challenge
   i. Modal split influence, related to suitable preconditions and incentives for the required hinterland modes, must be followed by all involved parties.
   ii. Integrated planning to optimize information exchange in supporting real-time data, precise infrastructure, and active participation

by the government is in demand. Facilitating co-education is another obligation for the government to develop integrated planning.

iii. Realization of a core network, a decent core network can be achieved through stimulation of trimodal network development with a specific location of the hinterland terminal. The mentioned terminal has to connect three parties: municipal, county, and state. Legal framework with neighboring countries is another addition to this concept.

iv. Synchromodal frame, creating an equal legal approach for road, rail, inland waterway, air, and maritime transport, is another challenge to tackle.

Synchromodality offers various benefits. Agbo et al. (2017) divided the benefits of synchromodality based on benefited parties: shippers, service providers, and authorities or citizens.

1. Shippers will be more flexible in arranging more suitable modes following the requirements of the transported goods. Aligned transport requirements are expected to reduce the transport or whole logistics costs. The flexibility in planning will make modes-shifting possible with less CO2 emissions.
2. Service providers, since synchromodality is projected to have dynamic transport modes shifting, it means that the opportunity for rail, barge, or short-sea transportation companies to make more revenue improves. As the requirements of the shippers may vary, the service quality is expected to improve along with the growing number of customers.
3. Authorities will benefit from the improved number of existing infrastructure occupancies. As mentioned above, synchromodality is expected to reduce congestion while leading to fewer $CO_2$ emissions. In

employment, synchromodality is projected to establish variation and competitive occupations.

### 2.4.6 Optimization

In optimizing the synchromodality transport system, Phillipson (2023) proposed to focus on the control level, combined with optimization and information that the logistics service providers can attain.

Focus on information can be seen in two views: local and global. Local-level information means the coverage span of the system's neighborhood, while global information means the coverage area is the whole system.

Control degree and optimization are also divided into local and global points of view. Worldwide control and optimization are where every contributing party in the system tries to attain globally optimized results for the system. When decision-makers try to optimize their local goals, it is called local control and optimization.

The clusters mentioned above are simplified and depicted in the figure below

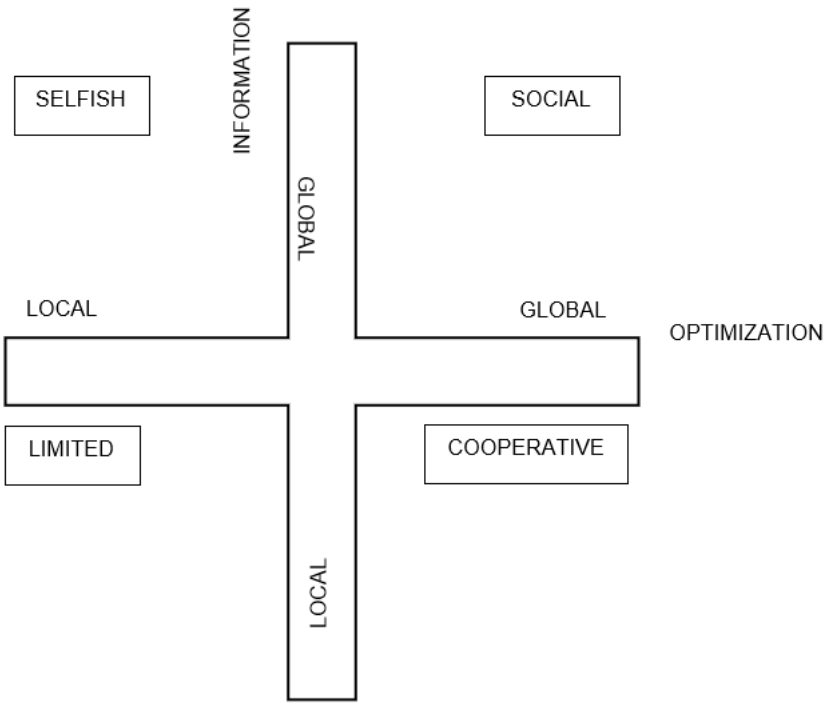


*Figure 3 Optimization framework of synchromodality (Phillipson, 2023).*

| | |
|---|---|
| Limited | : local information for local optimization |
| Selfish | : global information for local optimization |
| Cooperative | : local information for global optimization |
| Social | : global information for global optimization |

## 2.5 The transformation from Intermodality to Synchromodality

Driven by the increasing demand for cost reduction, efficiency improvements, and customer satisfaction, a logistics transformation is a chain of adopting new technologies and innovative practices to improve logistics operations' efficiency, flexibility, and intelligence (Liu et al., 2021).

Based on the features offered by synchromodality mentioned in the previous sub-chapter, the transformation from intermodality to synchromodality is expected to reduce costs and enhance efficiency and the share of modes used within the system. The freedom of choosing desired transport modes according to the

requirements may reduce transportation costs by adjusting according to the budget planning of the shippers. Real-time information supports shifting to other available transport modes if the planned one is unavailable to keep the delivery time within a reasonable window. In addition, the increasing level of complexity and uncertainty in the global supply chain grew an awareness between logistics services providers and manufacturers to be more open in circulating information to benefit more (Liu et al., 2021).

