INTERMODAL TRANSPORT OF GRANITE FROM SOUTHERN VIETNAM TO NORTHERN EUROPE

Case: Sai Gon Cuu Long Logistics and Trading Company

LAHTI UNIVERSITY OF APPLIED SCIENCES
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Nguyen, Thi Mai Lien

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NGUYEN, THI MAI LIEN:

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ABSTRACT

The national cargoes of Vietnam have increased dramatically over the last few years. To meet the demand of freight transport, strategic attention has been paid to the development of intermodal transport and door- to- door services. Yet the current investments in this area are not up to their potential. On the other hand, very few local businesses are capable of providing a complete shuttle service.

This thesis is based on the real case of Sai Gon Cuu Long Logistics and Trading Company. The goal set is to improve the efficiency of the company's door- to-door intermodal service of granite transport from Southern Vietnam to Northern Europe. Consequently, an optimal chain of intermodal transport is identified.

Analysis of this study is conducted by a qualitative method, on the basis of a deductive approach. Data collection process embraces monitoring and communication sources.

The theoretical part of this thesis provides a framework for intermodal system analysis. The notions of terminals and modes are respectively studied. Following literature reviews on technical and organizational components of an intermodal chain is a study of intermodal transport operations and performance measurement.

Based on the theoretical background, the empirical part examines the case chain in chronological order. Firstly, a sketching of the transport case and a brief description of freight forwarding arrangements are given. Next, aspects of the key terminals and modes are discussed. With the resources in place, port operations and hinterland practices will be elaborated on. At the end, a relative evaluation of the chain performance is given in terms of timing and freight rates, on a benchmarking basis.

To conclude, implications on the previous findings and resultant recommendations are put forward. Accordingly, main points of the model intermodal system will be remarked, emphasizing a saving of 167 EUR per 20 foot container in the overall transport budget and 7-10 days in the direct transport timing.

Keywords: Sai Gon Cuu Long, intermodal transport, freight forwarding, Vietnam.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

GLOSSARY

AVG System	Average Gantry Crane System
BAF	Bunker Adjustment Factor
B/L	Bill of Lading
Booking note	Document asking the shipping line for shipping service
CAF	Currency Adjustment Factor
Closing time	Published deadline for export containers to be accepted for a sailing of the carrier
Consignee	A person to whom containers are shipped
Consignment	A shipment of goods to a consignee
Consignor	The person who is the supplier or owner of commodities shipped
Door-to-door	Through transportation of a container from consignor to consignee
Door W x H	Door Weight x Height
Dry cargo	Cargo that is not liquid and normally does not require temperature control
DWT	Deadweight Tonnage
EDI	Electronic Data Interchange
ETA	Estimated Time of Arrival
FCA	Free Carrier
FCL	Full Container Load
FCL/FCL	The container is packed by the shipper and unpacked by the consignee
FEU	Forty- Foot Equivalent Unit
ICD	Inland Container Depot
ICT	Information and Communication Technology
ISO	International Organization for Standardization
LCL	Less than Container Load
L x H	Length x Height
Liner service	Vessels operating on fixed itineraries or regular schedules and established rates available to all shippers
Liner booking note	Document by the shipper for liner service

L x W x H	Length x Width x Height
NE5	Asia North Europe Service 5
Shipping line	Business that provides liner service
Shuttle service	Door-to-door service
TEU	Twenty-Foot Equivalent Unit
TCCT	Tan Cang-Cai Mep Container Terminal
Through B/L	A bill of lading that covers transportation by more than one carrier from the point of issue to the final destination
WTO	World Trade Organization

1 INTRODUCTION

1.1 Research background

Transport is a key function in the supply chain because it acts as a physical link between customers and suppliers and enables the flow of materials and resources (Naim, Andrew, Robert, & Nicola, 2006, pp. 297-311). Nowadays, when trading needs reach out from national or regional boundaries to a vast global platform with increasing freight amount being handled, the role of transportation is subsequently more emphasized.

Along with technological breakthroughs, transport vehicles and infrastructure development are positively accelerating. The concept of transport is now developing with more and more services being offered, among which intermodal transport is a favorable choice of many international merchants. It is transforming a growing share of the medium and long-haul freight flows across the globe, expanding steadily at the rate of ten percent each year (Genua, 2010).

In Vietnam's context, WTO membership from 2007 has helped boost the international trade and develop its freight transport capabilities. Recent statistics reveal that the national cargo growth potential is tremendous. The growing pace of containerized exports to North Europe is illustrated in Figure 1. (Winkler & Akbar, 2008, p. 9.)

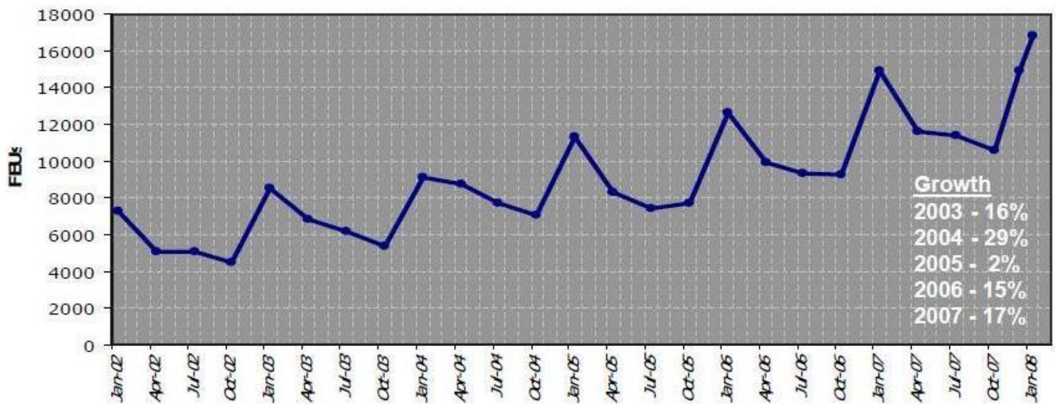

FIGURE 1. Vietnam to North Europe Trade Growth 2002-2007 (Winkler & Akbar, 2008, p. 7).

From 2002 to 2008, national export from Vietnam to Europe has been rising steadily, reaching 17,000 FEUs in 2008. In a very short term, the average growth of 20% per annum is expected to increase to 25% (Winkler & Akbar, 2008, p. 9). To meet the increasing demands of overseas transport, a substantial part of the state and private funds has been invested in transport renovation plans. In parallel with national development projects in road and rail building, the construction of port zones and upgrade of port activities are expanding strongly to enhance the national intermodal competence.

To be honest, however, the development of intermodal infrastructure in Vietnam, and Southern Vietnam particularly, is not fulfilling its potential. Among over 24 seaports in the 3,260 kilometers coastline, only five major locations in Viet Nam receive container vessels on regular basis, including Cai Lan, Hai Phong, Da Nang, Quy Nhon and Ho Chi Minh City (Vietnam Freight Transport Report Q4 2010, 2010). In the case of trans-ocean shipments, most containers must assemble at such transit ports in Singapore and Malaysia. So far, additional terminal handling costs incurred and longer travelling time of indirect routes have been of great concern to shippers.

Concerning hinterland resources, road transport is the most advanced and the dominant mode with a market share of approximately 60% of domestic cargo. To serve a network of about 223,000 kilometers, there are around 1,050 enterprises of national and international scale registered. On the other hand, Vietnam's railway transport sector has only one operator, the Vietnam Railway Corporation, established by law in April 2003 as a state corporation operating railway transport and related services. In general, very few international businesses are engaged in the local hinterland system. (Vietnam Freight Transport Report Q4 2010, 2010.)

When it comes to service quality, there are only 10-15% out of 1,000 logistics and trading businesses in Vietnam can provide door-to-door services, including international actors such as Maersk, NYK, APL, Linfox, and Toll (Vietnam Freight Transport Report Q4 2010, 2010). Local enterprises, albeit slowly, are thriving to improve their services and transport procedures which are currently below international level.

In this context, the thesis examines a case intermodal transport chain of granite between Southern Vietnam and Northern Europe. Correspondingly, door-to-door services will be arranged by the only one forwarder in Southern Vietnam, named Sai Gon Cuu Long Logistics and Trading Company. Hinterland practices in Southern Vietnam and Northern Europe will be organized by Sai Gon Cuu Long and its overseas agency. Updated enough, a new maritime alternative will be added to the case chain. The direct shipping route will be offered by Hanjin shipping line, calling at Cai Mep Port in Southern Vietnam and the Port of Hamburg in Northern Europe. With initial understanding of local transport, if Sai Gon Cuu Long can manage the flows of right information, deploy the right persons and utilize the right strategy, there will be a lot of space for increasing profits and better service quality.

1.2 Research questions and research objectives

The goal of this thesis is to contribute to the efficiency of transferring containers from Southern Vietnam to Northern Europe in terms of intermodal transport system. Information provided in this research will be of interest to numerous local transport operators in Vietnam who are looking for a standard door-to-door practice to consult and enhance their service.

Updating the new direct maritime route, this study demonstrates a cost-effective opportunity for the case company to improve their inter-continental pricing advantages, since the long-sea shipping leg is the cost center of the delivery chain.

On the other hand, efforts to help optimize hinterland performance at the 2 nodes in Southern Vietnam and in Northern Europe should not be overlooked. While information about hinterland transport practice in Southern Vietnam may be useful to European importers, the best practices of inland transport in Northern Europe may be helpful to Vietnamese freight forwarders.

The pertinent question put forward in this research is: What is the ideal system for a logistics service provider to offer a door-to-door intermodal transport service of

granite from Southern Vietnam to Northern Europe? The study consists of 6 chapters, in which the author carries out in-depth research into every single stage of the intermodal transport process. Specifically, the overall research problem is addressed through the following 5 questions:

1. Who and what are involved in the export chain?
2. How does Sai Gon Cuu Long organize hinterland transport?
3. How does Sai Gon Cuu Long organize port operations?
4. What costs need to be covered?
5. What measures are used to evaluate the overall performance?

1.3 Research method: Case study

First and foremost, this thesis is set up as a single case study. A case study investigates a contemporary phenomenon within its real-life context, using multiple sources of evidence and providing an opportunity to analyze many specific details overlooked by other methods (Kumar, 2005, p. 113). It is a research strategy which covers the logic of design, data collection techniques and specific approaches to data analysis.

Research design

In practice, the quality of any business research is much defined by the quality of its design and how well it is conducted. Research design is the overall plan and structure of investigation so conceived as to obtain answer to research questions. It includes an outline of what the investigator will do from writing hypotheses and their operational implications to the final analysis of data. (Blumberg, Cooper & Shindler, 2008, p. 195.)

In selecting the specific design to use, a number of different design approaches exist but, unfortunately, no simple classification system defines all the variations that must be considered (Blumberg, Cooper & Shindler, 2008, p. 195). Herein, there are three distinct methods to decide on: inductive, deductive and combination of both.

An inductive method is defined as “the research that draws general conclusion from empirical observations” (Ghauri & Grønhaug, 2002, p. 13). By sharp contrast, a deductive method involves the collection of data and the construction of theories based on specific observations (Saunders, P., & Thornhill, 2003, p. 85). Alternatively, the combination of these two methods can devote to building and testing theories at the same time.

In this case, deductive research is applied. The author observes a real carriage case which will be tested against the ground theories of intermodal transport chain, thus draws a conclusion. From a scientific perspective, it is labeled as a descriptive study, which describe a phenomena associated with a subject population. The objective of description can be reached by both qualitative and quantitative techniques. Firstly, qualitative method is defined “as an array of interpretative techniques which seek to describe, decode, translate and otherwise comes to term with the meaning, not the frequency of certain more or less naturally occurring phenomena in the social world” (Cooper & Schindler, 2008, p. 162). In a quantitative research, on the other hand, “findings are arrived at by the statistic methods or other procedures of quantification” (Ghauri & Grønhaug, 2002, p. 86).

As to this thesis, qualitative method is used as the main theme. Owing to its flexible nature, this method offers explorative findings and in-depth knowledge of the current business practice (Gray, 2009, p. 166). Nevertheless, the research still includes a hold of numerical data and figures.

Data collection

The classification of data collection distinguishes between the monitoring and interrogation/communication processes. Monitoring includes studies in which the researcher inspects the activities of a subject or the nature of some material without attempting to elicit responses from anyone. In the interrogation/communication study, the researcher questions the subjects and collects their responses by personal or impersonal means. (Blumberg, Cooper & Shindler, 2008, p. 197.)

The theoretical part of the thesis relies mostly on monitoring study. In that sense, collected reference information originates from formal studies, books and academic articles about logistics, transport and intermodal transport issues.

The empirical part of the thesis, on the other hand, is based on communication. Qualitative data is consolidated from archival reports (i.e. service records, lists, maps and charts) and direct observation (i.e. a field visit to Cai Mep Port). Remarkably, the comprehensive interviews with Mr. Pham Quang, Director of Sai Gon Cuu Long Logistics and Trading Company provided precious insights into the contemporary intermodal practice in Vietnam, some shortcuts to the prior history of the case, and some relevant figures of freight rates.

1.4 Scope and limitations

First and foremost, the scope of thesis is limited to freight transport despite the fact that both people and freight transport can be considered from an intermodal perspective.

Intermodal transport, in fact, can be provided by various combinations of road, rail, sea and air transportation modes. Within the parameters of this thesis, the author particularly focuses on the ocean navigation, and the other combinations of modes include the only use of short haul road transport in Southern Vietnam, and either long haul rail or road transport in Northern Europe. In consequence, such intermodal terminals as sea-port container terminals will be involved in the chain as service centers. Details about distribution centers and rail terminals are not discussed.

As mentioned, the case door-to-door service chain involves the combination of seaborne transport and road/rail transport between two terminals. In this case, the task of ocean navigation is not carried out by the freight forwarded itself, instead contracted to an external shipping line. Choices of the receiving and delivering ports remain with the shipping line from the beginning. Hence, there will be no

analysis of port selection as well as berthing, mooring and pilotage arrangements between the shipping line and port operators.

Regarding maritime routing, there are 9 vessels calling at Cai Mep Port in the route NE5 provided by the Hanjin shipping line as clarified later in chapter 4. However, only configurations of the vessel Port Kelang are taken into consideration. Sai Gon Cuu Long indeed needs an efficient tracking system for this container ship with the information updated continually by the shipping line.

Amid research, it is recognized that the activities happening in the port of delivery happen in an opposite order to those in the port of receiving. In that sense, provided that comprehensive research has been made into operation planning in the former one, there will be no further discussion about the later.

As titled, the thesis deals with granite, a traditional product of heavy industry. Still, the procedures of consolidation, handling and distribution will not regard it as such a dry bulk cargo. Instead, ISO container-based systems are used as the main theme. Correspondingly, containers are handled as a load unit throughout the chain. The use of ISO containers is also restricted to those types designed to be hauled by road, rail or vessel, not aircraft containers or oversize ocean containers. From the scientific side, 20 foot containers are deployed due to the heavy nature of granite. However, this research is not explaining any technical issues but assuming that specific requirements for security and safety of containers are all met. The case transshipment chain of containers physically ends once containers are received at certain warehouses in Munich, Budapest and Warsaw. Hence, there will be no further discussion about the process of de-consolidation and reverse transport of empty containers.

Transport as a contractual arrangement is a complex process in which involved parties are subject to comply with much regulation, involving specific benchmarks in employing people, damage and risk liability, insurance, etc. (United Nations Development Program, 2009). Within the parameters of data sources, no intensive but general instructions about documentation will be given in this study.

Last but not least, in freight rates calculations, surcharges are to some extent controversial since they include more than 20 types of relevant fees. Hence, this study will only consider the charges that are most concerned by shippers: Currency Adjustment Factor and Bunker Adjustment Factor. Further explanation of these concepts will be presented in section 2.7.1.

1.5 Thesis structure

Port-hinterland dynamics of the case study will be approached chronologically. To structure the research, the author follows a classical approach of examining issues and methods, in which levels of operational planning and management will be respectively presented.

The framework of this research follows the streamline of containers from warehouses in Southern Vietnam to the final warehouses in Northern and Central Europe. Theoretical and empirical parts are the backbones of this thesis. To begin with chapter 2, the theoretical part provides a concept of intermodalism in its original and variable forms, and how to approach it as a chain and an extended chain. This chapter goes further with the analysis of intermodal transport systems in terms of technological elements and organizational elements. Issues of intermodal transport operations and performance measurement are also presented.

In the empirical part, a transcontinental Asia- Europe chain is examined to identify the focal activities and actors involved in an effective multimodal freight network. The purpose of chapter 3 is to present a framework for freight forwarding arrangements in which the presence of intermodal transport operators is briefly reviewed along with the documents regulating their responsibilities. Also in this chapter, configurations of the two case ports and transport modes are elaborated on. Next, chapter 4 explores the key issues in port operation planning at the port of shipment and the port of destination. The main points of hinterland transport practices in the export and import zones are correspondingly discussed. Chapter 4 ends with the cost, time calculations and benchmarking results. Up to this point, the research question is basically answered. Subsequently, chapter 5 pinpoints some strategic remarks after making conclusions about the overall cost and timing

of the chain. In the end, the paper is concluded in chapter 6 which will synopsize the main idea of the study. The content of these parts are visualized in the following Figure 2. In this case structure, C stands for chapters.

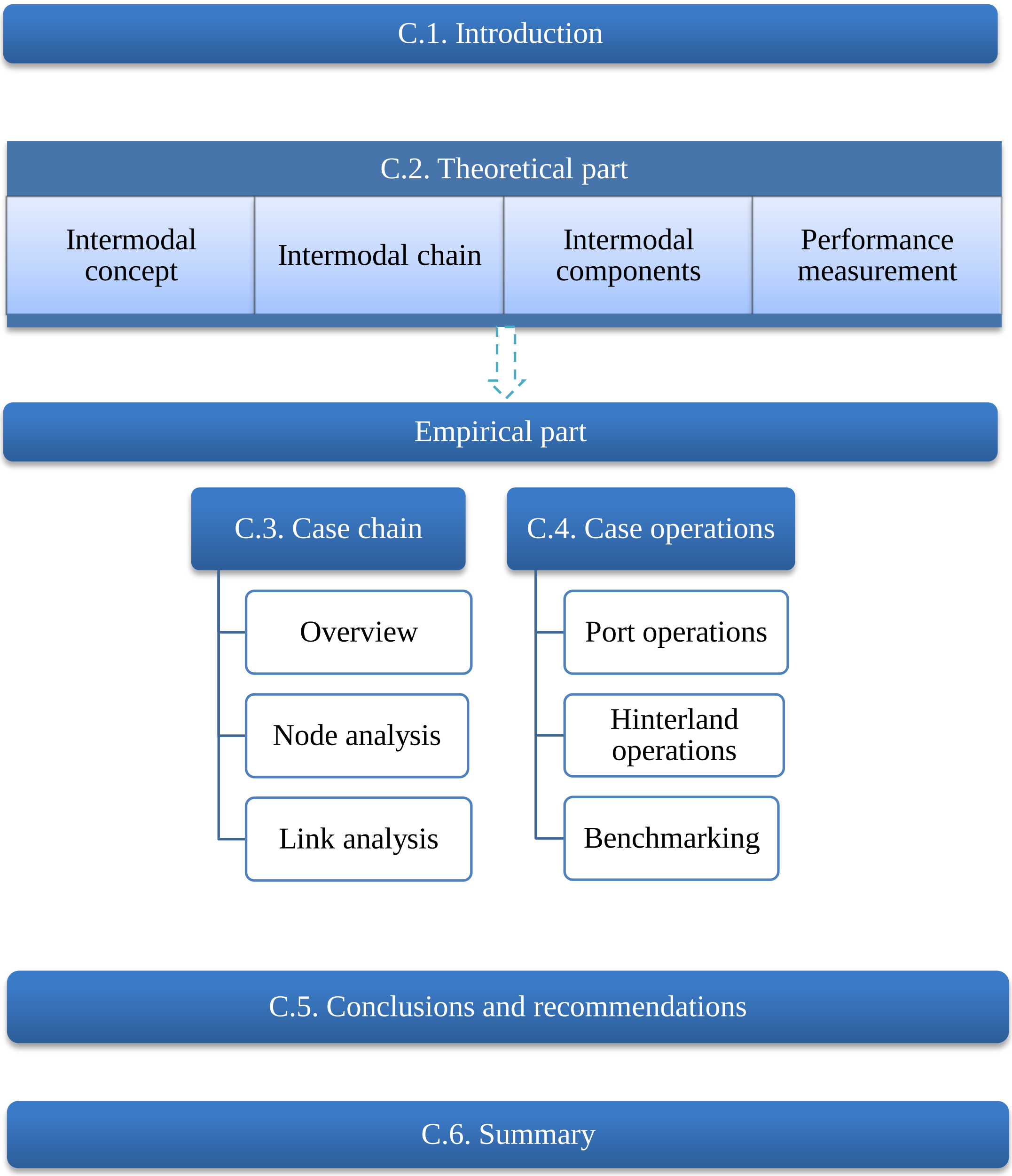

FIGURE 2. Thesis structure.

2 INTERMODAL TRANSPORT SYSTEM

In general, a system can be understood as a set of different elements so connected or related which performs a unique function not performable by the elements alone (Harrington, Carr, & Reid, 1999, pp. 54-57). Likewise, an intermodal freight transport system can be regarded as a structure consisting of various technical and managerial elements. In this context, technological elements will be discussed in terms of intermodal modes, intermodal terminals, and intermodal vehicles and equipment. On the other hand, the concept of managerial elements will be elaborated on in recognition of intermodal transport operators and their relevant liability. After all, insights into intermodal transport operations and pertinent performance indicators will be revealed. Yet first and foremost, the concept of intermodalism will be reviewed in the following subheading.

2.1 Intermodal transport concept

Prior to the era of intermodalism, all modes saw each other as competitors, trying to exploit their advantages in terms of costs and service with a view to maximize the line haul productivity as much as possible. Competition between the modes has therefore erred on producing a segmented and un-integrated transport network. As of 1960s, efforts to integrate different transport systems of separate modes into intermodalism took place. The adaptation of intermodalism involves at least 2 modes in a single trip, exploiting them in the most productive manner. For example, the line-haul economies of rail can be utilized for long distances, and the efficiencies of trucks in subsequent haulage for the flexible local pick-up and delivery. (Rodrigue, Slack, & Comtois, 2011.)

Notwithstanding the increasing emphasis on intermodalism by governments and industries, no precise consensus definition of the shuttle service does exist. In this chapter, several typical definitions for intermodal transportation will be cited along with some potentially important concepts, which help capture the full scope of intermodal systems. Subsequently, literature reviews on intermodal transport chains and their functions will be presented.

2.1.1 Intermodal transport definition

In 1993, the European Conference of Ministers of Transport defines intermodalism as "the movement of goods in one and the same loading unit or vehicle which uses successively several modes of transport without handling of the goods themselves in changing modes" (Tuimala & Lukka, 1999, p. 3). In practice, this definition appears to be general and thus less pertinent in this context. Another proposal is "a vertically and horizontally integrated door-to-door transport system managed by an external integrator, comprising partnerships, utilizing multimodal transport system capabilities and the advantages of intermodal transport units with a purpose to create strategic alternative to physical movement of goods from the consignor to the final customer" (United Nation, 1980). To a large extent, this notion has the same meaning as freight forwarding, a set of full-house intermodal transport services outsourced to a third party logistics provider (Tuimala & Lukka, 1999, p. 7). Contracting out logistics to a third party brings about relative improvements of service and productivity since the duty of transport is in the hands of an expert who knows the problems and owns resources. In all, the key point is that intermodal transport is not the mere addition of transport modes together, but instead a mode in its own rights, with specific structures of organizations and production (Bukold, 1993, p. 24).

2.1.2 Related terminology

As a matter of fact, several concepts are misleadingly considered synonymous to intermodalism when having relatively similar characteristics. The intriguing issue in this subheading is to present the exact meanings of multimodal transport and combined transport. These are the most relevant terminologies to intermodalism.

Common sense presumes multimodal transport as the preceding version of intermodal transport. In other words, multimodalism constitutes the physical prerequisites for the practicability of intermodal transport without a strategic approach. This transport method is defined as "the carriage of goods by at least two different modes of transport on the basis of a multimodal transport contract from a place in one country at which the goods are taken in charge by the multimodal transport

operator to a place designated for delivery situated in a different country" (United Nation, 1980). The employment of multimodal transport system can be a necessity to overcome geographical hindrances by loading vehicles upon or into each other (Woxenius, 1998, p. 93). But the ultimate goal is to achieve lower overall costs, shortened transit times in long haul trips, reduced environmental encumbrances and road congestion, and improved service quality (Proffitt, 1995, pp. 20-24).

Woxenius (1994) states that combined transport is a system in which freight is carried through by rail, inland waterways and sea (to avoid bottlenecks on the roads) for the major part of the journey, then by minimal- length road links at the end of the chain (Tuimala & Lukka, 1999, p. 7). In the shaping of combined transport, road haulers and forwarding agents are the main players; whereas railway, inland waterway and short sea shipping companies play as subcontractors (International Road Transport Union, 2003, p. 1).

2.1.3 Intermodal transport chain approach

Chain approach is apparently an optimal way to visualize the real process of intermodal transport. In that sense, the concept of a transport chain should be viewed as a single entity rather than fragmented groups, each performing its own function (Gentry, 1996, p. 37).

Translated from the subsequent Figure 3, an intermodal transport chain is divided into 2 distinguishing network-alike elements: links and nodes. Links refer to transport activities utilizing at least 2 modes along infrastructural elements such as road, railway, or maritime paths. Nodes, on the other hand, represents transshipment locations or points (ports, terminals specifically) that support the transport function of freight movement and storage. The number of nodes and links will constitute the complexity of an intermodal transport chain. Therefore, to achieve the required efficiency, there is a need to maintain effective execution of transport links and efficiency in connecting several transport modes into a single integrated freight movement. (Tuimala & Lukka, 1999, pp. 9-10.)

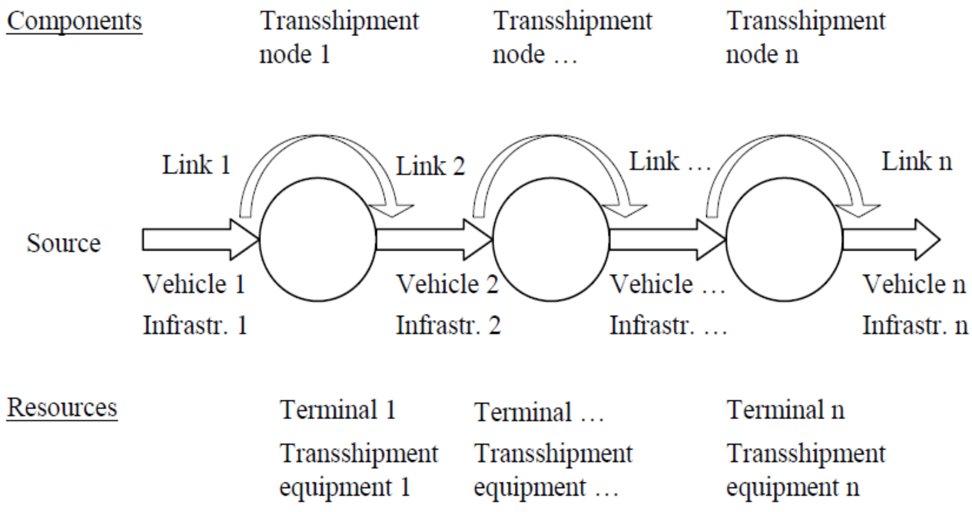

FIGURE 3. Intermodal transport chain (Woxenius, 1998, p. 101).

In fact, however, an optimal transport chain involves a number of organizational elements other than the notions of location and infrastructure within links and nodes. The process is now more than simply taking a consignment from a ship or a factory, transferring it to railroad, and eventually transferring to drayage contractor for delivery to a consignee. As shown in Figure 4, it might also involve several businesses and legal interactions with existing governmental policies and regulations that are established by a complex network of influators.

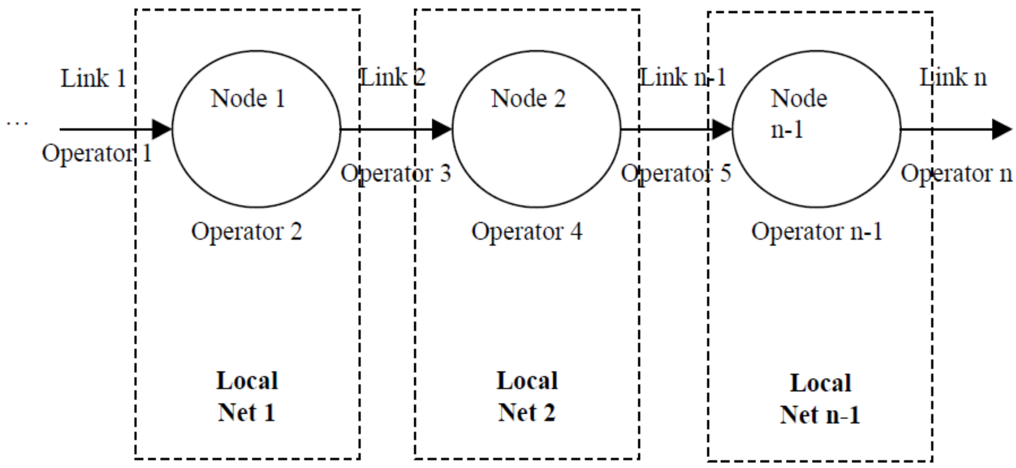

FIGURE 4. Extended intermodal transport chain (Tuimala & Lukka, 1999, pp. 11-12).

Albeit not being official chain parties, influators are engaged in intermodal transport chains to develop strong relationships, to share resources and to provide locally coherent services in co-operation with the consignee and consignor. Located mainly at nodes and points of intersection, they are having substantial influence on the competitiveness and efficiency within sections of the whole channel. Such influators can be port authorities, customs officials, and value added logistics service providers, etc. (Tuimala & Lukka, 1999, p. 11.)

2.1.4 Functions of intermodal chains

The transshipment of one unit from one mode to another happens at a terminal specifically designed for a specific purpose. According to Figure 5, intermodal chain is characterized by 4 main functions: composition, connection, interchange and decomposition. (Rodrigue, Slack & Comtois, 1998.)

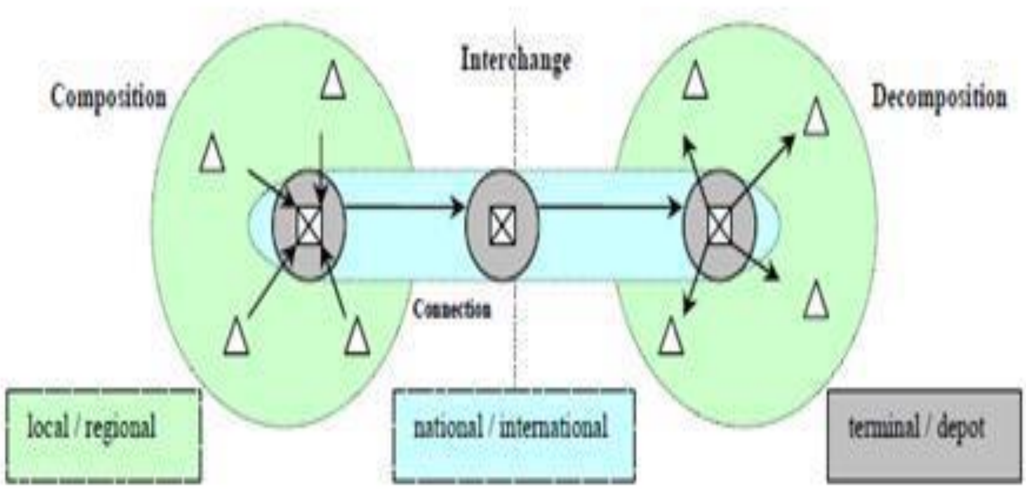

FIGURE 5. Intermodal transport chain and its function (Rodrigue, Slack & Comtois, 1998).

Initially, loads of freight are collected from various suppliers by truck, rail or maritime shipping and then assembled at a terminal which presents a point of convergence between the local/regional and the national/international distribution

systems. At this “first mile” stage, freight is consolidated into specific handling units, packaged and warehoused before being transferred to the next step. (Rodrigue, Slack & Comtois, 1998.)

Next, the connection phase happens at the national/international level. In effect, high capacity transport modes (a containership, a freight train or fleets of trucks) are made use of to enable the flow of consolidated freight between at least two terminals. The efficiency of the connection phase is determined by economies of scale residing in long haul trips and an adequate frequency of service. (Rodrigue, Slack & Comtois, 1998.)

In many cases, the interchange stage might occur at terminals which are commonly referred to as intermediate hubs. Those terminals play a dominant role in streaming the flow of goods, providing sufficient fluidity and continuity within the national or international transport systems. (Rodrigue, Slack & Comtois, 1998.)

Finally, one of the most difficult segments of the transport chain is visualized. As long as a load of freight reaches a terminal adjacent to its destination, it is decomposed and transferred to a local/regional distribution system. Closely linked with the function of consumption, the decomposition step principally occurs in the metropolitan areas and encompassed urban logistics. It also entails resultant activities supporting the reverse logistics of depots. (Rodrigue, Slack & Comtois, 1998.)

2.2 Intermodal transport modes

Of critical importance in constructing an intermodal transport chain are a number of specific links and nodes. As mentioned, links refer to transport activities utilizing at least 2 modes along infrastructural elements such as road, railway, or maritime paths. Generally, the concept of links is largely about the selection, combination and utilization of transport modes. The following subheading is indeed indicated to describing the functions and characteristics of intermodal modes as well as various aspects of intermodal modal selection.

2.2.1 Functions of intermodal modes

Transport modes are an important component of the distribution system. They are the means by which mobility of freight is made feasible between the nodes. Depending on the surface over which they travel, transport modes are categorized into 3 main types: land (train, road and pipelines), water (shipping) and air. (Slack, Rodrigue & Comtois, 1998.)

In the case of modal flow in intermodalism, distinct modes are deployed in different legs of the transport chain depending on the advantageous characteristics they offer. The efficiency of a transport system probably rests on the efficiency of these technical elements. To follow the study's parameters, this section only deals with the land (road and rail) and sea water modes only.

2.2.2 Characteristics of intermodal modes

Transportation modes distinguish themselves by typical characteristics. Taking such characteristics into consideration, both in terms of advantages and disadvantages, will lead the transport operator to an optimal modal choice.

Apparently, road transport is the dominant mode, with the lowest level of physical constraints. It is also the main method used for national freight transport in all European nations. This type of transport mode operates at low to medium costs, characterized by its average level of flexibility and door-to-door capabilities. Yet in practice, the high cost of maintenance merely limits road transport to light industries, in which small batches of freight can be moved in a rapid manner. (Stuart, 2009, p. 23.)

By mere contrast, rail transport has traditionally been associated with heavy industries until recently, when containerization and intermodalism allows a better interconnected link between different modes (Slack, Rodrigue & Comtois, 1998). In practice, this kind of mode is only practicable when infrastructure premises of traced paths, bound vehicles, and specific locomotives are available. The possible

diseconomies incurred in short haulage trip may also detract the attractiveness of road transport.

Last but not least, maritime transport is referred to as a form of freight delivery between port terminals. Owing to its buoyancy and limited friction, the main advantage of water transportation is its economies of scale and the ability to move cargoes in unlimited quantities and sizes over long distances. However, terminal costs and inventory costs of maritime transportation are among the most expensive. On the other hand, this mode underlines some navigational challenges mainly connected with dominant winds, currents and general weather patterns. The expression of maritime transportation rests on the planning of regular itineraries, also known as maritime routes. (Rodrigue, Notteboom & Slack, 1998.)

With respect to the concept of maritime routes, they are defined as the corridors of kilometers/miles in width which try to eliminate discontinuities of land transport by linking distant ports. In other words, maritime routes draw arcs on the earth water surface as intercontinental maritime transportation efforts to follow the great circle distance. In the wake of containerization, the flexible term of Pendulum service emerges as a favorite form of containerized maritime circulation. It constitutes a series of port calls along a maritime range, commonly encompassing a transcontinental service from ports in another range and structured as a continuous loop. (Rodrigue, Notteboom & Slack, 1998.)

2.2.3 Intermodal modal choice

In operational planning, different transport modes are deployed in different segments of the transport chain corresponding to certain demands of freight traffic. In total, there are 6 factors that need to be considered in evaluating and planning the dispatch of any item (Stuart, 2009, p. 22).

TABLE 1. Modal selection factors (Stuart, 2009, p. 22).

Cost	Relative costs (i.e. of vehicles, fuel, labor, management)
Reliability	Past experience of the operator
Time base	Frequency of collection times and dispatch times
Forced routing	Customers who buys on ex- works terms will decide
Operational fac-tors	- Customer location - Order size - Service quality requirement - Product nature (hazard, size, weight, liquid, etc.)
Strategic factors	- Manufacturing premises - Warehouse location - Marketing/Customers strategies - Budget

As listed in Table 1, costs, reliability, time base, forces routing, operational and strategic factors are focal indicators of modal selection. In many cases, these factors may be conflicting, especially in the example of cost and time base trade-off. All things considered, the smooth transshipment between different modes in the intermodal transport chain must be ensured.