One of the new features offered by this concept is real-time data to add flexibility in mode shifting. Through a digital transformation, the logistics process is more straightforward to cope with through efficiency improvements, responsiveness, and supply chain sustainability (Cichosz et al., 2020), along with some benefits:

1. Improved operational efficiency: Improvement in this matter can be done through automation in manual processes and streamlining workflows.
2. Customer experience enhancement: Improved visibility, tracking, and communication enable logistics service providers to serve customers better.
3. Innovative business models: New perspectives can be built through updated business models, e.g., on-demand logistics, crowd shipping, and platform-based logistics.
4. Strategic differentiation: Attracting new customers requires different services, quality, and cost strategies.
5. Competitive advantage: Improved responsiveness, agility, and innovation are ways to gain an advantage in competition among logistics service providers.
6. Improved stakeholder relationships are one of the ways a more robust relationship can be built through a transformation in digital frameworks.
7. Cost savings: An optimized operation, reduced waste, and improved efficiency can be achieved through digital transformation.

The need to transform into more advanced modes is evident and is supported by the infant development of synchromodality; the concept itself is a part of the Physical Internet roadmap (ETP – ALICE, 2018), which is expected to give a

flexible planning, reduction in cost, improvement efficiency, and increased share of transport modes usage.

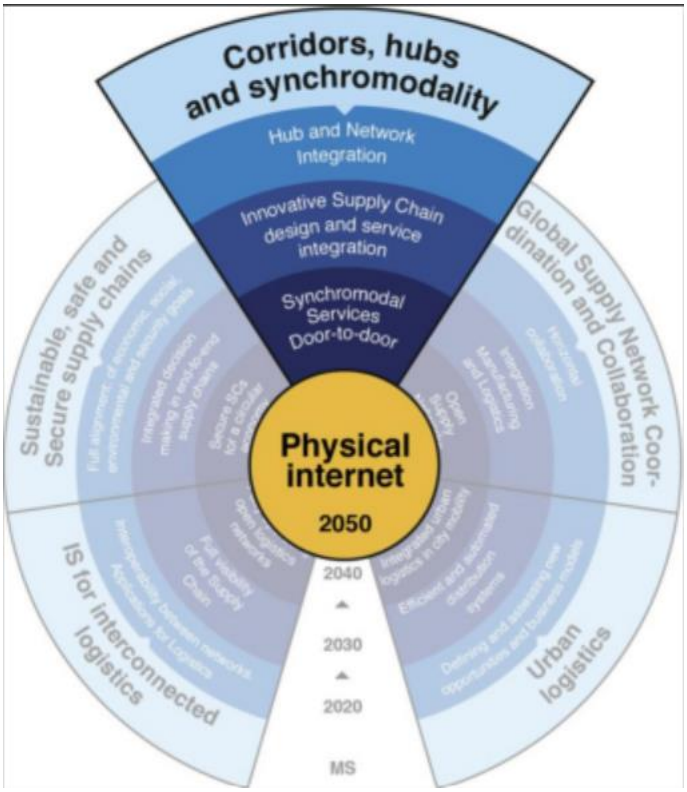


*Figure 4 Physical Internet roadmap (ETP-ALICE, 2018)*

Even though the focal of intermodal transport is in vertical integration, the differentiating feature between intermodality and synchromodality lies within the horizontal integration in the whole system to integrate all the involved transport modes into a single window (Behdani et al., 2014). From this perspective, the integration is expected to create more space in transport modes, choosing to adjust to the sophisticated demand from shippers.

## 2.6 Decision Maker Role

According to Yazdani et al. (2017), a decision-maker consists of an individual or group of people who are responsible for making well-informed and effective decisions in a particular context. An organization's decision-maker is usually

taken from people with knowledge and expertise in the organization's context and fundamentals.

A decision-maker must be influencing enough to ensure that the functional and structural body works to achieve the predetermined goals. In a research conducted by Musso and Francioni (2012), some influential factors of a decision-maker role in strategic decision-making processes context are defined :

1. Competencies

   In this subject, competency in making decisions with strategic rationality is considered as the vital one. This competency is used to develop prudently thought-out objectives (Elbanna, 2006; Schwenk, 1995).

   Another, a decision-maker is expected to have competencies in rationality and intuition throughout their career (Musso & Francioni, 2012).

2. Personality characteristics

   The need for achievements and a risk attitude are the two drivers in personality characteristics that influence decision-making (Papadakis, 2006; Papadakis & Barwise, 2002; Papadakis et al., 1998). When the need for achievement within a decision-maker is high, they will likely have more desire to be in control and spark their effect within their operating circle.

   Risk attitude is related to the ability of a decision-maker to bias in the practice of a more formal and rational process; higher levels of risk attitude will also lead a decision-maker to take quicker action and elaborate more by intuition rather than deploying formal and sensible analysis (Musso & Francioni, 2012; Papadakis, 2006; Taylor & Dunnette, 1974).

3. Socio-demographic characteristics

   Educational level is one of the influencing factors belonging to socio-demographic characteristics of a decision-maker; this subject has the potential to affect strategic decisions significantly (Gibcus et al., 2009; Papadakis, 2006; Papadakis & Barwise, 2002; Papadakis et al., 1998; Hitt & Tyler 1991).