2.3 Intermodal transport terminals

As mentioned before, nodes of transport chains are practically referred to as transport terminals. In this section, one of the main types of intermodal terminals- port terminals- will be examined with respect to functions, configurations, terminal sites, and its connection with hinterland networks. Yet firstly, categories of intermodal transport terminals and their generic functions will be overviewed.

2.3.1 Types of intermodal tranport terminals

Indicated in Figure 6, there are three main types of intermodal terminals, namely port terminals, rail terminals, and distribution centers (Slack & Rodrigue, 1998).

Yet in this research, particular focus will be around the theory of port terminals as containers are not to be processed at distribution centers or rail terminals.

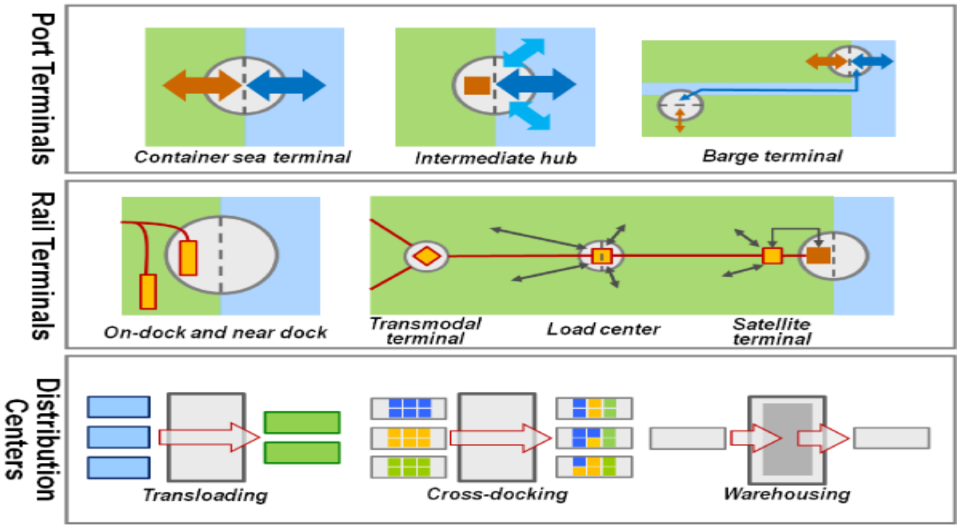

FIGURE 6. Types of intermodal terminals (Slack & Rodrigue, 1998).

In general, any container terminal can be modeled as a set of elementary functions: a transport function for transporting containers, a transfer function for transshipping containers and a stacking function for storing containers (Jaap, Ottjes, Hans, Mark, Joan, & Gabriel, 2007, p. 20). The interconnection between these elementary functions is illustrated in the following Figure 7.

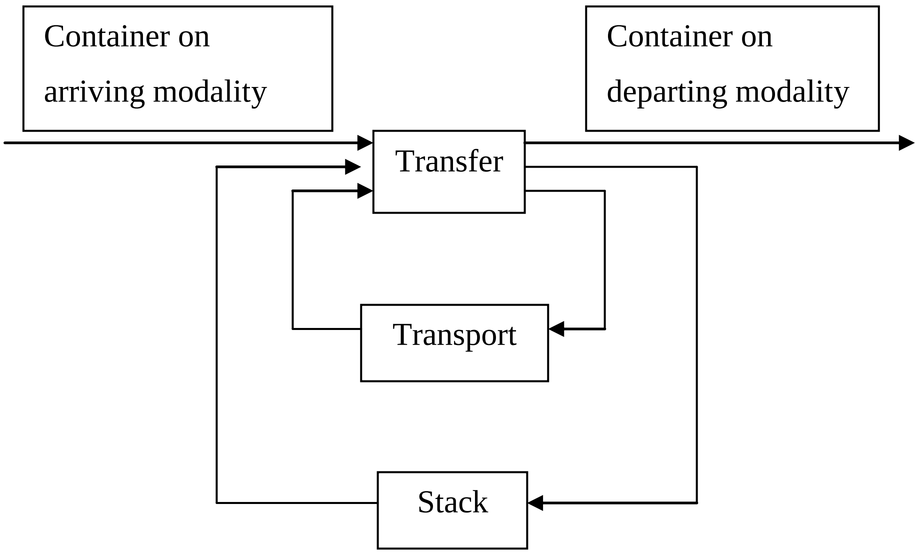

FIGURE 7. Container terminal functions (Jaap, Ottjes, Hans, Mark, Joan, & Gabriel, 2007, p. 20).

While a transport function deals with the movement of containers within a transport mode/vehicle, a transfer function is related to the movement of the handling units between different interterminal systems. On the other hand, a stacking function entails the function of buffer areas into which containers are stacked in a number of blocks. Translated from the above figure, a transfer function can temporarily be coupled to both transport and stack functions. In this sense, a set of quay cranes (transfer function) may be coupled to an AVG system (transport system), and a collection of stacking cranes (transfer function) may be coupled to a stack area (stack function). (Jaap, Ottjes, Hans, Mark, Joan, & Gabriel, 2007, p. 20.)

2.3.2 Port terminals

Port terminals allow the largest flow of freight, more than any other modes combined. The following subheadings are designated to further explore varied aspects of this notion.

2.3.2.1 Functions of port terminals

As a matter of fact, a port terminal demonstrates almost every function that can be found in the basic concept of terminals. Figure 8 shows that a port terminal reaps the advantage of a geographical location so as to confer a relative level of accessibility to another transport system on a regional/ global scale or to a local one within a market area. It can be a place where freight either originates and terminates, or is handled throughout the transport chain in batches, not individually. Coming in different designs that are customized for particular modes, port terminals involve the use of some specific infrastructure. (Slack & Rodrigue, 1998.)

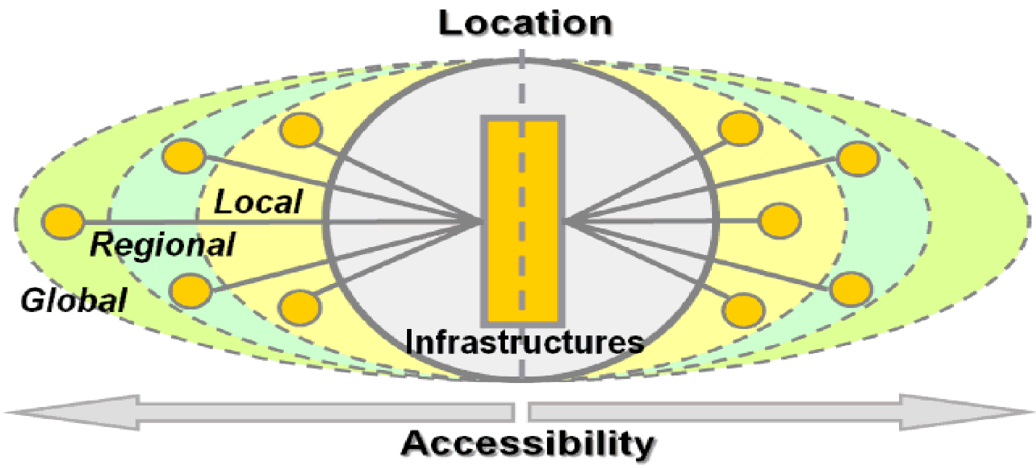

FIGURE 8. Functions of transport terminals (Slack & Rodrigue, 1998).

In the wake of the super-sized maritime container ships invention, intermediate hub terminals emerged, serving the role of a buffer where containers await to be loaded from one shipping network to the other. In some cases, port terminals perform as points of interchange where the movement of the same transport mode is involved. Otherwise, they may be points of transfer where freight is streamed along different modes. (Slack & Rodrigue, 1998.)

2.3.2.2 Configurations of port terminals

Figure 9 presents the standard configuration of a container sea terminal. The main modalities include long-sea, short-sea, inland waterway, road and rail. Of these, a major proportion is dedicated to storage activities.

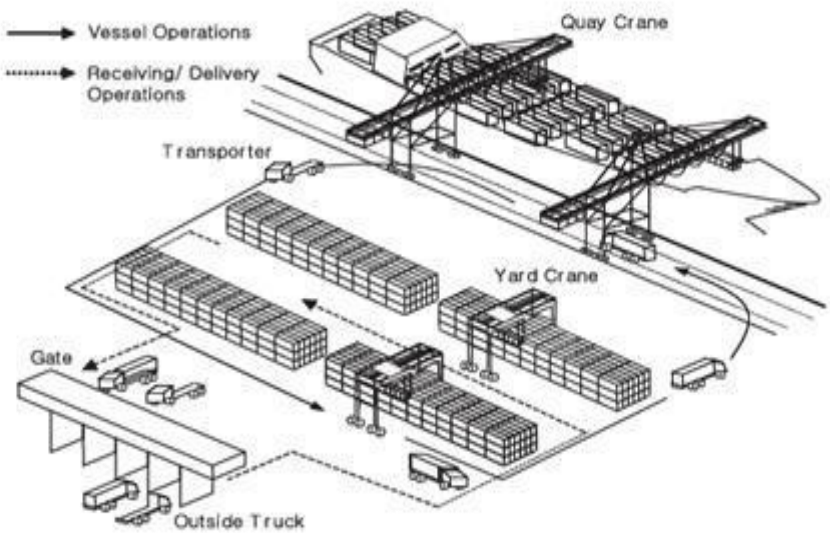

FIGURE 9. Port zones (Park & Kim, 2003, p. 23).

In all, we consider a container port with 3 main areas. The sea side of a port terminal is the interface between the inner-port area and the far-reaching ocean. Operating in this area are mostly quay-cranes, which provide the loading and unloading services of containers into and from ships. The land-side area, on the other hand, provides the crossing point between the terminal and its proximity hinterland zone. Herein encompasses an intensive cluster of associated equipment, added value activities as well as business interactions. Last but not least, the third area of a port terminal- the so-called container yard- is predominantly dedicated to stacking loaded and empty containers for import and export. (Crainic & Kap, 2005, pp. 477-478.)

2.3.2.3 Port terminal sites

The amount of freight loads processed at ports is by far the greatest, even more than the total in other terminals. In addition to the need of facility establishment, ports must present a convenient point of convergence between inland and maritime transport. As shown in the following figure, there is a variety of port sites which differentiate themselves by geographical factors: (Port Sites, 1998.)

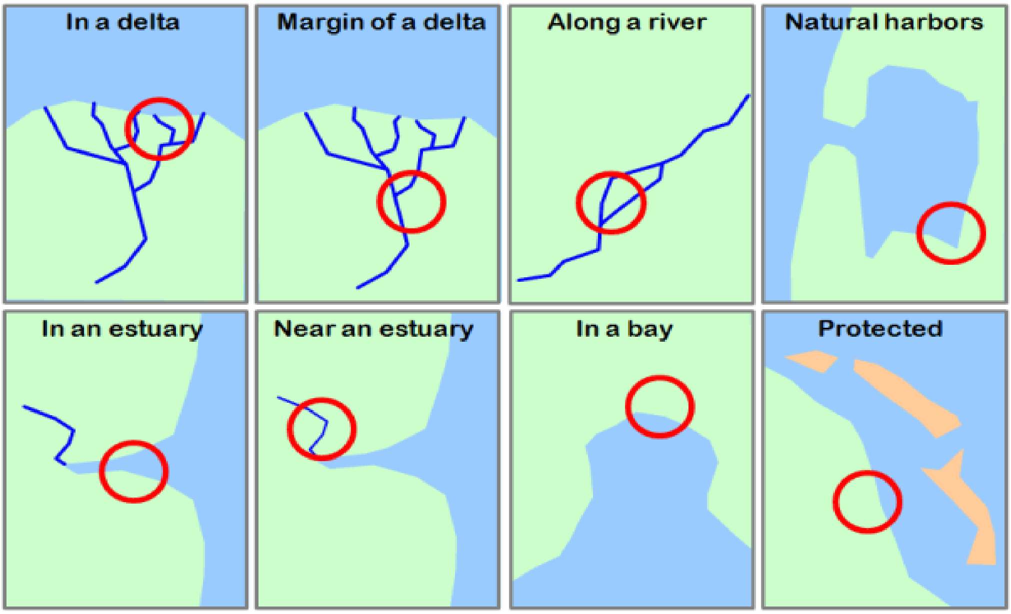

FIGURE 10. Port sites (Port Sites, 1998).

In general, port terminals can be directly linked to either a river or a sea. They can also be located in a delta, in the margin of a delta or along a river. Otherwise, ports will be found in an estuary, near an estuary, in a bay, on natural harbors or adjacent to a protected maritime area. Nowadays, with regard to geographical sites, the global intermodal transport system has underpinned the role of port terminals as gateways. Figure 11 reveals a strategy that port terminals may take advantage of.

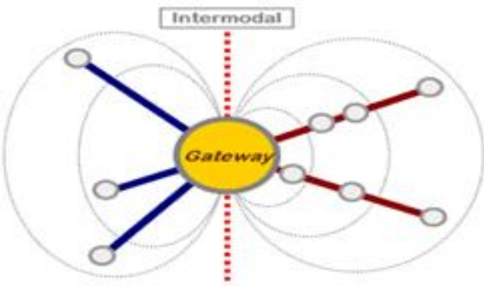

FIGURE 11. Port terminals as gateways (Slack & Rodrigue, 1998).

The apposite development of intermodal terminals into gateways has offered better facilities of convergence and transshipment in the worldwide maritime circula-

tion. Particularly in a transcontinental merchandize, a gateway commands an entrance to and an exit from a region, a country or a continent, and commonly implies a shift from one mode to the other (such as maritime / land). For that reason, it allows a momentous congregation of transport infrastructure and linked activities such as warehousing, insurance and finance, etc. (Slack & Rodrigue, 1998.)

2.3.2.4 Port terminals and hinterland transport

In essence, port terminals are active in a system of freight distribution which entails the notions of hinterland and foreland activities. While foreland means the ports and overseas markets connected by shipping lines from the port, the concept of hinterland refers to a land space, as such a regional market area, over which a port terminal distributes its traffic, services and interacts with clients. From the geographical perspective, fundamental hinterland binds a cluster of customers into a traffic zone due to proximity. The competitive hinterland, on the other hand, displays the area over which port dynamics have to compete with others for business. Inbound hinterland traffic is more consumption based, while outbound hinterland traffic is an outcome of extraction or production. In both cases, container intermodal ports serve as a place of convergence for the traffic coming by roads or railways. (Slack, Rodrigue & Notteboom, 1998.)

In the shaping of intermodal transport solutions, port terminals and hinterland interactions play critical roles. Actually, the two concepts should be regarded as a continuum rather than distinct areas. Any changes in the dynamics of port terminals will result in some opportunities and challenges in inland traffic generation. This is particularly true in the case of door-to-door services, where the continuity of freight distribution must be insured through the legs of maritime circulation and dispatching loads of freight to final destinations. In such a case, port terminal is a critical point of maritime and land interface, while hinterland is a key area for competition and coordination among actors (Slack, Rodrigue & Notteboom, 1998).

2.4 Intermodal transport equipment and vehicles

Port handling efficiency is one key competitive advantage of sea ports. Explicitly, how productive a port is much depends on its berth depth, its storage facilities and, its crane productivity (Beßler, 2010). Proper handling also means proficient interactions between technologies and handling units. Step by step, this section will provide insights into containers and a series of commonly used intermodal equipment and vehicles. Comprehensive understanding of technical resources may lead to credible port solutions.

2.4.1 Containers

On the whole, containers are the foremost expression and a major component of intermodal transport which enables maritime and land transport modes to interconnect more proficiently. Containerization involves the movement of cargo where they are stowed into a large container and then transshipped as a single unit to a dedicated destination (Stuart, 2009, p. 27). The initial impulse to a container-based system was attributed to the advantages of standardization, safety, less handling, improved transfer equipment as well as cost economies, excellent international door-to-door service, and visible growth of the industry (Crainic & Kap, 2005, p. 472).

Most maritime containers are made of steel, while the majority of domestic containers are made of aluminum, conferring hardiness and flexibility. At the beginning, containers came in as large size boxes with a double door at the end and corner twist locks to facilitate universal handling. Yet thus far most international container traffic has switched to 20 foot or 40 foot container basis. Accordingly, containers have been standardized regarding dimensions and load capacity corresponding to the regulations of the International Standard Organization, which are largely accepted all over the world nowadays. As afore mentioned, granite stone transportation is restricted to the use of 20 foot containers. Dimensions and maximum load of 20 foot containers (TEUs) are depicted in the table below.

TABLE 2. TEU dimensions and maximum load (United Nations Development Program, 2009, p. 3).

Sea Freight Containers	
	20 foot container
Capacity (m3)	30
Internal dimensions L x W x H (meters)	5.89 x 2.32 x 2.23
Door W x H (meters)	2.30 x 2.14
Maximum load (tons)	18

In reality, there probably exist some slight variations in these figures depending on the producers of containers (United Nations Development Program, 2009, p. 9). Accordingly, the maximum volume in metric units of TEUs may reach 38 m^3, and the maximum payload mass 21.6 tons (Containerization, 2011). Shipping lines are free to use whatever types of container as long as they are complying with requirements of versatility, safety and specific regulations about the maximum load in definite countries.

On the basis of structure and use purposes, there are 9 distinctive types of containers, including: general purpose, reefer, open top, flat rack, open sides, half height, and some special types for the conveyance of liquid, grain, etc. Nevertheless, classifications based on Sea/Ocean Services only categorize containers into Full Container Load (FCL) and Less than Container Load (LCL). FCL is a “door-to-door” concept according to which shippers hand the containers over to a carrier after they fill the complete containers themselves, load them at their premises, and have them stowed and sealed. Upon arriving at the destination premises, containers will be unpacked by consignees. This might be suitable for those shippers who have sufficient cargoes to fill a complete container, or prefer to load the containers themselves. Otherwise, they can resort to LCL service if there is not sufficient freight to fill in a complete container. In this case, cargoes from various shippers are delivered to one carrier to be stowed into containers by the carrier themselves. Once containers arrive at the carrier’s depot, they are unpacked and consignees will come and collect their relevant cargoes. (Stuart, 2009, pp. 27-28.)

2.4.2 Intermodal handling equipment

As mentioned, the main functions of a port terminal are to provide transferring, transporting and stacking facilities for containers within the port site. In practice, smooth-running port operation means proper use of technically sophisticated lifting and transferring equipment. Common intermodal handling equipment includes quay cranes which transfer containers from sea vessels to trucks/rail wagons; gantry cranes operating in storage yards; and folk lifts moving around on the land side of port premises.

The folk lift is by far the most basic intermodal equipment but entails some limitations. In practice, the usage of folk lifts is merely limited to loaded 20 foot containers or empty containers of other dimensions. (Slack & Rodrigue, 1998.)

Working on the land side of ports, straddle carrier (gantry crane) is a flexible piece of equipment that can be deployed in various intermodal operations, including loading/unloading railcars and trucks as well as stacking containers up 4-high. Its stacking density varies between 500 and 700 TEU per hectare. (Slack & Rodrigue, 1998.)

Quay cranes work on a hoisting system basis, designed for the purpose of unloading or loading containers from quays to vessels and vice versa. Currently, a Panamax portainer can accommodate ships up to 13 containers alongside and a Post Panamax portainer 18 containers in width. Since quay cranes cannot move, containers are brought to them by straddle carriers. They probably operate on the seaside of ports. (Slack & Rodrigue, 1998.)

2.4.3 Intermodal vehicles

Undoubtedly, the development of intermodal equipment must be parallel with that of intermodal vehicles. Up till now, common intermodal vehicles of sea, road and rail transport are cellular container ships, piggybacks (rail transport); and trailers (road transport). Their application will subsequently be described without any emphasis on technological aspects yet on practical sides.

Container ships in sea transport

Container ships are used for container shipping by sea. Their capacity is preliminarily counted on a TEU or FEU basis. The most recent technological transformations affecting water transport have focused on improving the size, the automation and the specialization of vessels. (Rodrigue, Notteboom & Slack, 1998.)

At present, there are 6 generations of container ships ranked based on capacity as depicted in Table 3. Basically, vessels of different sizes are utilized on different routes: those with capacity of about 1,000 TEUs are appropriate for feeder services, whereas larger ships of thousand TEUs better suite transcontinental maritime routes. (Larry, 2011.)

TABLE 3. Container ship generations (Rodrigue, Notteboom & Slack, 1998).

		Length	Draft	TEU
First (1956-1970)	Converted Cargo Vessel Converted Tanker	135 m 200 m	< 9 m < 30 ft	500 800
Second (1970-1980)	Cellular Containership	215 m	10 m 33 ft	1,000 – 2,500
Third (1980-1988)	Panamax Class	250 m 290 m	11-12 m 36-40 ft	3,000 4,000
Fourth (1988-2000)	Post Panamax	275 – 305 m	11-13 m 36-43 ft	4,000 – 5,000
Fifth (2000-2005)	Post Panamax Plus	335 m	13-14 m 43-46 ft	5,000 – 8,000
Sixth (2006-)	New Panamax	397 m	15.5 m 50 ft	11,000 – 14,500

Of great relevance in this study is the world largest ship transverse Panama canal, referred to as Post Panamax (maximum capacity of 8000 TEUs). This type of vessel is customs- built, and yet requires specialized deepwater terminals to call at. Comprehensive description of this vessel type can be found in the case study.

Trailers in road transport

For inter- European Community movements, the common type of vehicle in road transport are trailers, which have a vast range of sizes as shown in Figure 12.

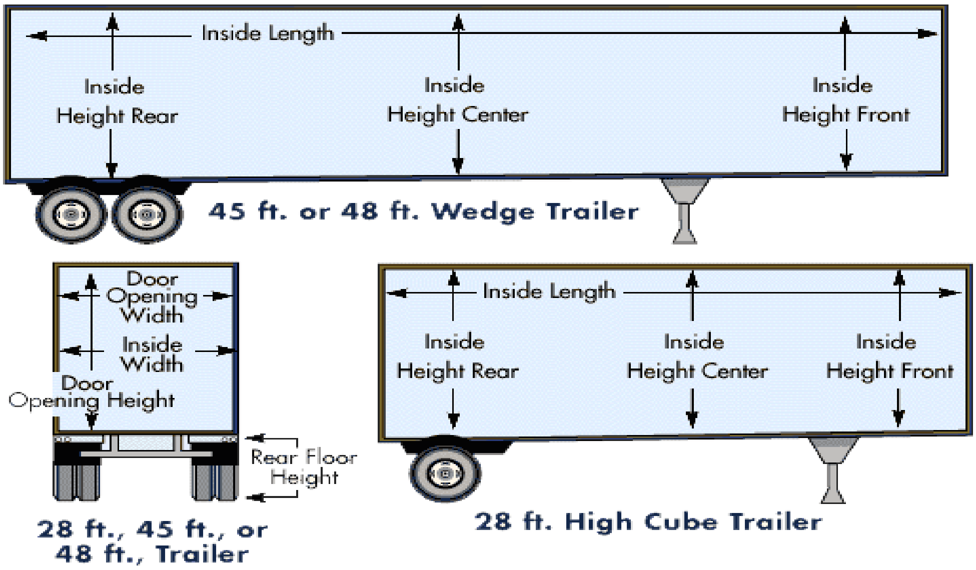

FIGURE 12. Trailer dimensions (YRC, 2011).

A trailer uses twist locks to fasten and engage containers to the carrying bodies so that they can be moved on road by tractors. Presently, there are no international standards set for trailers as found with ISO shipping freight containers, but we can notice from Figure 3 that some classifications still exit to clarify the internal and external dimensions of the vehicle. Accordingly, the maximum (L x H x W) dimensions of trailers are (48 ft. x 28 ft x 28 ft), equivalent to (14.6 m x 8.5 m x 8.5 m).

Piggybacks in rail transport

The piggyback (Trailer on Flat Car) method is commonly used in Europe, especially convenient when the transport distance is great. The concept is about truck trailers being loaded onto flat cars for shipment by rail (Stuart, 2009, p. 33). So far, the employment of piggyback system has brought positive effects in eliminating the time restriction and volume restriction that can be noticed in road trans-

port. However, it remains a costly undertaking due to the route limitations on many important rail lines and incompatible clearance for bridges and tunnels in fully scaled piggyback operations. The common dimensions (L x H) of piggybacks are (12.2 m x 2.7 m).

2.5 Intermodal transport operators

In door-to-door services, it is not likely that consignees and consignors will themselves conduct the process of dispatching or collection of containers. Instead, most of them will engage a third party logistics provider to take over the shipment. It is when the role of freight forwarders stands out. Inland carriers and shipping lines are also the main actors in making the shipment feasible in a shuttle service.

A forwarder is not part of the contractual arrangements made between the buyer and the seller, but reserves a particular role in the transport chain and assumes entire responsibility for the shipment from the moment cargoes become available. In most instances, they register consignments with carriers, call them forward for delivery to berth of the carrying vessel, prepare B/L, pay for the freight and related expenses, prepare necessary documents, and finally spread out documentation with instructions from their principals. Depending on local conditions, customs clearance may also be processed by these specialized firms. (United Nations Development Program, 2009, p. 10.)

Inland carriers are those who take over the consignment from the point of delivery and transport it to an indicated wharf/berth/warehouse of departure (United Nations Development Program, 2009, p. 10). At the other end of the shipping route, either the same or another carrier agent will again transport the consignment from the point of receiving to final destinations. Alternatively, this concept may be used instead of rail or road haulage firms.

Shipping lines are commonly known as overseas carriers who offer regular scheduled services calling at a number of ports. In many cases, a number of container ships will be involved into a single route with a view to insure a certain level of

service and frequency at port calls. In that sense, cargoes of small quantities but having high unit value can be assigned to any ship out of a fleet depending on the interests of shippers. Liner shipping services are available to any importer or exporter prior to demand. (Rodrigue, Notteboom & Slack, 1998.)

Apart from the mentioned actors, a transport chain may involve liabilities of some other sub-contractors who do not have direct contact with suppliers or principals. Common examples that can be signified are those firms offering container handling, warehousing, and banking services, etc. (United Nations Development Program, 2009, p. 11.)

2.6 Intermodal transport operations

While strategic planning by and large aims at long-term missions and visions of management, operational planning focuses on implementing and monitoring the physical flows. Operational planning results in a series of activities which are performed corresponding to standards/conditions set in strategic planning.

Optimal operational plans are joint efforts of all stakeholders at all levels. They all necessitate data of network, demand and operating characteristics. Some sections of operational planning include routing, schedule, crew assignment, connection patterns, and flow distribution. (Sussman, 2000.)

Routing is the mainstay of operational planning. Route assignment indicates how a geographical distance is covered from the point of delivery to end-customers (Benson, Bugg & Whitehead, 1994, p. 25). In practice, we define which countries/maritime areas that we will pass through, at the same time investigate suitable modes and infrastructure that supports such in certain links and nodes. In door-to-door services, final routing plan will undergo joint evaluation by various parties, among which the logistics service provider plays the main role. With the existing knowledge and business relations, they will allocate compatible infrastructure to make a practicable routing plan.

In accordance with routing, scheduling is a central part of operational planning. Dealing with requirements about time, an adequate schedule will foster the quality implementation of activities and organization. It is a critical basis for a satisfactory service of level. The schedule must be accountable and suites the departure and arrival requirements, for instance a vessel should depart on a given day to subsequently accommodate the agenda suitable to provide an agreed service. (Sussman, 2000, p. 21.)

Crew assignment is concerned with the allocation and provision of drivers to cater for the demands on traffic in a cost-effective manner recognizing that there is an uneven need (Sussman, 2000, p. 22). However, this concept is commonly known as the capacity to meet demands in various areas of transportation human resources, not only the assignment of drivers or crew members (e.g. managers, assistants, yard operators, etc.)

Flow distribution looks at the imbalance of flows, and how to distribute units within the transport system to where they are needed. Flow distribution plays a preponderant part in intermodal management. It may causes different problems due to geographical imbalance of demand, transportation orders, supply and available units. (Sussman, 2000, p. 25.)

Connection patterns are commonly known as the time needed for transfers. In some literature, connection patterns are seen as terminals. So as to operate as a transport system, connection patterns must be adequately scheduled (Sussman, 2000, p. 23). Connection patterns are tightly concerned with routing and scheduling. Any circumstance such as vehicle breakdowns, traffic congestion or unseen weather changes can cause connection patterns to be altered.

2.7 Intermodal performance measurement

An ideal evaluation of intermodal performance would be to define a reference point by means of which the system might be characterized as “good”. Nevertheless, in the context of an open and partial system like the case chain, such an absolute evaluation is impossible. Hence, final measurements will rest on the ben-

chmarking methodology. The so-called relative assessment “compares the system’s performance with the respective performance of another system of a similar type or with its performance in the past or future”. (Pau, Janjaap & Herman, p. 47.)

The major performance indicators of an intermodal transport chain include pricing, timing, service quality (including damage and loss control), and ease of use (including administration, asset management and human resources) (Ockwell, 2001, p. 11). In fact, assessment of transport chain performance, from the perspective of the service provider, should be able to deal with different information in precision and in measurement scale. Service quality and ease of use, however, cannot be retrieved in absolute terms within the parameters of this study. For that reason, the framework of performance assessment boils down to the analysis of pricing and timing.

2.7.1 Pricing

To customers, pricing outcomes are known as the freight rates that they have to pay to the transport service providers to move containers door-to-door. Assuming that intermodal operation will usually apply a through transport freight rate, freight rate per TEU is considerably a suitable measurement (Ockwell, 2001, p. 15).

Freight rates are paid by the service user to service providers to allow them cover the transport costs, at the same time create some profits for their business. In that sense, the only distinction between transport costs and rates is either a profit or a loss made by the service provider. Generally, freight rates are visible to the customer because transport service provider needs to provide this information to secure transactions. Due to competitive pressures, rates can be flexibly adjusted, provided that profitability is paramount. (Comtois & Rodrigue, 1998.) In this case, the freight rate is the total accumulated costs that Sai Gon Cuu Long must pay for moving the containers. The final freight rate in the contract term between Sai Gon Cuu Long and the buyer in Hamburg will be higher than the calculated figures in this so as to leave a space for business profitability.

In a door-to-door intermodal transport chain, a five part freight rate is to be paid by the customer, including payments for terminal handling charges, inland transport fees at both ends of trading in Southern Vietnam and Northern Europe, plus ocean freight rate.

Terminal handling charges (THC) are asked for by the shipping line to cover the cost of container handling, loading, unloading and other related expenses that they are charged by port operators at the port of shipment and port of destination. In some cases, terminal handling charges are compiled in surcharges. While freight rates are paid in US dollars, terminal handling charges normally in local currencies. (Terminal Handling Charges, 1998.)

Ocean freight rate is the fee paid to the shipping line for maritime transport of containers. It is driven by the global market, the available capacity and the relation of shipping supply and demand (European Commision, 2009, p. 14). Overall, ocean freight rates are subject to change on a monthly basis. The following table defines the scope of activities they cover.

TABLE 4. Split of terminal handling charges and freight rates (European Commision, 2009, p. 6).

	ACTIVITY	COVERED BY
01	Delivery MT and receiving full (+all associated clerical work and reporting)	THC
02	Inspection and reporting condition of container/completion interchange	THC
03	Inspection and reporting of seals and wiring, removal invalid labels, re-sealing	THC
04	Movement of container on/from chassis, barge or wagon	THC
05	Internal transport of container to or from stack	THC
06	Handling container into or out of stack	THC
07	Reporting of chassis, barge and wagon activities in and or out of terminal	THC
08	Storage of full container within time limits defined by Conference	THC
09	Take laden box out of stack	THC
10	Internal transport from stack to ship's side under hook	THC
11	Move of container from ship's side to ship's rail	THC
12	Move of container from ship's rail into ship's cell	Freight rate
13	Operating and closing hatch covers	Freight rate
14	Lashing of container	Freight rate
15	Physical and clerical planning of vessel operation + reporting	Freight rate
16	Overtime	Freight rate
17	Wharfage	Freight rate

In addition to the basic fees of terminal handling and ocean navigation, customers are responsible to pay some surcharges to the shipping line. In that meaning, all shipping lines are entitled to impose additional charges which are supposed to cover abnormal costs arising in respect of which no provision has been made in

the freight rates. Surcharges are regularly reviewed in the light of such unforeseen situations as the fluctuations of monetary values or the increase of the international oil price. (Export Help, 2011.)

Bunker Adjustment Factor (BAF)

The mentioned rise in the international oil price is supposed to be covered by the bunker adjustment factor (BAF). While "bunkers" is the generic name given to fuels that allow the ship's operations, the bunker adjustment factor reflects the floating part of ocean freights that represents excess due to oil prices (Export Help, 2011). The cost of bunker oil fluctuates continually, with comparatively little warning.

Currency Adjustment Factor (CAF)

When expenses are paid in one currency and money earned by the shipping line in another, currency adjustment factor is entailed to cover exceptional changes in exchange rates (Export Help, 2011). This fee is always displayed in a percentage of the total ocean freight rate and subject to regular review.

Last but not least, hinterland transport costs are included in the final freight rate. They are commonly referred to as inland haulage rates. The inland haulage rate is paid to the inland carriers who take over the haulage of containers between the origin or destination warehouses and the carriers' appropriate terminals (Hanjin Shipping Co., Ltd, 2005).

2.7.2 Timing

Timing can be assessed over two main dimensions: frequency of services and transit time. While frequency of services is comparatively straightforward to measure timing efficiency, transit time is even more relevant. As to the case transport chain, transit time means the duration from the time of container availability for collection at the point of consolidation to the time of delivery at the point of de-consolidation (Ockwell, 2001, p. 15). The abstraction of real case into this framework calls for further empirical work in section 4.3.

3 CASE STUDY: SOUTHERN VIETNAM- NORTHERN EUROPE INTERMODAL TRANSPORT CHAIN

The study of intermodal transport of granite from Southern Vietnam to Northern Europe is based on a chain approach mentioned in section 2.1.3. Present throughout the case chain are the key transport operators and pertinent technical infrastructure, including intermodal transport modes and terminals. In details, this chapter will examine the notions of Cai Mep Port and the Port of Hamburg in connection with foreland and hinterland links. Yet before venturing further into the exploration of those areas, an overview on the case chain and general instructions on transport arrangements will be put forward within the parameters of this study. Ultimately, the question of what and who are involved in the case intermodal transport chain will be answered.

3.1 Overview of the case transport chain

The case chain deals with a door-to-door service of container transport from Southern Vietnam to Northern Europe. Its design and traffic flow are demonstrated via Figure 13 and Figure 14, which encompasses 3 carriage phases linked together.

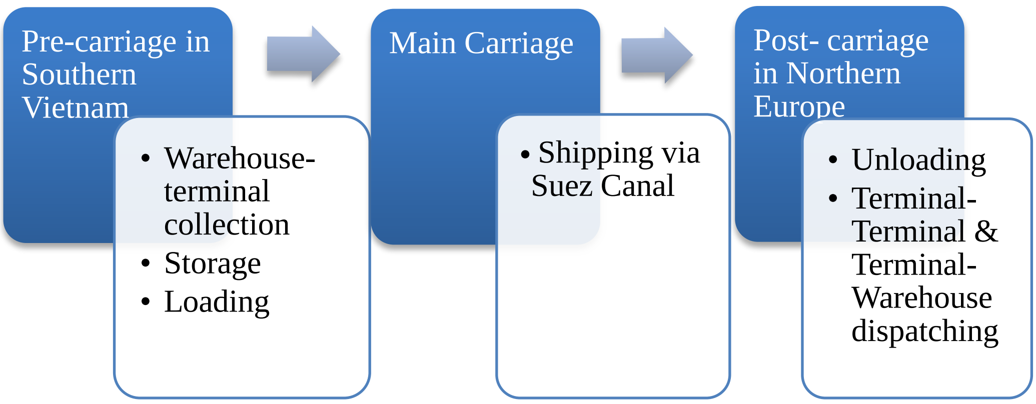

FIGURE 13. The case chain of container transport.

Accordingly, pre-carriage in Southern Vietnam characterizes the process of transportation from a number of facilities in the focal economic area in Southern Viet-

nam (mostly from Ho Chi Minh City) to Cai Mep Port (Vung Tau Province). At this stage, containers may be stored before being loaded on ship. Next, in the main carriage, containers depart to the Port of Hamburg (Germany) via Suez Canal. At the other end of the chain, containers are unloaded and dispatched from the Port of Hamburg to 3 warehouses in Munich (Germany), Warsaw (Poland), and Budapest (Hungary). The overall transport chain is symphonized by the key transport operators who work on the basis of freight forwarding arrangements.