A decision-maker with a higher education level will be more comprehensive in acquiring information, which consecutively leads to more rational and formal strategic decision-making processes (Papadakis, 2006).

4. Typology

   Typology is influential in the strategic decision-making of a firm or organization. Small-sized firms or organizations tend to be more concentrated in their personnel, such as managers or owners (Liberman-Yaconi et al., 2010).

# Chapter 3: Research Design and Methodology

## 3.1 Research Design

As the author has explained in Chapter 1, this study is intended to examine the knowledge span of logistics service providers in an intermodal logistics network regarding the synchromodality concept, the possibility of transformation from intermodality to synchromodality, and the likelihood of a logistics service provider to get support from other logistics service providers to be appointed as a decision-maker.

The methodology used in this research is the qualitative method, consisting of a literature review and semi-structured interview.

## 3.2 Methodology

This chapter explains the detailed methodology used to answer the research questions and the data used for the analysis.

To fulfill the research objectives outlined in Chapter 1, this research uses a systematic literature review and semi-structured interviews.

**a. Systematic literature review**

Paul and Criado (2020) defined a literature review as a research methodology involving collecting and synchronizing previous research in a particular area. This research methodology aims to fill the gap between the knowledge, headlining key findings and providing a comprehensive overview of the current research state. The literature review can be done in several methods, such as narrative or integrative reviews, systematic reviews, meta-analyses, and integrative reviews.

In a literature review, different approaches have different guidelines depending on the specific predetermined goals and the review phase (Snyder, 2019).

Table 1 Approaches to literature review (Snyder, 2019).

| Approach | Systematic | Semi-systematic | Integrative |
|---|---|---|---|
| Typical purpose | Synthesize and compare evidence | Overview research area and track development over time | Critique and synthesize |
| Research question | Specific | Broad | Narrow or broad |
| Search strategy | Systematic | It may or may not be systematic | Usually not systematic |
| Sample characteristics | Quantitative articles | Research articles | Research articles, books, and other published texts |
| Analysis and evaluation | Quantitative | Qualitative/quantitative | Qualitative |
| Examples of contribution | Evidence of effect<br>Inform policy and practice | State of knowledge<br>Themes in literature<br>Historical overview<br>Research agenda<br>Theoretical model | Taxonomy or classification<br>Theoretical model or framework |

Systematic literature reviews formerly developed within the medical science context and are not quite famous among business research, but the numbers keep increasing (Davis et al., 2014; Snyder, Witell, Gustafsson, Fombelle, & Kristensson, 2016; Verlegh & Steenkamp, 1999; Witell, Snyder, Gustafsson, Fombelle, & Kristensson, 2016).

A systematic literature review works as an identifier and appraisal tool for the relevant research and acts as a collecting and analyzing tool for data from previous research (Liberati et al., 2009). This literature review method was designed to identify the whole empirical evidence suitable with the inclusion, which was defined formerly to answer specific research questions or hypotheses (Snyder, 2019). By applying a systematic literature review, bias is expected to be minimized to ease the conclusion and decision-making process (Moher et al., 2009).

By applying a systematic literature review, the constant effect across the study is expected to be identified along with the required demonstration method (Snyder, 2019).

This study occupied steps founded by Denyer & Trenfield (2009) in doing a systematic literature review, which is depicted in the figure below:

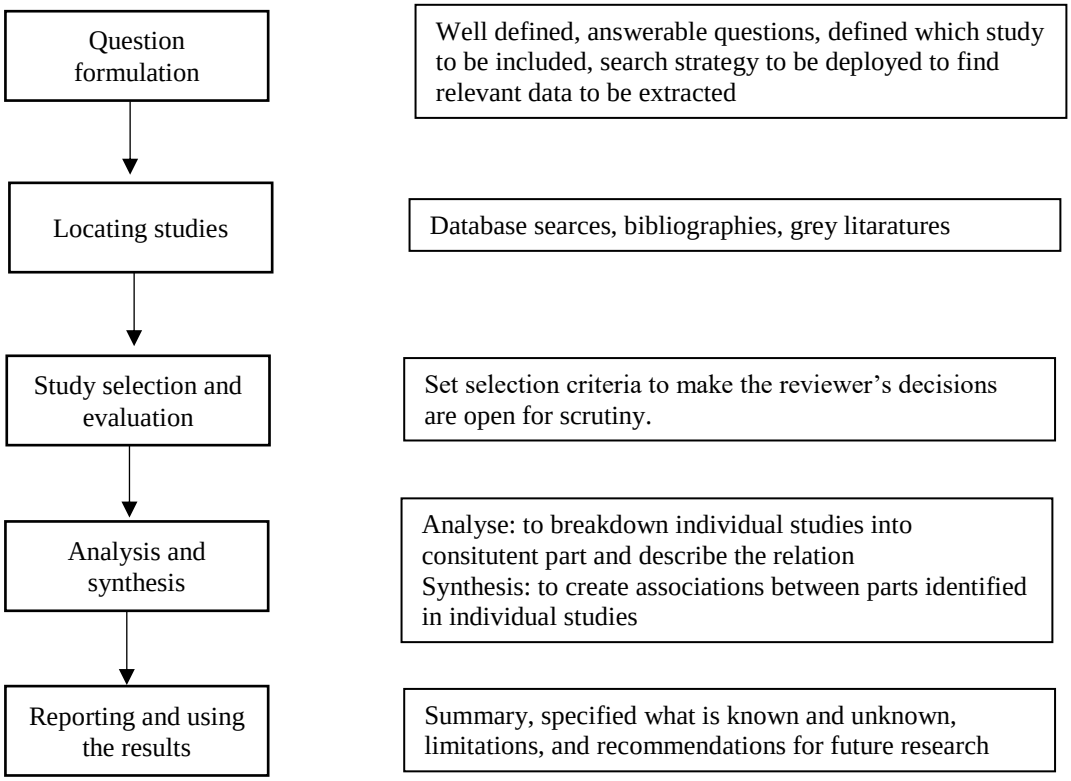


*Figure 5 Steps of systematic review process (Denyer & Trenfield, 2009, modified by the author)*

To initiate the study, formulating questions is essential as it is the key to locating the studies; once the study location is found, it is easier to focus on the relevant literature.

In this research, the approach used to formulate the questions is called CIMO, which was found by Denyer et al. (2008) and stands for Context, Intervention, Mechanism, and Outcome. As for this study, this CIMO approach is explained below:

**C** – Status of the knowledge span from logistics service provider in an intermodal logistics network regarding synchromodality in general, transformation from intermodality to synchromodality, and decision-maker role in the concept.

**I** – The views of synchromodality regarding practicability, transformation, and decision-maker role of the concept from logistics service providers in an intermodal logistics network.

**M** – Mechanisms of practicing synchromodality, the transformation from intermodality into synchromodality, and decision-making processes in synchromodality.

**O** – Possible benefits of synchromodality implementation for logistics service providers in an intermodal logistics network.

Based on the approach above, the following research questions were developed:

1. What are the views of logistics service providers in an intermodal logistics network about the practicability of the synchromodality concept in general?
2. What are the views of logistics service providers in an intermodal logistics network about the possibility of transformation from intermodality to synchromodality concept, based on their current?
3. Given the need for a decision-maker role, how likely can a logistic service provider get support from other logistics service providers to become the

decision-maker of transportation shifting and tariff the synchromodality concept?

As detailed in the explanation above, the data collection or locating studies process is done by reviewing the available literature, including non-peer-reviewed literature. The search strategy is presented below:

*Table 2 Search strategy (Author, 2023)*

| No | Database | String used | Number of literature found |
|---|---|---|---|
| 1 | Science Direct | "Synchromodality" | 144 |
| | | "Synchromodality" AND "logistics" AND "service" AND "provider" | 90 |
| | | "Synchromodality" AND "transformation" | 27 |
| | | "Synchromodality" AND "decision AND "maker" | 76 |
| 2 | Scopus | "Synchromodality" | 48 |
| | | "Synchromodality" AND "logistics" AND "service" AND "provider" | 9 |
| | | "Synchromodality" AND "transformation" | 1 |
| | | "Synchromodality" AND "decision AND "maker" | 3 |
| Total | | | 398 |
| Duplicates | | | 206 |
| After duplicate removal | | | 192 |
| Final analysis | | | 92 |

To find the most relevant sources, the data selection process started with two infamous databases, ScienceDirect and Scopus. The title, abstract, and keywords search string are listed above.

The author found no publication timeline constraint, as the pilot study was started in 2010, and time constraints will make the source less relevant to be reviewed. Started with keywords “Synchromodality,” “Synchromodality logistics service,” “Synchromodality transformation,” and “Synchromodality decision maker,” resulted in 398 publications which were then tested for duplication. The author used RefWorks to filter the duplicates from 398 publications into 192. The second filter was done by implementing criteria regarding the presence of keywords used in the search strategy, which resulted in 92 publications, the list enclosed in the Appendices.

**b. Semi-structured Interview**

According to Schostak (2006), an interview is an extended conversation between partners that tries to learn "in-depth information" about a particular topic or issue and allows for interpreting an occurrence in light of the meanings the interviewers assign to it.

Four types of interviews are often used in social sciences, according to Stemler (2001) :

1. Structured interviews, this type of interview gives less freedom to both interviewer and interviewee, as it only contains "yes" or "no" questions (Berg & Lune, 2017). It is organized with direct questions without the need to do explanations in response to the questions.
2. According to Gubrium & Holstein (2002), open-ended interviews give the interviewer and interviewee more flexibility. Therefore, there will be more possibilities for the interviewer to follow up on any development they found interesting in the answer and let the interviewee elaborate more on multiple issues (Dörnyei, 2007: 136).
3. Semi-structured interviews, this type of interview provides greater flexibility than a structured interview since it gives the interviewer a chance to go deeper into the interviewee's comments (Rubin & Rubin, 2005:88).

The author followed several steps by Rabionet (2014) in conducting semi-structured interviews for the data analysis, which were detailed as follows:

1. Selecting types of interview

   In this study, the interview method used to address the research questions is the semi-structured interview. The author intends to go deeper into the interviewees' answers to comprehensively understand the practicability of the synchromodality concept, the possibilities of transformation, and the decision-maker role.

2. Establishing ethical guidelines

   Entering the professional space of others needed to take ethics into account. In doing so, the author practiced direct ethical acts before interviewing, such as coordinating the availability of the interviewees and their schedule regarding personal and professional matters and hierarchically reaching out.