3.2 Freight forwarding arrangements

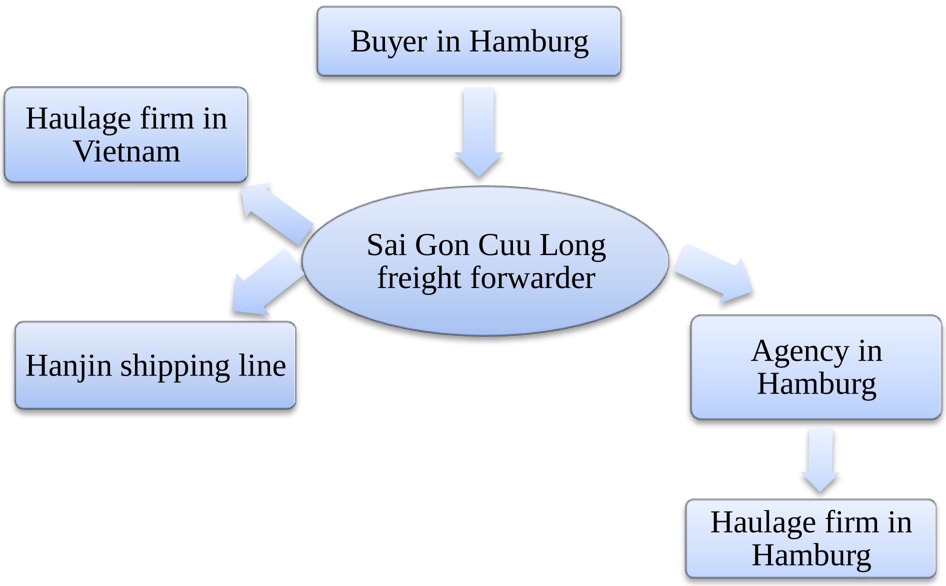

FIGURE 14. Framework for freight forwarding arrangements.

First and foremost, the buyer and the seller must unanimously agree on a trade contract term which defines their responsibilities and liabilities. In this case, dispatch formalities will be made on the basis of Free Carrier Incoterms 2010 (Pham, 2011), clarified by Appendix 5. The selection of container type and terms of container transport remains with the seller. They will consolidate containers and load them at their premises. For the subsequent freight carriage, container insurance and other costs and risks, the buyer will be responsible (Export911, 2011). Basically, granite are consolidated into general purpose containers and transshipped on a FCL/FCL basis.

In this case, the buyer in Hamburg proceeds to assign container carriage to a freight forwarder in Vietnam, named Sai Gon Cuu Long Logistics and Trading Company. Indeed, Sai Gon Cuu Long becomes a representative on the spot who will work for the buyer’s account and take care of their interests. They will contact the seller, prepare documentation, consolidate orders, and organize inland haulage and trans-ocean shipping.

On the long-sea shipping leg, Sai Gon Cuu Long is entitled to decide on a shipping line to perform the main carriage. In this case, Hanjin- an experienced Korean actor in the world map of intercontinental shipping servicers- is selected. They are expected to provide credible allocation of the delivering and receiving ports, and the shortest maritime route with regular schedules.

When it comes to hinterland practice, Sai Gon Cuu Long will themselves organize connections within Southern Vietnam by engaging a local haulage firm. In practice, it is necessary that Sai Gon Cuu Long themselves contact the port operators in Cai Mep for storage and customs clearance procedures. Hinterland practice in Northern Europe will be performed by an agency of Sai Gon Cuu Long in Hamburg City. Likewise, this agency will contact the port operators in the Port of Hamburg for customs procedures, buffering and dispatching containers from the terminal to final destinations. To complete regulations of FCA, Sai Gon Cuu Long must receive enough information from the buyer to instruct their subcontracted carrier to come and take over containers from the seller. On the other hand, the buyer will themselves notice the seller about the carriage and provide sufficient support so that all parties fulfill their obligations.

As regards documentation, the advantage for those who make use of intermodal transportation is that they have only one document which indicates a specific carrier who is legally responsible for the whole process with his own staff and the agents or branches that he is employing (United Nations Development Program, 2009, p. 12). In this context, Sai Gon Cuu Long is assigned by the buyer to be the carrier of the whole transport system, working corresponding to a multimodal transport contract and a through bill of lading. Other than such basic documents, the freight forwarder will make subcontracts with Hanjin shipping line on a liner

charter basis and with local carriers in the two countries. Price quotes offered by the 3 subcontractors will be available to Sai Gon Cuu Long in advance so that they can accumulate the total costs and embed them in the through bill of lading.

As per FCL/FCL terms, there are 4 focal transport contracts to be completed in advance by the mentioned transport operators, briefly described Table 5.

TABLE 5. Transport parties and documents (European Intermodal Association, 2010, pp. 7-29).

Parties	Documentation
Buyer- SGCL	- Multimodal transport contract - Through B/L
SGCL- Hanjin shipping line	- Liner booking note - Liner B/L
SGCL- Hamburg agency	- Agency agreement
SGCL- Local haulage firm	- Haulage contract

3.3 Intermodal chain nodes

As clarified in the theoretical part, a transport chain is defined by specific links and nodes, which embrace a cohesive set of infrastructure and economic activities**.** In the following subheadings, the notions of Cai Mep Port and the Port of Hamburg will be elaborated on. Firstly, background information about their locations and recent productivity will be presented. Next, specifications about intermodal infrastructure supporting port dynamics will be demonstrated.

3.3.1 Cai Mep Port: the key node in Southern Vietnam

As per the liner booking note, the shipping line Hanjin indicates Cai Mep Port as one of the two key nodes within the transport system, through which the supply of goods is circulated to meet overseas demands. Cai Mep Port (Tan Cang- Cai Mep Container Terminal) is based in Ba Ria-Vung Tau province, on the side of Thi Vai River, 80 km south of Ho Chi Minh City (Appendix 3, 4). The port is navigated at

10°32'25 N - 107°01'52E, 33 km distant from the pilot station. (About Us: Transport System- Throughput Capacity, 2011.)

In 2006, Cai Mep Port was designated to be the first deep-sea port under the Vietnamese Government's Detailed Master Plan. Its establishment within the port conglomeration of Cai Mep- Thi Vai is expected to share a large proportion of freight transport that has been overwhelmed in Southern Vietnam (Appendix 2). Commencing operation in June, 2009, the port is principally one of the new subsidiaries of Saigon New Port Corporate. The ambition of Sai Gon New Port Corporate is to promote Cai Mep Port to become the leading deep-sea terminal in Vietnam and an active hub in South East Asia for international shipping lines to call at. Figure 15 presents the total container revenues of Cai Mep Port from June 2009 to September 2010. Accordingly, the terminal has shown a dramatic increase of 75% over the 16 months. (Sai Gon New Port Corporation, 2010, p. 30.)

FIGURE 15. Container revenues of Cai Mep Port 2009- 2010 (Sai Gon New Port Corporation, 2010, p. 30).

At the same time, net productivity and portstay productivity have been improving by 20% and 10 % respectively from January to August 2010, cutting the average working time down to 13.2 hours in August, 2010. Figures in the following graph

reveal a promising development of Cai Mep Port in terms of equipment utilization.

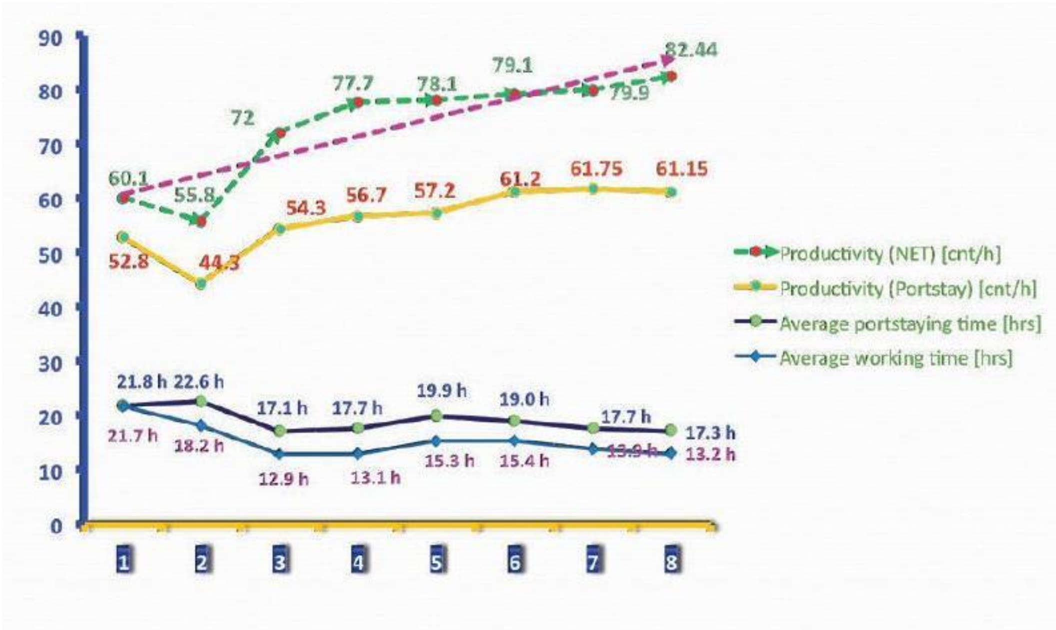

FIGURE 16. Handling productivity and working time of Cai Mep Port (Sai Gon New Port Corporation, 2010, p. 31).

When it comes to intermodal infrastructure, Cai Mep Port has 300 meters of berth length for mother vessels and 180 meters of barging berth at upstream. Currently it can handle vessels of maximum 110,000 DWT (equally 11,000 TEUs) and circulate about 600,000 TEUs per year. Before dredging, Cai Mep Port can accommodate vessels with a maximum draft of 14 meters. The large turning basin diameter of 610 meters makes it easier and safer for large vessels to come and leave the port. At quay side and yard, there are 3 gantry cranes, 3 Post Panamax quay cranes, 10 rubber tire gantry cranes, 3 forklift truck, 20 trailers and 2 Liebherr cranes for barbing shipments between ICDs. Current ICT applications include the EDI system connecting the terminal with partners and customers, shipside and container yard auto planning, container handling equipments assignment, real time container location report and wireless/hand-held devices. (About us: Facilities-IT System, 2011.)

On the whole, the selection of Cai Mep Port is presumably not a random choice but credible in all aspects of a transcontinental maritime route. Being the first

deep-sea port in Vietnam, it is by far the optimal choice of shipping lines with respect to accessibility. The terminal is also equipped with the most modern infrastructure that can accommodate post-generation ships, with a large turning basis to allow them enter and leave the port easily. Nevertheless, one hindrance is that Cai Mep Port is located remote from most of the industrial zones in Southern Vietnam. To transport containers from different premises in these areas, Sai Gon Cuu Long must have an astute choice of transport mode and consider all possible risks that may arise in routing and scheduling their hinterland practice.

3.3.2 Port of Hamburg: the key node in Northern Europe

Present in the maritime route offered by Hanjin shipping lines as the receiving port, the Port of Hamburg is deemed to have efficient port services, sufficient hinterland infrastructure, and convenient clearance processes.

The Port of Hamburg is by far the top port in Germany, ranked third in Europe after Rotterdam (Netherlands) and Antwerp (Belgium). Located along the main circum-equatorial maritime route that goes through Suez Canal, the port exploits its gateway function at the international level of Central and Eastern Europe, and the local level of the seaport city-region Hamburg. From here, there are regular hinterland transport links that continuously circulate the flow of containers within Germany and its proximity areas.

The European mega-port is located 115 kilometers or 70 nautical miles from the North Sea, following the Elbe River. It is a city port situated on the southern shore of the river which is directly opposite the city’s center and mostly surrounded by the settlement area (Gaffron, Waßmann-Krohn & Benecke, 2008, p. 9). Though the port is around 100 km from the North Sea, it is largely accessible to the world’s biggest bulk carriers and container ships (Beßler, 2010, p. 5).

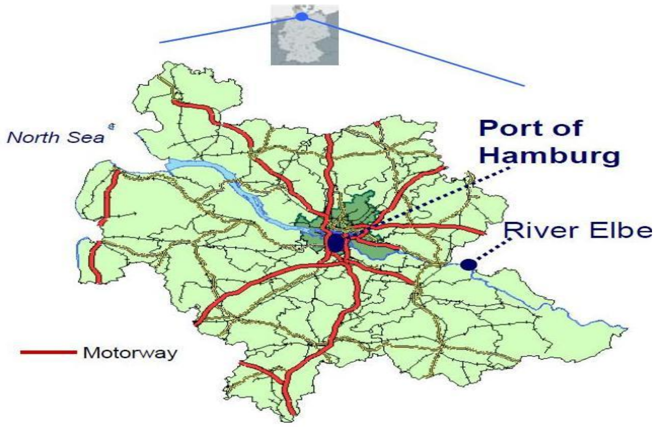

FIGURE 17. Location of the Port of Hamburg (Gaffron, Waßmann-Krohn & Benecke, 2008, p. 9).

In 2005, the Institute of Shipping Economics and Logistics made a demand forecast for the Port of Hamburg, taking into account the most actual data. Based on this forecast the Hamburg Port will have annual average growth rates of 9.4% until 2015. This assumption results in a total handling potential of about 18 million TEUs in 2015 – provided that the necessary capacities inside the port as well as the land access are all prepared. (Institute of Shipping Economics and Logistics, 2007, p. 11.)

As a regard to intermodal traffic flow, the port has shown a remarkable rising degree of containerization, representing a steady increase of 13% in container handling: 4.2 million TEUs turned over in 2000 and 9.9 million TEUs in 2007 (Figure 18). The prognosis for the period from 2009 to 2025 forecasts a rapid rise in container handling volumes to at least 27.8 million TEUs in 2025. (Hamburg Chamber of Commerce, 2011, p. 3.)

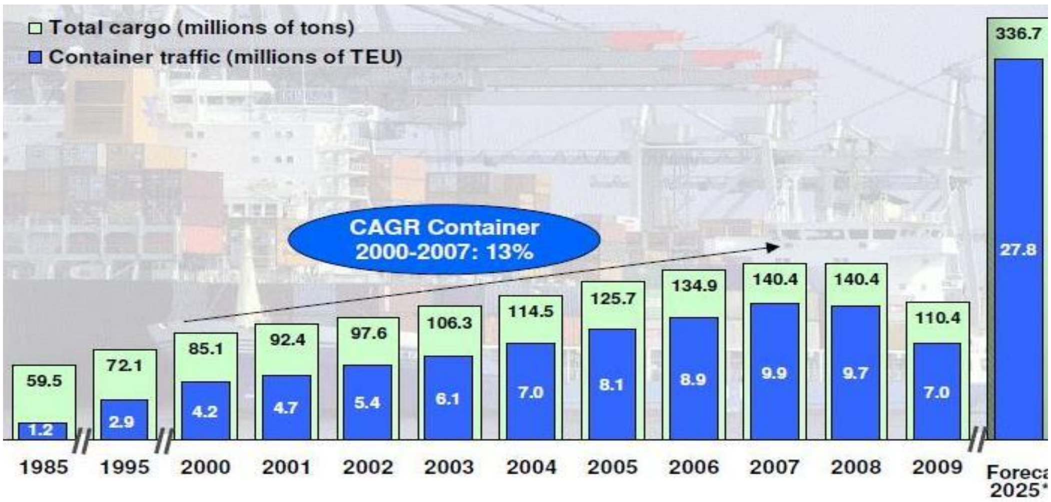

FIGURE 18. Container traffic of the Port of Hamburg (Hamburg Chamber of Commerce, 2011).

Currently, intermodal connections of the Port of Hamburg is spilt into 35% road transport, 30% rail transport, 15% transshipment, 10% inland waterways and 10% pipeline (Beßler, 2010, p. 7). The port has 4 container terminals: Burchardkai (CTB), Tollerort (CTT), Eurogate, and Altenwerder (CTA). In this case, the assigned vessel will call at Eurogate terminal (Pham, 2011). The following figure reveals the position of these terminals within the Port of Hamburg site.

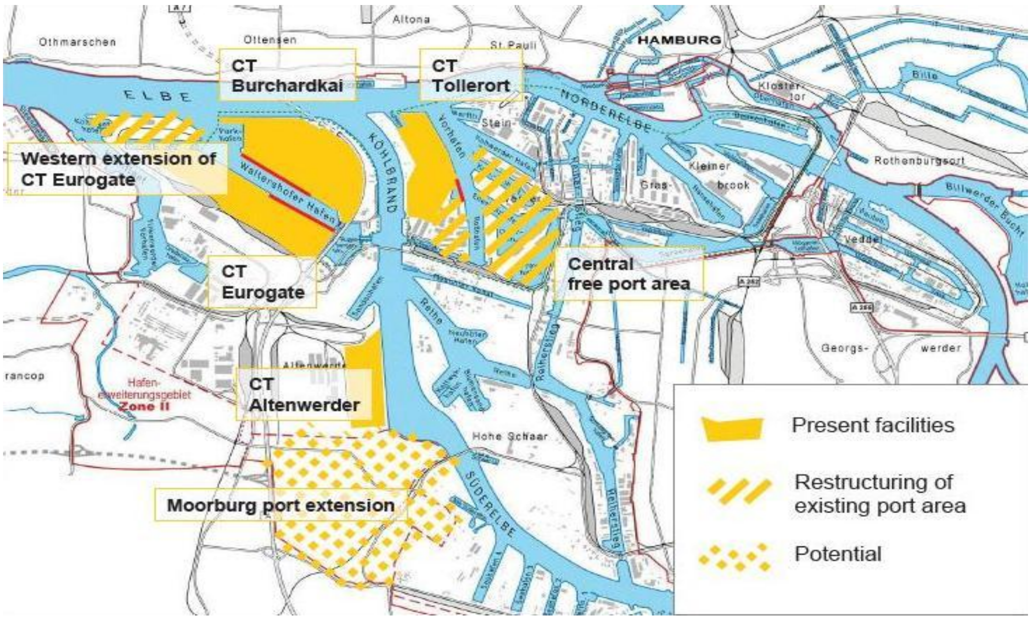

FIGURE 19. Layout of the Port of Hamburg (Hurtienne, 2007, p. 4).

Eurogate Container Terminal is located in the South Western part of the port of Hamburg. It is currently using 6 large- vessel berths, with 2.7 million TEUs being handled per year on an area of 1.4 million square meters (Kuenz, 2009, p. 1)**.** The terminal is by far the most dynamic terminal in Europe, which offers a completely wide range of intermodal transport services.

As regards hinterland services, rail transport is the most important transport mode in the Port of Hamburg. Particularly in the case of Eurogate, intermodal rail transport will be performed at Eurokombi.

Directly located at Eurogate terminal site, Eurokombi is the largest railway station for combined cargo transport in Germany. Annually, its handles approximately 700,000 cargo units with 11 handling tracks, each 720 meters in length, and six cranes. Its advantageous location in the environmentally friendly Hamburg site enables Eurokombi to become a center of excellent optimal hinterland connections by truck or rail. With an unbroken chain, Eurokombi has achieved the best possible transit times. (Eurogate Container Terminal Hamburg GmbH, 2010, p. 11.)

3.4 Intermodal chain links

3.4.1 Long-sea links

Apparently, performance of an intermodal transport chain is not complete without the support of connected links. First and foremost, the long sea link is feasible via the use of vessels. The larger the carrier is, the larger infrastructures are required at port terminals (Sangeeta, 1999, pp. 43-44). The bigger the vessel size is, the greater the changes will be in berth design, shore storage tank capacity, harbour design featuring channel depth and turning basin and harbour traffic control (Branch, 2007, pp. 65-67).

Tran- ocean practice of the case chain is a Pendulum service, with the vessel calling at various ports in various countries. In this case, the deployment of the Post Panama vessel Hanjin Port Kelang at Cai Mep Port is a promising driver in the

improvement process of Cai Mep Port’s infrastructure, at the same time offers lower costs to customers due to its economies of scale.

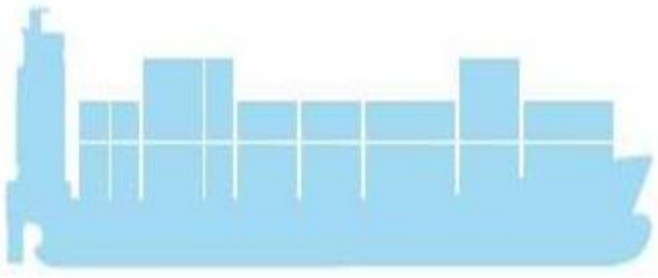

FIGURE 20. Draft layout of a Post-Panamax vessel (Eurogate Container Terminal Hamburg GmbH, 2010, p. 6).

Normally, the vessel’s name is identified by the shipping line. To be chosen, the container ship must comply with certain safety and commercial criteria clarified in the International Code for the Security of Ships and of Port Facility (ISPS Code) which is issued on the shipping line’s official website. As it is shown in Table 6, details of the calling vessel Port Kelang include its name, overall length, maximum capacity in TEU, and gross tonnage.

TABLE 6. Port Kelang vessel figures (Container ship-Info , 2011).

IMO number: 9312949	1st name: HANJIN PORT KELANG	Flag / nationality: Panama
Owner: Hanjin Shipping	Operator: Hanjin	Completion year: 2006
Shipyard: Hyundai Samho Heavy Industries Co. Ltd., South Korea	Yard / hull number: S270	Engine design: B&W
Engine type: 12RT-flex96C	Power output (KW): 68.382	Maximum speed (Kn): 26,5
Overall length (m): 304,00	Overall beam (m): 40,00	Maximum draught (m): 14,50
Maximum TEU capacity: 6655	Container capacity at 14t (TEU): 4840	Reefer containers (TEU): 600
Deadweight (ton): 85.250	Gross tonnage (ton): 75.000	

3.4.2 Hinterland links

As mentioned, the selection of transport mode is based on numerous factors, among which time and costs are of principal consideration. In this context, road transport is suggested for inland practices in Southern Vietnam, and road-rail combination model for inland practices in Northern and Central Europe.

On one hand, the choice of rail transport is not favored due to the fact that facilities in Southern Vietnam are comparably remote from the main routes of rail terminals. On the other hand, most of the current rail connections are used in passen-

ger transportation. Especially within a short distance, road transport offers higher reliability and speed than others. In this case, trailers and tractors will be utilized.

At present, the best haulage operators resort to rail-road combination practices. Reasonably, rail transport is used on a terminal-to-terminal basis, and road on a terminal-to-consignee basis. On one hand, rail transport is employed for its safety and speed (Stuart, 2009, p. 24). On the other hand, road transport is the main method use for national freight transport in all European countries (Stuart, 2009, p. 23). In this case, road option becomes practical for its flexible service transit times and low cost operations. Piggybacks will used to move containers from terminals to warehouses and trailers are used for final delivery to customers.

4 CASE CHAIN OPERATIONS

The case chain operations are examined against the backdrop of different carriage legs in which they happen, in chronological order. Fundamentally, inland activities in the two countries must be closely connected with port dynamics. Of critical concern to hinterland efficiency are the routing and scheduling plans. Of great importance to port productivity are the optimal crew assignment, flow distribution and connection plans. In all aspects, the dominant rule underlined is safety. Subsequent to this chapter, the issues proposed in the research question 2 and 3 are illuminated.

4.1 Pre-carriage in Southern Vietnam

This section is dedicated to depicting a set of operational events in Southern Vietnam. Thorough understanding of this phase can be achieved by examining 2 sub-phases: (1) Transport from facilities to port; (2) activities at the port itself. Respectively, the sub-phases will be analyzed.

4.1.1 Hinterland transport in Southern Vietnam

The pre-carriage phase initiates with the transportation of containers from the production facilities in Southern area, mostly from Ho Chi Minh City to Cai Mep Port. Conventional container trucks with the capacity of 2 TEUs per trip will be used. Of greatest importance to transport operators in this sub-phase is the planning of route and schedule.

Routing

Subsequent to the booking note, Sai Gon Cuu Long will contact the shipping line Hanjin for depots. When Hanjin informs, Sai Gon Cuu Long will ask the haulage firm to take the order and a copy of the liner booking note and come to specified destinations to collect depots. The trucks then move to warehouse premises where granite blocks will be consolidated into containers, stowed and sealed by the seller themselves. The overall process is presented in Figure 21.

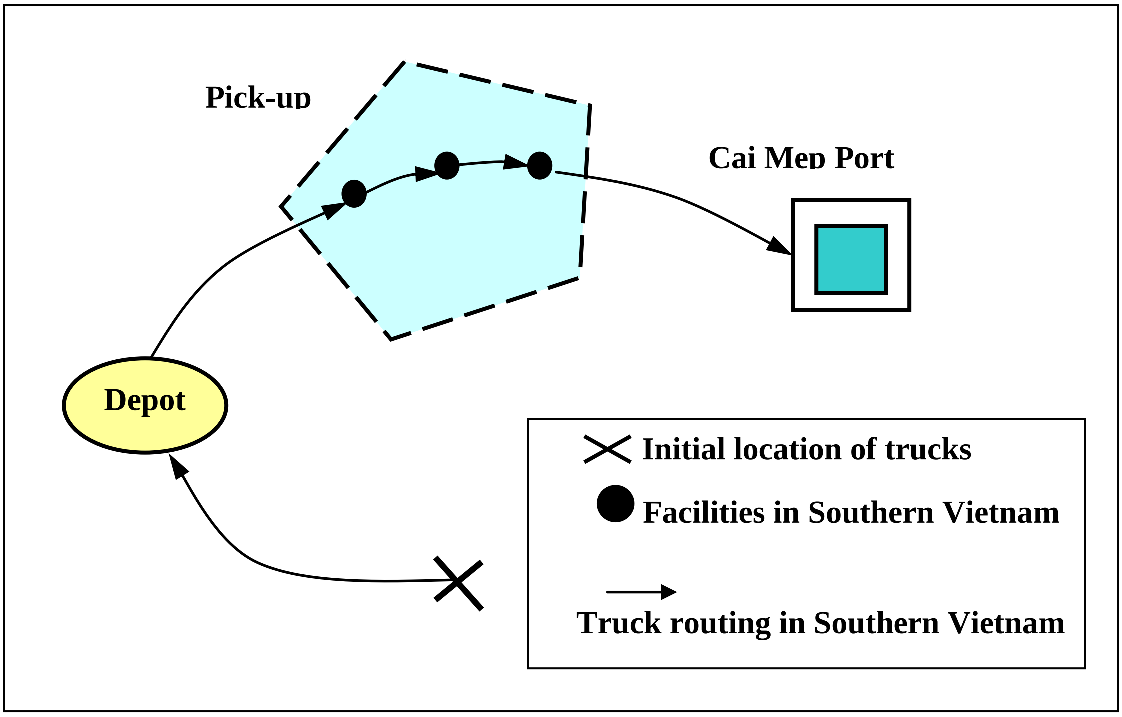

FIGURE 21. Routing in Southern Vietnam.

"In the case of road transport when loading takes place at the seller's premises, delivery is completed when the goods have been loaded on the vehicle provided by the buyer "(UNDP, 45). Rough routing from Ho Chi Minh City to Cai Mep Port (Ba Ria- Vung Tau Province) is demonstrated in Figure 22.

FIGURE 22. Routing from Ho Chi Minh City to Ba Ria-Vung Tau Province.

Specifically, drivers will find their way to Cai Mep Port in Ba Ria-Vung Tau province by following the arrow, passing Hanoi Road to National Road 51, which covers around 80 km from the center of Ho Chi Minh City. From the Highway 51, Cai Mep Port can be accessed by the provincial road 965, which is about 4 km in length. At present, the infrastructure of road transport is not developing at the same rate as the flow of containers between terminals. Severe congestion regularly happening on the Highway 51 and serious downgrade of the road may force the hauling firm to pay a lot of money for damage and delays incurring along their trips.

Scheduling

Initially, it is of great importance for Sai Gon Cuu Long and its haulage firm to decide on the number of trucks. This will allow them not to suffer from any waste in fuel and road fees. The total number of trucks in an order means the total number of TEUs being divided by the truck capacity in TEU.

When timing hinterland transport, the trucking team must ensure that containers are stored on the container yard within the free time of 5-6 days regulated by the port authorities. Since the berthing time for Port Kelang vessel is 18 hours from 12 am Sunday to 6 am Monday (Appendix 6), the trucks may arrive at the storage yard at 6 am the previous Wednesday. Because it normally takes 3 hours to travel from Ho Chi Minh City and other 25 minutes to process documentation at the port gate, the truck should set off latest at 2h35 am on the same day. At Cai Mep Port, the closing time is principally at the same time as the vessel's ETA.

In case the trucks travel in the day time, a contingency plan is critical to consider the risk of congestion. At cross roads on Hanoi Road, traffic jam regularly happens at around 7 am- 9 am and from 5 pm onwards. On one hand, it is the case of rush hours when people come to work in the morning and go back home in the afternoon. On the other hand, this road endures an intensive flow of cargoes clustering around various ICDs in the city. Consequently, it is advisable that the haulage firm leads to Cai Mep Port from Hanoi Road at 10a.m- 4p.m.

4.1.2 Port operations at Cai Mep Port

Upon arrival at the port gate, containers are registered with major data (e.g. destination, content, names of shipper, shipping line and outbound vessel). Within the parameters of this study, no details about customs clearance by Sai Gon Cuu Long, Hanjin shipping line and the port officers are discussed.

Storage

Once the trucks stop at the storage yard, containers are loaded on the pre-defined locations in the yard. At the transfer point on the storage yard, container reach-stackers (with top-lift spreader) pick up containers from the delivery trucks and stack them onto indicated positions. Yard operators will also deploy container stacking cranes for sorting and arranging containers on the container yard.

In practice, the detailed plan of containers' buffer storage is a joint effort of the port operators and Hanjin shipping line. A block comprises 25-35 yard bays, and a yard bay has 6-10 stacks of containers. Commonly, locations of outbound containers are scattered over a wide range of space on terminal yard. Pre-planning locations for containers, either as individuals or as a group, must ensure optimal interactions between land-sided activities with outbound ships.

After the trucks finish positioning containers on the storage yard, Sai Gon Cuu Long's representative receives a Mate's receipt from Hanjin shipping line. From this point, Hanjin takes their liability for loading containers onboard and international shipping. The total free time of container buffer storage is 5-6 days.

Stowage planning

The vessel carrier Hanjin will conduct a stowage plan to reserve specific places on the ship bay for stacking containers. The slot and the sequence into which outbound containers are stacked are also planned in advance.

Stowage planning should comply with the various requirements for the ship strength and stability. Furthermore, Hanjin must consider the burden of additional container manipulations when containers bound for succeeding ports are stacked into higher tiers than those that must be unloaded at a certain port. Normally, the distance between containers is 100 mm, between containers and the broadside is 100 mm.

Loading

Loading practice of containers is done by a gantry crane, one by one as per the loading plan. A special crane operator, in this case, will take care of the process from a cabin located on the top end of the crane.

Initially, containers are moved from the storage locations to the gantry crane by trucks, forklifts or tractors. Without delay, the spreader is lowered on top of the container and it will clock the four corner castings by a twist lock mechanism. Now the operator lifts the container up and loads it onto the precise position on the ship, keeping the stability of ship in mind. Spreaders will be retrieved once the goods are placed on the ship bay.

The lifting capacity of gantry cranes is much dependent on their size and differs from different manufactures. At Cai Mep Port, 3 gantry cranes can practice at most 90 moves per hour. Once the loading step is finished, Sai Gon Cuu Long will bring the Mate’s receipt to Hanjin shipping line to get the liner bill of lading.

4.1.3 Main carriage via Suez Canal

Routing

The port rotation offered by Hanjin shipping line is named NE5 (Asia North Europe service 5), plying through Gwangyang-Busan-Shanghai-Yantian-TCCT-Singapore-Hamburg-Rotterdam-Le Havre-Algeciras- Singapore-Kaohsiung (Appendix 12). The maritime route of this service is drawn in Appendix 12. (Sai Gon New Port Corporation, 2010, p. 29.)

In the new service, the shipping line Hanjin assigns a fleet of total 9 Post Panamax vessels, each having the capacity of carrying 6,500 TEUs on the service (Leach, 2010). All of them are cellular vessels and capable of positioning containers on the upper stacks.

Scheduling

The first direct service from Vung Tau Province, Southern Vietnam to Hamburg, Germany was launched on 18th October, 2010 by the vessel Hanjin Port Kelang, numbered 0025W. The berthing time of vessels are from 12 pm on Sunday to 6 am on Monday. Unless there is any damage or delay claims, the vessel is expected to arrive at the Port of Hamburg after 19 days, at 23 pm on Saturday. At present, Hanjin keeps providing a regular schedule for their fleet to call at the two terminals. (Tan Cang Cai Mep News, 2010.)

4.2 Post-carriage in Northern Europe

Apart from Cai Mep Port, the Port of Hamburg is the second key node of the case transport chain. Located in Hamburg City, Germany, the port terminal plays the role of a gateway to Northern and Central European markets. Applying the same mode of analysis as in the case of Cai Mep Port, the post-carriage leg in Northern Europe include hinterland transport and inner- port operations.

4.2.1 Port operations at the Port of Hamburg

The sequence of operations at the Port of Hamburg happens in a reverse order to that at Cai Mep Port. Hence, there is not any special discussion in this section. Basically, the ship will berth at Eurogate terminal. At this point, the main trolley of a portainer will move containers off the vessel and put them one by one down on the lash platform. From here, a fully automated trolley will take over the containers and transfer them to a gantry crane. This gantry crane may either move to the container yard for buffering or directly to the piggybacks at Eurokombi for further hinterland transport movements.

At port site, the gantry crane finds its way to certain destinations on the container yard by radio wave instruction. After that, folk lifts will unload containers to the pre-defined places. In practice, each block is comprised of 10 rows which cover 37 TEUs; at each row 4 containers can be stacked.

In the leg of hinterland transport by train, gantry cranes will load containers from the storage yard onto Eurokombi's piggybacks and lead them to intermodal terminals in Warsaw, Munich and Budapest. On the whole, the process is remote controlled.

4.2.2 Hinterland transport in Northern and Central Europe

Amid the intermodal chain, there is a question of how to deliver containers by hinterland connections. In reality, the best transit times are achieved by the practice of unbroken chains. Indeed, container unloaded from the NE5 will directly be transferred to Eurokombi's piggybacks by gantry cranes for hinterland movements. From here, containers are directly dispatched to 3 intermodal terminals in Munich (Germany), Warsaw (Poland), and Budapest (Hungary), then to the proximity area. The overall hinterland routing in Northern Europe is displayed in Figure 23.

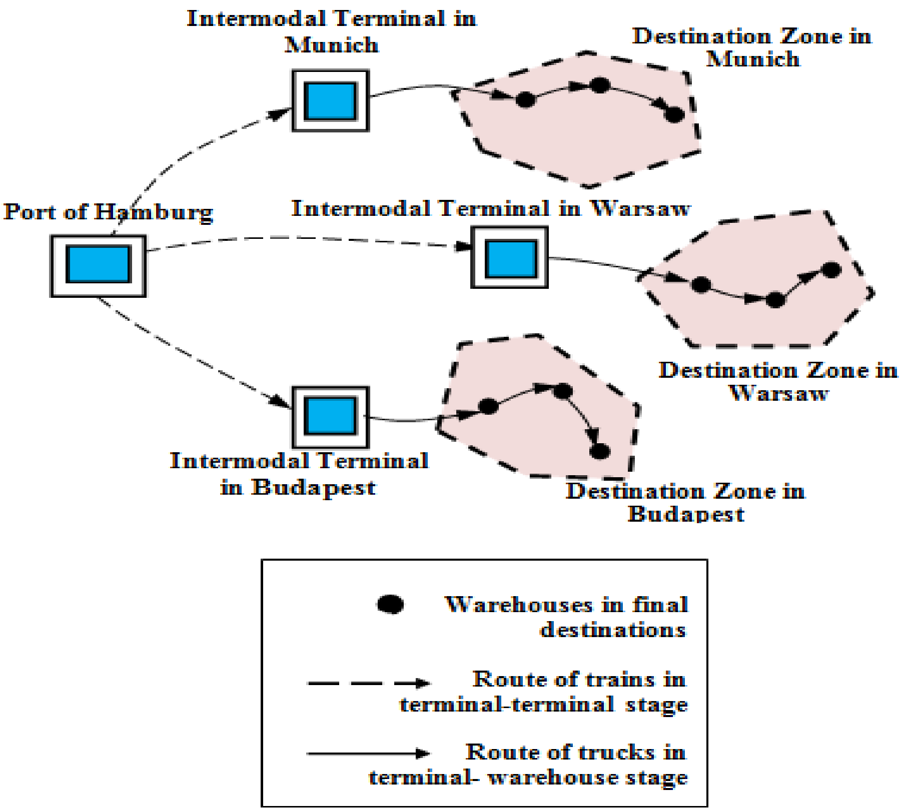

FIGURE 23. Hinterland routing in Northern Europe.

Timing

At Eurokombi, shuttle trains operate at regular time intervals between the same origin-destination combinations. Basically, there are around 3-5 trains per week departing from Eurokombi to intermodal terminals in Munich, Warsaw and Budapest (European Intermodal Association, 2010, pp. 7-31).

TABLE 7. Routing frequency from Eurokombi (European Intermodal Association, 2010, pp. 7-31).