3. Crafting the interview protocol

   The introduction stage and questions session are the core of an interview protocol. Presenting yourself professionally and suitably will create a good impression on the interviewee and a good atmosphere during the interview. Questions development and follow-up sessions are significant to notice as they need an ahead subject development. In this study, the author created interview material and a guide given to the interviewee before the interview, enclosed in the Appendix.

4. Conducting and recording interviews

   This study uses an online platform to conduct interviews, Microsoft Teams, with a recording feature. The author used artificial intelligence, Otter, and Tactiq to establish a clear transcript and summary.

5. Analyzing and summarizing interviews

   Following the study's objectives, the author analyzed the interview content to understand the practicability of synchromodality, the transformation

from intermodality to synchromodality, and the decision-maker within the concept. The contented responses are expected based on the current condition of the interviewees' port, terminal, or logistics service provider. The summary of the interviews is established using a manual note and an artificial intelligence Tactiq to assist the cross-checking with the transcript.

6. Reporting and findings

   In this study, the author has reported findings in Chapter 4. The findings are acquired from the interview summary analysis to highlight the point in the interviews and their summary regarding the practicability of synchromodality, the transformation from intermodality to synchromodality, and the decision-maker within the concept.

# Chapter 4: Data Analysis and Findings

## 4.1 Data Analysis

Prior to data analysis, the data-finding process in this research is acquired by conducting semi-structured interviews with several logistics service providers in an intermodal logistics network. To fulfill the procedural matter, the following interview guide is designed and implemented:

1. The interview will be held online via Microsoft Teams
2. Each interviewee will be given the material at least two days before the online interview.
3. The identity of the interviewee will be made anonymous.
4. The interview will be recorded, and the script will be generated through Microsoft Teams.
5. The recording, including the transcript, will be stored in Google Drive connected to account W1011878@wmu.se right after the interview is completed and will be permanently deleted after the degree is awarded.
6. Below are the scenario and the interview questions:

   Dear Participants, please answer the following questions after reading the explanation above. Please always consider your current role in the intermodal logistics network and project it in your answer.

   1. After reading the explanation above, please provide your overview of the practicability of the synchromodality concept.
   2. Provided the future potential mentioned above, based on the current condition in your terminal/port/freight forwarding company, is it possible to transform from intermodality to synchromodality concept? Please provide your reasoning.
   3. If the transformation from intermodality to synchromodality concept is proceeding in the vicinity and needs a decision-maker role, please provide your reasoning for appointing a decision-maker role.

The interview guide provided above is used to acquire the data from interviewees with the following profiles:

*Table 3 Interviewee profiles (Author, 2023)*

| Interviewee | Organization | Years of working in LSP | Educational Background | Position in LSP |
|---|---|---|---|---|
| Interviewee A | Port | 15 years | Master's degree | Mobility expert |
| Interviewee B | Terminal operator | Five years | Master's degree | Terminal manager |
| Interviewee C | Port | 14 years | Doctoral Degree | General manager |
| Interviewee D | Terminal operator | Five years | Bachelor's degree | Operational consultant |
| Interviewee E | Terminal operator | Five years | Bachelor's degree | Operational manager |

Which is then analysed and clustered based on the interview questions for each interviewee:

### 4.1.1 Interview Question 1

#### a. Interviewee A

Clearance about the definition of synchromodality may be a barrier to the concept. Therefore, a common ground in understanding the practicability of the idea needs to be found. This understanding is related to freedom of modes-shifting as the newly offered feature of synchromodality and the shippers' preference for en route modes-shifting, which may be a constraint towards the modes-shifting feature, *"…prefer to use certain modes."*

Nevertheless, at the same time, the practicability of the concept may be enabled by real-time data; this statement is also supported by Behdani et al. (2014), that real-time data significantly supports information sharing. Openness in information sharing is also expected

to improve as the complexity of the global supply chain increases (Liu et al., 2021).

**b. Interviewee B**

The practicability of synchromodality involves the freedom of transport modes (Zhang & Pel, 2016; Brümmerstedt et al., 2017; van Duin et al., 2019), which decision depends on some specific people in some particular circumstances.

Enabling the concept may be best paired with having predetermined pricing for last-minute decisions and precise service measures to ensure the decision-making and reach the service level agreements or KPIs, *"...you need some general agreement on pricing and some service-level agreements or KPIs."*

**c. Interviewee C**

The quest to find the most convenient connection is the practice of synchromodality, and it does not have to be tied to one specific transport mode or physical connection *"...to allow the cargo to flow through the most convenient connection."*

However, this concept is dependent on the geographic context in a practical manner, *"...so you might have different actors that play different roles, depending on the geographic context."*

Nevertheless, the practicability of the synchromodality concept can never be fully implemented without the idea of the physical internet, which is considered an enabler. As for the current state, synchromodality is just an ambitious plan rather than an implemented one, regardless of the adaptivity, *"...synchromodality concept is more likely to be ambitious even if it is adaptive, but you can never go fully synchromodality unless you have the physical internet."*

Synchromodality is part of the physical internet roadmap (ETP – ALICE, 2018).