Routing	***Frequency***
Hamburg- Munich	5 times per week
Hamburg- Warsaw	3-5 times per week
Hamburg- Budapest	3-5 times per week

Routing

Rail services are employed in combined transport connecting Hamburg and Munich, Hamburg and Warsaw, and Hamburg and Budapest as followed. While the case of Hamburg- Munich sets an example for national hinterland operations, the cases of Hamburg- Warsaw and Hamburg- Budapest for Central European hinterland connections. All of them are organized by experienced actors who offer the best logistic solutions with sustainable mobility and profitability according to the published compendium of European Intermodal Association. Further analysis of the economic aspect will be demonstrated in section 4.3.

Routing Hamburg- Munich

The hinterland transport practice from the Port of Hamburg to Munich terminal via Eurokombi railway station is organized by the port operator Eurogate, the inland terminal operator Eurokombi and the main haulage firm BoxXpress Germany. BoxXpress is a licensed private operator who specializes in the rail transport of overseas containers within European regions. Other than a constantly growing network of block trains and customized services, BoxXpress also offers data process support deploying internet portal to allow the precise and timely flow of information about on the containers' status, vehicles' movements, and other logistic transport requirements envisaged in long distance transport.

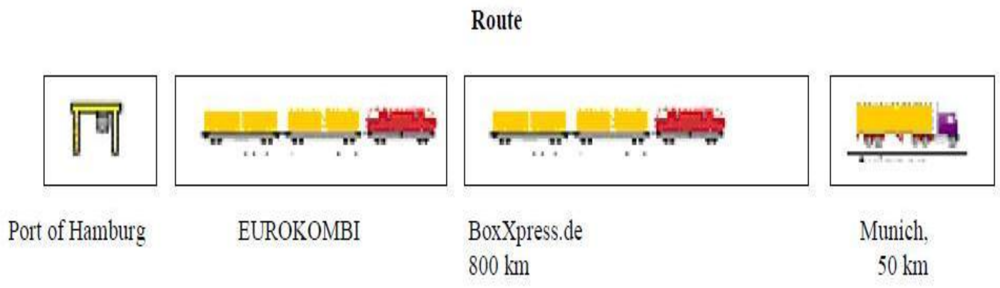

FIGURE 24. Routing Hamburg- Munich (European Intermodal Association, 2010, p. 8).

Illuminated in Figure 24, intermodal trains travel a distance of 800 km with at 120-140 kilometers/ hour. They operate 5 times a week with the maximum load of

94 TEUs (European Intermodal Association, 2010, pp. 8-9). The post haulage from Munich terminal to consignees in the region covers approximately 50 kilometers, practiced by trailers. This combination offers high frequency, reliability, punctuality, and high degree of security.

Routing Hamburg- Budapest

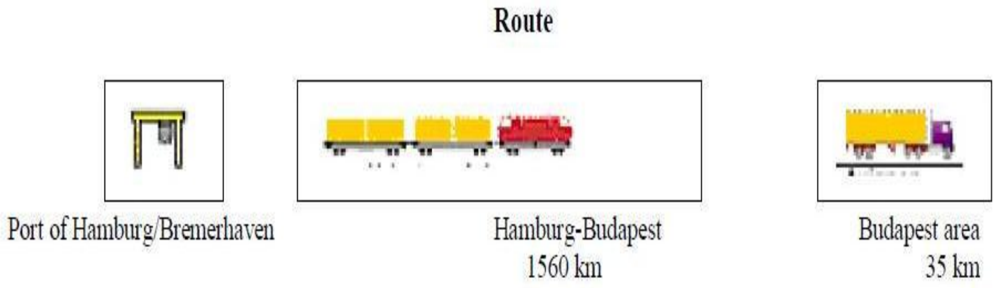

FIGURE 25. Routing Hamburg- Budapest (European Intermodal Association, 2010, p. 11).

The transport network from the Port of Hamburg to the intermodal terminal in Budapest is operated by Eurogate port operator and Eurokombi inland terminal operator. Logistics activities are supported by BoxXpress Hungary, a joint venture between Eurogate, BoxXpress Germany, Tx-Logistik Austria and Floyd Budapest. (European Intermodal Association, 2010, pp. 11-12.)

The main haulage from Eurogate terminal to Budapest Bilk terminal spreads over 1560 kilometers, executed by piggybacks. Each train can carry maximum 96 TEUs per departure. From Budapest Bilk terminal, tractors carrying trailers over a distance of 35 kilometers to reach customers' warehouses in the region. For the whole route, no loco changes are needed at borders. As a result, the service offered by BoxXpress Hungary takes only 27 hours in total. (European Intermodal Association, 2010, p. 12.)

Routing Hamburg- Warsaw

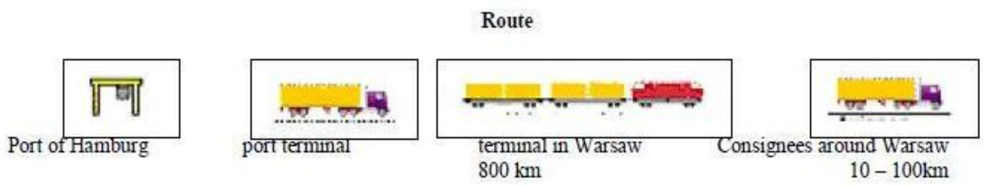

FIGURE 26. Routing Hamburg- Warsaw (European Intermodal Association, 2010, p. 30).

Regularly served terminals in Poland are Gadki, Gdansk, Gliwice, Lodz and Warsaw. From these terminals, containers can be forwarded by rail or road to Belarus, Ukraine and other Baltic countries. Figure 26 defines the whole process.

The shuttle service system connecting Hamburg and Warsaw is organized by Polzug Intermodal GmbH. Today, Polzug is recognized as a competent leader in the international tough transport market for its high load factor per round trip, high flow aggregation, reliability and punctuality for large volumes and long haul carriage. Also the storage of containers near inland terminals is a particular advantage. (European Intermodal Association, 2010, p. 30.)

Piggybacks depart from Hamburg to Warsaw 3-5 times per week, each carrying maximum 54 TEUs. The average load is 8 tons per TEU. For the post haulage, containers are transported 10-100 km to consignees around Warsaw region by trailers or conventional trucks. (European Intermodal Association, 2010, pp. 30-31.)

4.3 Performance measurement of the case chain

According to the theoretical background, performance measurement of a transport chain is generally based on benchmarking timing and freight rate. The school of information used in this section is retrieved via personal interviews with the current director of Sai Gon Cuu Long other than online sources published by the Hanjin shipping line (Appendix 1). As a matter of fact, the final freight rate can be flexibly changed corresponding to competitive pressures by adjusting component

fees in the contract terms between Sai Gon Cuu Long and Hanjin, between Hanjin and terminal operators at Cai Mep Port and the Port of Hamburg, and between Sai Gon Cuu Long and their engaged haulage firms. Always, the freight rate must be transparent to the customers, yet not necessarily equal to the final price asked by the forwarder Sai Gon Cuu Long.

4.3.1 Freight rate of the case chain

For container being transported on a Free Carrier term, the buyer in Hamburg is responsible for a five- part freight rate, including terminal handling charges at Cai Mep Port and the Port of Hamburg, inland transport fees at the both ends of trading in Southern Vietnam and Northern Europe, and ocean freight rate via Suez Canal. It is noticeable that Euro is applied as the common currency, and the rate of currency exchange is based on the system published on the Financial Times (Latest currency news, conversions, and exchange rates, 2011). Accordingly, 1 USD is equivalent to 0.7115 EUR on 28 March 2011.

According to the official website of Hanjin shipping line, the buyer basically pay 75 USD (53 EUR) for terminal handling of the Westbound Europe departure at Cai Mep Port, plus 200 EUR for terminal handling of the Westbound shipments from Asia at the Port of Hamburg (Surcharge, 2011). Provided that there are no extra charges for storage that excess the regulated free time at ports, the total amount asked for is EUR 253 (Appendix 11). In practice, this rate can be negotiated by Hanjin shipping line and their port authorities at the two terminals.

Ocean freight rate is paid to Hanjin shipping line for the trans-ocean transport of containers via Suez Canal. By March 2011, Hanjin provides the East-West maritime service at 1, 000 USD (712 EUR) (Pham, 2011). In addition, the buyer is subject to pay 600 USD (427 EUR) for BAF and 16.31 % of the total ocean freight rate for CAF (period of chartering: 1 March 2011- 31 March 2011).

Last but not least, to transport a TEU from the warehouse zone in Southern Vietnam to Cai Mep Port, the buyer pays on average 247 USD (175 EUR) (Appendix 7). The combined transport practice from Eurogate to Munich, Budapest and War-

saw involves different layer prices applied for road and rail transport (Appendix 8, 9, 10). The total freight rate for the trip of containerized granite from Southern Vietnam to Northern Europe is compiled in the following Table 8. In this context, Phase 1 means pre-carriage in Southern Vietnam, Phase 2 main carriage via Suez Canal, and Phase 3 post- carriage in Northern Europe. There are different prices of inland transport applied for containers coming from the North, the South and the Center of Ho Chi Minh City. Hence, an average value will be used.

TABLE 8. Freight rate of the case chain from Southern Vietnam to Northern and Central Europe.

		Final destination		
Price type		**Munich (EUR)**	**Warsaw (EUR)**	**Budapest (EUR)**
Phase 1	Warehouse-Terminal Haulage Fee	175	175	175
	Terminal Handling Charges at Cai Mep Port	53	53	53
Phase 2	Ocean Freight Rate	712	712	712
	BAF Surcharge	427	427	427
	CAF Surcharge	116	116	116
Phase 3	Terminal Handling Charges at the Port of Hamburg	200	200	200
	Terminal-Terminal Pre-Haulage Fee by train	225	370	450
	Terminal- Warehouse Post-Haulage Fee by truck	150	500	260
	Transhipment costs train-truck	30	0	54
	Others (buffer, customs clearance)	6	50	50
Total		**2, 094**	**2, 603**	**2, 497**

Unless the price of haulage applied for 20 foot containers is published, it is assumed to be half of the price set for standard 40 foot containers either larger or smaller than 16,5 tones. By rough calculations, the buyer in Hamburg will respectively pay 2,094 EUR; 2,603 EUR and 2,497 EUR for the routes Southern Vietnam- Munich, Southern Vietnam- Warsaw and Southern Vietnam- Budapest. In Table 9, estimated transport costs are displayed in percentages.

TABLE 9. Freight rate of the case chain in percentage.

		Final destination		
	Price type	**Munich**	**Warsaw**	**Budapest**
Phase 1	Warehouse- Terminal Haulage Fee	8%	7%	7%
	Terminal Handling Charges at Cai Mep Port	3%	2%	2%
Phase 2	Ocein Freight Rate	34%	27%	29%
	BAF Surcharge	20%	16%	17%
	CAF Surcharge	6%	4%	5%
Phase 3	Terminal Handling Charges at the Port of Hamburg	10%	8%	8%
	Terminal-Terminal Pre-Haulage Fee by train	11%	14%	18%
	Terminal- Warehouse Post-Haulage Fee by truck	7%	19%	10%
	Transhipment costs train-truck	1%	0%	2%
	Others (buffer, customs clearance)	0%	2%	2%
Total		100%	100%	100%

The subsequent Figure 27, 28, 29 will take the above figures as inputs to generate some strategic conclusions in intermodal transport planning. The biggest groups of costs are labeled ocean freight rate and surcharges. The rest of costs are attributed to hinterland routing costs in Southern Vietnam and Northern Europe.

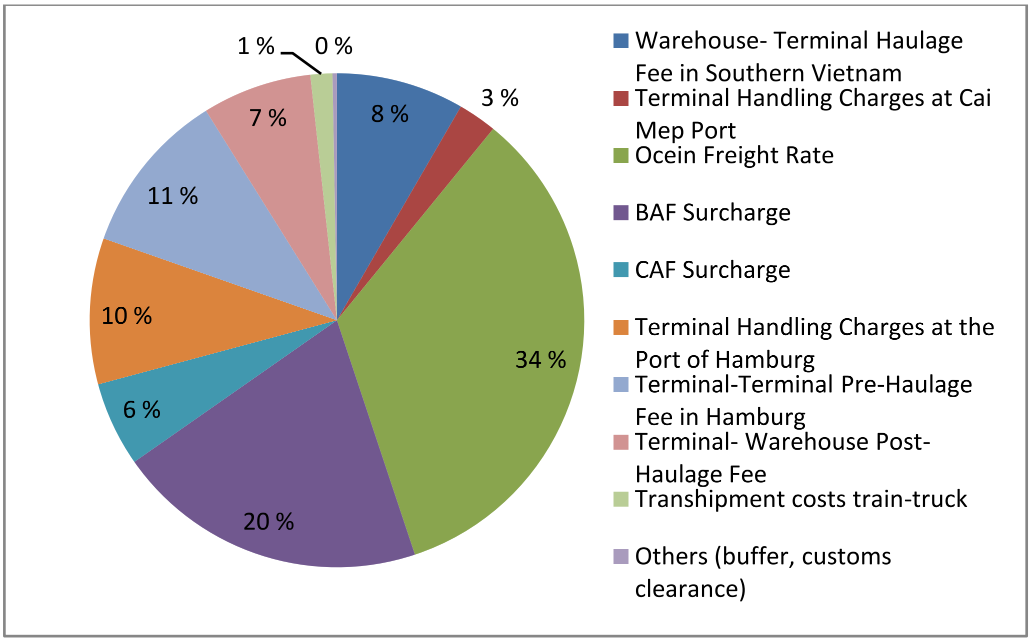

FIGURE 27. Shares of costs in the freight rate: Routing Hamburg- Munich.

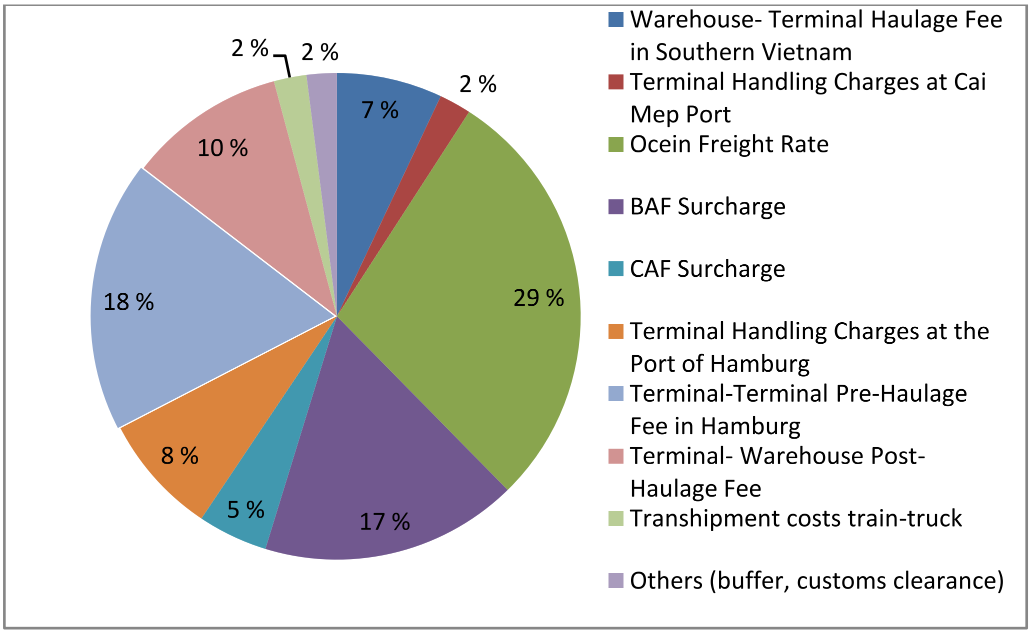

FIGURE 28. Shares of costs in the freight rate: Routing Hamburg-Budapest.

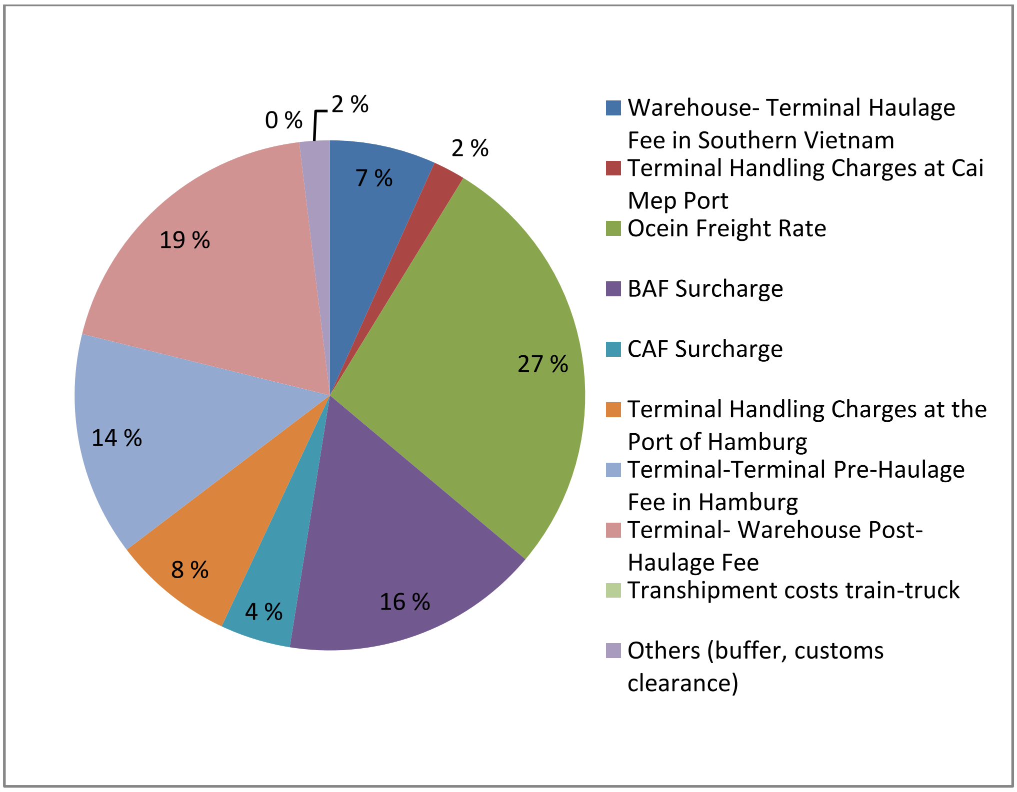

FIGURE 29. Shares of costs in the freight rate: Routing Hamburg-Warsaw.

As shown, ocean freight rate accounts for a great share of overall freight rates, which constitutes more than 27% of the total. The accumulated surcharges are surprisingly high at this time of year, almost equivalent to the ocean freight rate. Inland transport costs in the case of routing Hamburg- Munich are approximately half of those in the cases of Hamburg- Warsaw and Hamburg- Budapest because of the shorter transport distance and lower fees of customs clearance. All together, the fees charged by Hanjin shipping line make up more than half of the intermodal transport rate.