**d. Interviewee D**

Supported by Acero et al. (2021), to practice synchromodality, it is recommended to have an advanced grade of technology to support decision-making based on real-time data, which was already mentioned previously as an enabler, "*…it sounds like a concept which can be built upon when you have advanced technology."*

Another enabler in an operational manner is coordination and acceptance of several stakeholders in potential actors or players within the concept, *"…still need to be accepted by shippers or any possible stakeholders within the concept, and coordination is also key."*

Nevertheless, the shipper's acceptance may be a constraint.

**e. Interviewee E**

Synchromodality is expected to drive the freedom of transport modes option and the service level where network utilization improved, *"…developing this concept will help the growth of service level, and you are free to choose the transport modes."*

### 4.1.2 Interview Question 2

**a. Interviewee A**

Synchromodality is an adaptive concept, and the transformation is practically enabled with suitable arrangements and technology. The technology may bring another advantage to this concept, such as on-demand logistics, crowd shipping, and platform-based logistics (Cichosz et al., 2020).

Nevertheless, the constraints of this concept vary, ranging from time, volume requirements, and goods sophistication, *"…it is practically possible and adaptive, but challenging in a timely manner, volume requirements, and goods sophistication."*

**b. Interviewee B**

The decision-maker role and the capability to provide adequate supporting facilities are enablers in transforming from intermodality into synchromodality for ports or terminals. In addition, the awareness related to the modes-shifting budget issue is a recommended prerequisite for the decision-maker, *"…to provide adequate facilities is fine, but we also need to have the decision-maker role in doing so, and he or she needs to know who is handling the budget issue in changing modes."*

**c. Interviewee C**

As previously said, the transformation from intermodality to synchromodality concept may be enabled by the collaboration among some parties (Cichosz et al., 2020), such as port authorities, transport service providers, and customers, *"…with the agreement of the infrastructure service providers of the transport service providers, and the customers, they could devise a way to move towards synchromodal concept."*

This collaboration is also expected to make the relationship between stakeholders more robust; it will also be another form of business that will probably be more advantageous for logistical matters.

At the same time, integrating different transport modes is required to cover geographical dependencies, which are constraints towards the transformation. Nevertheless, tackling this requires another constraint: approval from the authority board. However, building awareness regarding the need to integrate can be grown through *"…there is a need to coordinate infrastructure development; when the preposition of synchromodality is either the interaction between transport*

*segments or the need to think about developing infrastructure, the role probably needs to be done by the transport authority."*

**d. Interviewee D**

As real-time data is an enabler in synchromodality, it is essential to emphasize that transforming into this concept is empowered by adopting an advanced technology, *"...yes, it is possible to transform, but you need to update the technology to a certain higher level."*

It is also suggested to be more open in information sharing to address the complexity of the global supply chain (Liu et al., 2021).

In addition, the transformation from intermodality into synchromodality may also be enabled by having a similar understanding of the possible involved actors within the system regarding the value added to the concept to see the feasibility in the future, *"...stakeholders, actors, and involved parties need to be on the same page to see what the added value of this new concept is."*

**e. Interviewee E**

Regarding the transformation from intermodality to synchromodality concept, the mindset shift to accept the value added by the implementation of synchromodality along with the coordination between stakeholders within involved parties and technology advancement are enablers which are better to have *"...mindset, coordination, and technology are the core of this concept."*

The mindset relates to accepting that the newly offered features in synchromodality will bring more advantages to the business than the already existing goods transportation modes.

### 4.1.3 Interview Question 3

#### a. Interviewee A

Logistics service providers and shippers are considered the main actors and enablers in decision-making regarding transport modes shifting and pricing.

There are three possible scenarios in transport modes and their pricing decision-making:

1. Shippers, with the advisory of the subcontracting party in logistics pricing, are responsible for the transportation price when shippers transport their goods independently. Arranged by an in-house department within their organization, they are their decision-makers in modes shifting.
2. If shippers subcontract the transportation of their goods to a logistics service provider, they must negotiate with the appointed logistics service provider to deal in a fair number. Based on the contract with shippers, a logistics service provider can advise the shipper regarding shifting modes.
3. The third scenario is when shippers directly ask for a freight forwarding company to transport goods; the price negotiation will be between the shippers and the appointed freight forwarding company. In this term, freight forwarding is an organizer for goods transportation. It will subcontract the goods transportation to another party, and no additional fee will be charged if there is any shifting in modes. This is applicable due to the fixed price in the contract with the shippers.

   The advice from the appointed party related to transport modes shifting is an enabler in this matter; it will then make decisions on its behalf and with the approval of the shippers.

**b. Interviewee B**

In small-scale inland terminals, the shippers and the terminal operators are the enablers in modes shifting and transportation decision-making, as they are advisors or even decision-makers in shifting transport modes based on agreements and arrangements, *"…inland terminal operators and shippers are suitable for decision-makers with some agreements and acceptances."*

At the same time, the decision-making process of transportation pricing is arranged by the in-house department of the inland terminal, *"…we can give the price to the customer through our in-house department, and we can do the loading to barge or truck."*

**c. Interviewee C**

When the driver of the concept is efficiency, the logistics service provider is the suitable party in making decisions related to transport modes switching,*"…if the driver of this concept is efficiency, logistics service providers also have the right to make decisions in transport switching."*

Since synchromodality has geographical dependence as its constraint, the decision-maker role regarding transport shifting is also applicable to the transportation authority or infrastructure authority to coordinate the infrastructure development to support the practice of synchromodality,

*"…when the preposition of synchromodality is either the interaction between transport segments or the need to think about developing infrastructure, the role probably needs to be done by the transport authority."*

At the same time, the transportation tariff itself is to be decided by the logistics service provider, *"... the integrators or logistics service providers should determine the price to ensure a certain degree of competition."*

**d. Interviewee D**

On some terminal operators, the scope of work may be a potential enabler and barrier since it does impact the decision-maker role *"...because terminal operators mostly covered the entire part of the freight, except for the sales and marketing purposes. They do the cargo transportation, and the department arranges the price and the operational matters for them. Including modes shifting, so it is them to say yes or no."*

When the work plan turns out to be well, the scope of work itself can be considered an enabler in the decision-making process. On the contrary, when the procedure goes astray, it interrupts decision-making.

**e. Interviewee E**

The decision of mode shifting is to be made based on the real-time updates and decided by the logistics service provider with the approval from the shipper based on the contract that binds them, *"...a shift to different modes will be made due to demand from the situation courtesy of real-time updates. The logistics service provider makes decisions based on the contractual document with the shippers' approval."*

Regarding the decision-maker in transportation tariffs, it is evident that the logistics service provider has a comprehensive understanding. Thus, this actor is suitable for decision-making concerning transportation tariffs, *"...logistics service providers know the whole*

*process; the handling, the shipping, and the cargo whereabouts of, they should be the ones to decide the price."*

## 4.2 Findings

Depicting the semi-structured interviews with diverse participants, this section presents the findings from the data analysis to highlight the interviewees' views regarding the practicability of synchromodality, transformation from intermodality to synchromodality, and decision-maker role within the concept.

### 4.2.1 Overviews of the Practicability

The differences lie in the definition of synchromodality, which creates a barrier to its practicability. This concept proposes new features, including the freedom of booking and shifting the most convenient transport modes from a particular origin to a specific destination, enabled with real-time data.

This study has found that the practicability of the concept depends on the new features mentioned above, combined with the decision-making attitude of the shippers. Nevertheless, the shippers' preferences may be a constraint towards the newly offered features in the concept.

Practicing synchromodality means that the supporting facility has to be adequate and suitable to cover its constraint in geographical dependencies, and the actors within the system will vary according to the geographical location.

At the same time, the adaptation of the physical internet is the enabling factor to shape synchromodality from an ambitious concept to full implementation. It is also nice to have predetermined pricing for last-minute decisions and precise service measures, and the latter may practically improve this concept. Combined with good coordination and acceptance of the involved stakeholders, this concept is expected to drive the service level of each transport mode and network utilization. In

addition, to support the decision-making process and real-time data, the technological sector of the involved parties needs to be improved.

### 4.2.2 Possibility for Transformation

Considered an adaptive concept, transforming intermodality into synchromodality is possible with suitable arrangements and technology as enablers. Collaborations between port authorities, transport service providers, and customers are to be ensured to enable the operation of the transformation process. A similar understanding between involved parties regarding the added value of the concept is needed for the feasibility study and is necessary to support the transformation practically.

Constraints in this transformation vary from time, shippers' preferences, acceptances, volume requirements, facilities, and geographical dependencies.

### 4.2.3 Decision Maker Role

The likelihood of the decision-makers' role in synchromodality has several variations, ranging from classification based on the shipper's dependence on goods transportation to the scope of work.

Situated in a small-scale inland terminal operator, it is opined that the terminal operator should take the decision-maker role for the transport modes shifting based on agreements and arrangements with the shipper's approval. At the same time, the in-house department is in charge of the transportation tariffs. Delivered by another terminal operator, the decision-makers role for transport modes shifting and tariffs is the operator itself, based on the understanding of the scope of work.

As mentioned by a port, when the driver of synchromodality is regarding efficiency, the most suitable decision-maker role in transport shifting and tariffs is the logistics service provider; transportation authority is also applicable due to the concept's challenge in geographical dependency.

As explained by a logistics service provider, based on its knowledge of the logistics process, the logistics service provider will likely be appointed as the decision-maker in transportation tariffs. The shippers are likely to be appointed as the decision-makers in transport modes shifting by the advisory act from the logistics service provider.

In addition, another port opined about the decision-maker role in synchromodality is classified into below:

1. Independent means the shipper does the transportation of their goods by themselves. The transport modes shifting is to be determined on their own, while the tariffs are to be decided under the advisory of a logistics subcontracting party specified in pricing.
2. Subcontract: when the shipper subcontracts the transportation of their goods to a logistics service provider, it is obliged to advise the shipper regarding shifting modes and decide about it. The transportation tariff is based on the agreement between them.
3. The negotiated price between the shipper and freight forwarding company is considered the transportation tariff in freight forwarding. The chosen freight forwarding company then subcontracts the goods transportation to another party. This party may then give an advisory act to the freight forwarding company regarding modes shifting, which will then make decisions on behalf and with the approval of the shippers.

# Chapter 5: Conclusions and Recommendations

## 5.1 Conclusions

This study has tried to take its chance to create an understanding of the practicability of synchromodality in general through the views of logistics service providers, port, and terminal operators in an intermodal logistics network. This has been achieved through semi-structured interviews with participants from several backgrounds in logistics service providers.

The interviews concluded that the practicability of the concept depends on the new features, such as freedom in booking and shifting transport modes, and will enable real-time data. It is also considered a quest to transport goods with the most convenient connection; it does not have to be tied to one specific transport mode or physical connection.

Moreover, the concept comes with several prerequisites to be fulfilled, such as an advanced technology level to support real-time data, network collaborations, and physical connection. Thus, it can be said that without adapting the physical internet, synchromodality will be just an ambitious master plan rather than a full implementation, regardless of its adaptable characteristics.

In its practical manner, synchromodality has constraints ranging from time, volume requirements, goods sophistication, and geographical context. Nevertheless, despite the challenges mentioned above, synchromodality is advantageous to the shippers, as it gives them more flexibility in arranging more suitable modes following the requirements of the transported goods.

Additionally, synchromodality improves logistics service providers' network utilization and service level. At the same time, the authority board has also benefited from the increasing number of infrastructure occupancies. In addition,

this concept brings more integration between different transport modes, with collaboration, agreements, and acceptance of involved stakeholders.

Regarding the transformation into synchromodality, it is concluded that synchromodality is practically possible and adaptive with suitable arrangements and technology, supported by adequate facilities with a capable decision-maker role. It also requires a similar understanding between stakeholders regarding the value added within.

The likelihood of being appointed as a decision-maker is divided into decision-makers for the shifting transport modes and pricing. Both of them vary, as listed below:

1. Scenarios involving shippers, logistics service providers, and freight forwarding companies.
2. The scale of the port or terminal
3. The development driver
4. The dependency factor of the concept
5. The understanding of the logistics process

In conclusion, this study has given valuable insights into the general understanding of practicability for synchromodality, the possibility of transformation from intermodality into synchromodality, and the likelihood of logistics service providers being supported as decision-makers.

It revealed how the logistics service providers view the general practice of synchromodality, along with its constraints, enablers, barriers, drivers, prerequisites, and new features. It is also highlighted that the common understanding of the value added of the concept, the mindset shift, and the acceptance and coordination between stakeholders within the concept are substantial to support the transformation, as are technological advancements.

Moreover, the decision-maker role provided a variative scenario regarding the likelihood of a logistics service provider.

## 5.2 Recommendations

1. To tackle the constraint in shippers' preference, improving the service level on each transport mode may be the answer.

   Initiated by evaluation in specific departments, technical examinations must be conducted on time to anticipate obsolescence and unexpected accidents. A follow-up leads to maintenance and repair in poorly scored subjects. With coordination and collaboration with the financial department regarding budgeting, the operational team puts on priority lists and acts as agreed with the authority and other responsible parties. From this action, the service level is expected to improve and influence shippers to vary or shift their preferences with the help of the marketing area.

   Recommendation for future study is related to assessment in particular transportation preferences to establish upgrade planning towards existing transport modes and adapting new technologies to utilize the offered selections better.

2. An example of shippers' acceptance that becomes an issue is related to modes shifting. To some shippers unfamiliar with this concept, changing modes will be less efficient and may be an issue associated with a timely manner. From then on, they will have difficulty accepting logistics service providers regarding advisory in modes shifting. One way to address this matter is through a comprehensive understanding delivered by the logistics service provider about the need to do modes-shifting, supported by a well-arranged and feasible approach to convince shippers. The initial planning of transport modes shifting itself has to be sufficient to anticipate the constraints in modes-shifting, such as shippers' acceptance.

Recommendation for future research in this field is related to the knowledge span of synchromodality within the logistics and supply chain to accommodate the knowledge gap associated with this concept and its implementation.

3. Improving transport planning and infrastructure can address timely manner-related issues, goods sophistication, volume requirements, and geographical dependencies.

   Sufficient planning in transportation will make more room for adjustment for any obstacle happening en route. Having several backup plans based on previous days' experiences, feasibility studies, and a good understanding of the whole goods transportation process are well-advised to accommodate the goal and anticipate any possible constraints. The author gives a recommendation for future research regarding a comparative study between several different transport planning specified with distinguished transport modes. The study can be used to address the time efficiency of transport planning in a particular origin and destination, combined with some case studies in the related locations. To see which transport planning is more suitable for the specific area and case study.

   In addition, another case study can also work with financial planning related to the pattern of some specific cause of delay. This study intends to address the related issues to minimize loss or interruption in financial planning and find suitable, efficient, and economical solutions for the corresponding cause.

   The author recommends that constraints related to this matter be addressed by an assessment study on the existing goods' sophistication to forecast the development and anticipation plan. The research, of course, needs to be done along with its feasibility studies, taking into account sustainability and prospects.

This action also applies to adjusting the infrastructure offered towards volume requirements and geographical dependencies. A comparative study in transport modes integration to resolve volume requirements matters is explicitly recommended in carbon print level, financial, and legal aspects. It can be related to the geographical dependencies issue, planning which integration combination is the best for some specific area, accommodating the transportation gap regarding location, and adjusting to the volume requirements.

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# Appendices

Reference list of research publications included in the analysis for this study


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