4.3.2 Timing of the case chain

Apart from transport costs, timing should be a credible indicator of network performance. Similarly to freight rate calculations, the plan of container travelling time must consider the shares of inland connections, port activities or buffering, and trans-continental shipping.

Concerning NE5 service, it is offered once a week on Mondays. If there are no delays in road transport at the end of Southern Vietnam, Hanjin Port Kelang vessel is expected to arrive at Cai Mep Port on Sunday and leave on Monday. In all, it takes 19 days to transport containers from Cai Mep Port to the Port of Hamburg.

On the inland legs, it takes at most 3 hours to move containers from facilities to Cai Mep Port. At the other end of the chain, the longest connection between Hamburg and Warsaw terminals takes around 27 hours. Such inland practices comprise more than one day of travelling.

Last but not least, in times of peak seasons, containers may be buffered on container yards some days before the shipping line loads them onboard. The allowed free time for storage at Cai Mep Port is 5- 6 days (Tan Cang Cai Mep Corporation, 2010, p. 15) and at the Port of Hamburg 3 days (Eurogate Container Terminal Hamburg GmbH, 2007, p. 10). In all, it takes about 29 days for containers to reach the final customers.

4.3.3 Benchmarking of timing and freight rate

As proposed in the theoretical part, benchmarking is a suitable method in performance evaluation. In that sense, the compiled travelling time and freight rate of the case chain will be compared to those of the last routes based on the data provided. On the whole, differences between the two cases arise amid the hinterland leg in Southern Vietnam and the onshore routing. For the rest of the journey, port operations and hinterland transport fees of two cases are similar.

Prior to the case practice, most containers originating from industrial warehouses in Ho Chi Minh City set off from Cat Lai Port- an international port in proximity to the center. From this terminal, containers will be loaded and transported to either the Port of Singapore (Singapore) or Port Klang (Malaysia). Very often in practice, containers will stay on the container yards at these intermediate hubs from 3- 4 days before joining the new routing Singapore- Hamburg or Malaysia-Hamburg. As a consequence, the total transport time increases from 3-4 days. In peak seasons, this may rise to 7- 10 days.

The cost difference between direct and indirect services is mainly attributed to additional terminal handling charges incurred at transit ports, often estimated at 150 USD (107 EUR) per TEU at the Port of Singapore. On the other hand, inland costs in the 2 cases are different. The following table will summarize total costs in the case of Cat Lai Port.

TABLE 10. Freight rate calculations in the case of Cat Lai Port.

		Final destination		
Price type		**Munich (EUR)**	**Warsaw (EUR)**	**Budapest (EUR)**
Phase 1	Warehouse- Terminal Haulage Fee	94	94	94
	Terminal Handling Charges at Cat Lai Port	53	53	53
Phase 2	Ocean Freight Rate	925	925	925
	BAF Surcharge	427	427	427
	CAF Surcharge	151	151	151
Phase 3	Terminal Handling Charges at the Port of Hamburg	200	200	200
	Terminal-Terminal Pre-Haulage Fee by train	225	370	450
	Terminal- Warehouse Post-Haulage Fee by truck	150	500	260
	Transshipment costs truck-train	30	0	54
	Others (buffer, customs clearance)	6	50	50
Total		**2, 261**	**2, 770**	**2, 664**

As shown in the above table, customers shipping from Cat Lai Port must pay around 2, 261 EUR; 2, 2770 EUR and 2, 664 EUR for the final destinations of Munich, Warsaw and Budapest. Referring back to Table 9, the price of transport has now increased by 167 EUR/TEU, equivalent to 8%. At this point, the cost advantage of Cai Mep Port is evident.

5 CONCLUSIONS AND RECOMMENDATIONS

To generate an effective system of door- to- door intermodal transport service from Southern Vietnam to Northern Europe, it is critical to reflect on the case chain at this end of the thesis. Hence, this chapter will expound some implications from the last findings. Of great interest to the case company and the relevant parties are practical conclusions about the standard model of intermodal transport and discussion about the time and cost benefits derived from this model.

5.1 A standard intermodal transport system

Nowadays, Vietnam has been one of the most dynamic areas on the world map of maritime traffic. With more than 3,000 kilometers of coastlines, there is a great potential for the Government and businesses to develop a far-reaching maritime transport network along with related logistic activities. On the other hand, the national cargo growth has shown tremendous increase since the country participated in WTO in 2007. To meet an average rise of 20 percent per year, intensive investments in the national transport infrastructure and service upgrade are necessary. So far, the greatest attention has been evident in the field of intermodal transport and door-to-door services.

Nevertheless, current conditions with respect to resources and investments are probably not satisfactory. Only 5 out of the 8 port groups can accommodate container vessels on regular basis. In the case of transocean shipments, most containers originating from Vietnam must assemble at the intermediate hubs in Singapore or Malaysia before joining a larger shipment. Regarding service quality, only 10-15 % of logistics businesses in Vietnam can provide full- scale door-to-door services. In this picture, a standard model of shuttle service is truly practical in helping the local transport enterprises expand and improve their space of business. In essence, a new direct service is critically needed for benefits of time and costs.

Regarding this research, an effective system of intermodal transport was achieved by analyzing the case of Sai Gon Cuu Long, a freight forwarder in Southern Vietnam. In this case, Sai Gon Cuu Long deals with an intermodal contract of granite

transport from Southern Vietnam to Northern Europe on FCA basis. To a large extent, the research questions proposed have already been answered at this end of the study.

First and foremost, it is recognized that intermodal transport performance initiates with a strategic planning of carriage. From the beginning, the forwarder must approach the door- to- door service as a chain of successive phases. Throughout these phases, the key nodes, links, and transport operators are present. While nodes and links provide basic infrastructure for traffic flows and designs, transport operators play an important role in resource allocation and utilization.

Next, freight forwarding arrangements are processed via the establishment of transport documents. As per FCA, Sai Gon Cuu Long is the main operator who works in the custody of the buyer in Hamburg, fulfilling their responsibility and liability as regulated in the through bill of lading. In practice, Sai Gon Cuu Long will assign Hanjin shipping line to perform the overseas shipping, and another agent in Hamburg to organize post-carriage in Northern Europe. Hinterland transport practices also involve subcontracted haulage firms at both ends of the case chain. At this point, the question of who are involved in the transport chain is answered.

On the basis of a liner booking note, names of focal transport nodes are fixed by Hanjin. In that sense, Cai Mep Port is selected as the port of shipment in Southern Vietnam and the Port of Hamburg as the port of destination in Northern Europe. Owing to its advantage as the first deep sea port in Vietnam, Cai Mep Port allows containers to be directly transshipped to European countries without a buffer at intermediate hubs. In order to accommodate large vessels, the terminal is well equipped with the most modern infrastructure and construction. On the other hand, Hamburg has been a common name in the Westbound Asia- Europe maritime routes, at the same time a strategic gateway to numerous Northern and Central Europe markets. Analysis of port dynamics in terms of geographical location, productivity and infrastructure reveals that both terminals can allow smooth streamlines of containers.

Regarding intermodal links, the long- sea routing offered by Hanjin is performed by the Post Panama vessel Hanjin Port Kelang. The new generation ship is 304 meters long. Its maximum capacity is up to 6655 TEUs, equivalent to 75,000 tons. On the other hand, road transport is selected for hinterland practice in Southern Vietnam. Post- carriage in Northern Europe involves the combined employment of rail and road transport respectively in terminal- terminal and terminal- consignee routing. In practice, modal selection involves intensive research into the factors of cost, reliability, time base, forced routing, operations and strategies. The best choice is achieved when the transport mode operates up to its optimum with respect to these factors. However, the final target of intermodalism is to reach totally smooth traffic amid modal transshipments.

On the whole, there is a complex set of different technical and organizational elements engaged in the researched links and nodes. Up to this point, the question of what is involved in the case transport chain is answered.

Subsequent to node and link allocation, it is a challenge for Sai Gon Cuu Long to proceed to case chain operations. In reality, of great importance to hinterland practice are routing and scheduling. Otherwise, attention should be paid to crew assignment, flow distribution and connection patterns in planning port operations. At this stage, not only Hanjin shipping line, port operators and Sai Gon Cuu Long but also local haulage firms attend the chain. The role of Sai Gon Cuu Long in planning a comprehensive route, connecting business actors and managing transport resources is enhanced indeed. In all cases, a contingency plan is necessary to avoid risks of congestion as well as damage claims. Consequently, the question of how Sai Gon Cuu Long organizes hinterland and port operations is illuminated.

Last but not least, the freight forwarder needs to consider the performance of the holistic case chain. In short, timing and rates are the best indicators that Sai Gon Cuu Long and their customers can refer to in evaluating the service quality. In practice, calculations of time and freight rates must compile all phases of carriage. At the end, a benchmarking method should be applied to relatively compare the performance of the system with the preceding practices. At this end, the question about the total costs and overall performance evaluation can be clarified. In plan-

ning a door-to-door intermodal service network, cost-effective and time-saving results are expected. Relevant implications are needed to help the freight forwarder to focus on the real cost centers of the case chain and take necessary actions. As the matter of fact, if Sai Gon Cuu Long wishes to work in the long- term with their customers, the company must continuously try to find a way to improve its competence, especially by reducing the total freight rates. This would mean that Sai Gon Cuu Long invests more resources in exploring better modal potentials. Otherwise, they should define strategies in the door- to- door service at the outset.

5.2 Cost and time implications

As a matter of fact, a cost- effective and time-saving model is the ultimate target for all transport businesses in performing intermodal services. Following the calculations of chapter 4, this section will draw some further conclusions about transport costs and time from the viewpoint of benefits and bottlenecks. To attain practical implications, the biggest obstacle is that available public data about financial performance of the relevant research objects are very limited. In that sense, proposals by the author may be partial to some extent.

In this context, the cost and time benefits resulting from the case chain are attributed to the maritime route offered by Hanjin shipping line. Commencing from October 2010, the new direct route offered by Hanjin shipping line has saved a lot of money for exporters in Vietnam, at the same time improving their competitive edge on the global market. Some visible benefits are pinpointed herewith.

Time implications

Compared to the last Far East- Europe trips from Southern Vietnam in which vessels transit at Port Klang (Malaysia) or the Port of Singapore (Singapore), the new direct service NE5 offered by Hanjin shipping line shrinks the total time of transoceanic travelling from 23 to 19 days. The fleet of 9 vessels now allows cargoes to reach the final consignees faster and flexibly fulfill export demands, particularly in times of peak consumption.

As a result, the new service allows better management of the supply chain. Very often in the past, containers are subject to roll and finalize in the back-up list when transiting because of the congestion caused by the overflow of containers originating from China. In this new route, by contrast, transport planners in Southern Vietnam are completely active in their routing and scheduling. There will be no adjustment in the liner bill of lading now that there is only one vessel carrier is involved. And also, shorter traveling time means lower risks, damage claims.

Cost implications

On the whole, the current freight rate is shared equally by ocean freight rate, surcharges and inland costs. At this time of the year, an increase in surcharges is expected due to the political unrest in Libya, one of the biggest oil exporters in the world. In fact, the freight forwarder can hardly make any changes in this aspect.

Referring back to the last calculations in chapter 4, the decrease of 167 EUR per TEU in the case freight rate is impressive. This result is explicit because the new freight rate no longer entails additional costs for terminal handling at transit terminals in Asia. The fees paid to the shipping line for its maritime service is thus lower than the last practices. In essence, this price level of ocean freight rate is supposed to be maintained, for the shipping line would like to sustain its competitive edge in this area.

On the other hand, the best practices of inland transport have presumably been used in this case study, in both terms of time and cost benefits. The cost advantage offered by combined rail-road transport scenario might be bigger when dealing with higher volumes, higher number of shipments, and higher frequency of service at terminals.

6 SUMMARY

This thesis is designed to build up a standard practice of door- to- door intermodal service for the freight forwarder Sai Gon Cuu Long in transporting granite from Southern Vietnam to Northern Europe. Accordingly, an introduction of the research background, research questions and objectives are given along with the research methods, scope and limitations, and thesis structure. Analysis is divided into two parts: theoretical framework and empirical examination.

First and foremost, the theoretical content is collectively presented in chapter 2. The objective of this chapter is to provide basic literature reviews on an intermodal transport system. Within this chapter, intensive research is conducted into various aspects of the complex set. To start with, intermodal transport concept is reviewed with respect to its definition, related terminologies and the chain approach. Subsequent to this section, the intermodal transport system is regarded as a chain of interconnected links (transport modes) and nodes (transport terminals). Under subheadings 2.2, the basic functions, characteristics and selection factors of intermodal transport modes are discussed. Next, intermodal transport terminals are elaborated on in terms of type, function, layout, location and hinterland connections.

On the other hand, intermodal transport system is as a complex network of various elements. The rest of chapter 2 indeed contributes to describing the most common technological and organizational components, including vehicles and equipment, transport operations and relevant actors. At the end, a framework for performance measurement is set up. For an optimal evaluation, benchmarking methodology is adopted in relatively comparing the case system with the preceding ones. The 2 main indicators of performance are timing and freight rate.

Based on the theoretical background, a case study dealing with door-to-door intermodal service of granite transport from Southern Vietnam to Northern Europe is conducted. In details, the traffic design is divided into 3 main carriage phases linked together: pre-carriage in Southern Vietnam, main carriage via Suez Canal

and post- carriage in Northern Europe. Present along these phases are intermodal nodes and links.

Firstly, an overview on the case transport chain and freight forwarding arrangements are briefly introduced. Next, the notions of Cai Mep Port and Port of Hamburg are in-depth studied. The content of analysis focuses on the inner- port dynamics and relevant hinterland connections.

After identifying the key node terminals, it is necessary to examine the long- sea links and hinterland links of the case chain. By reasoning, optimal choices of mode are achieved. The engagement of the Post Panama vessel is compatible with current infrastructure of Cai Mep Port with respect to port size, berth depth, construction and provision of modern vehicles and equipment. Considering local transport conditions in Southern Vietnam, road transport turns out a credible alternative. In Northern Europe, based on the past experience, combined transport is employed. In that sense, rail transport is utilized in terminal- terminal routing for its speed and safety, and road transport in terminal- consignee for its flexibility. This combination requires ancillary transshipments at both national and international levels. Upon this point, the first research question is answered.

To answer the research question 2 and 3, chapter 4 ventures into describing the case chain operations. While focus of analysis in hinterland planning is around routing and scheduling, the main concern in port execution is basically about crew assignment, flows of distribution and connection patterns. The framework for operation discussion is on a chronological basis.

Finally, the question about the practical performance of the case chain is answered. In chapter 5, evaluation is based on the benchmarking methodology. Total time and freight rates involved in transporting a 20 foot container of granite are first calculated. Consequently, the time and cost benefits are presented in figures and percentages by rough comparison with the preceding practices.

To conclude, the need to establish a standard system of door- to- door intermodal transport service is evident. The model proposed in this thesis is by and large sa-

tisfied, especially in terms of time and costs. By embedding these suggestions, shippers and freight forwarders can save up to at least 167 EURO per TEU and 7-10 days in routing their containers from Southern Vietnam to Northern Europe.

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Interview

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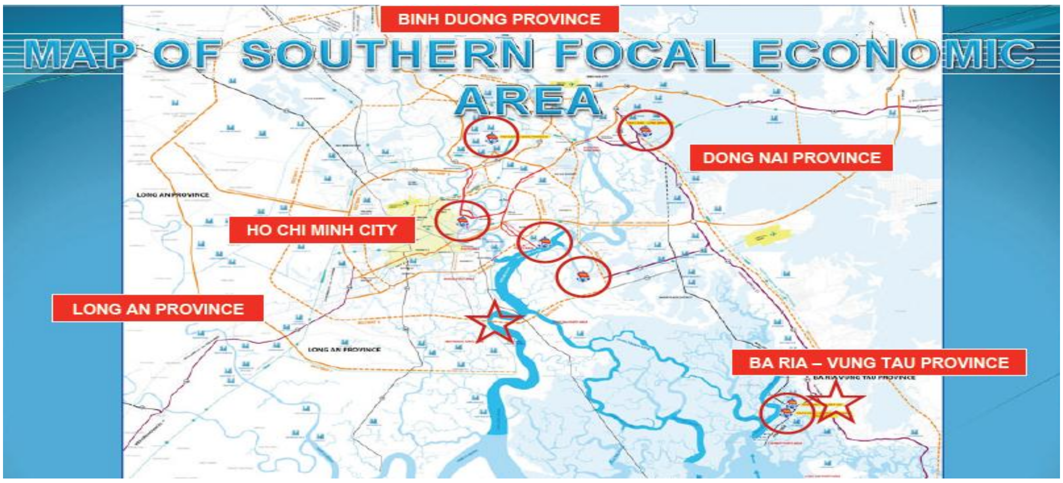
APPENDICES

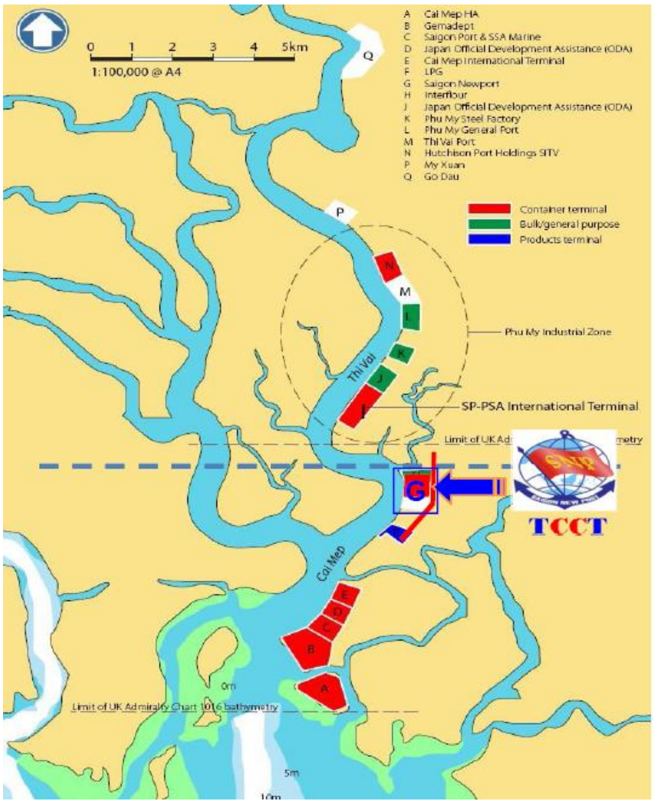
APPENDIX 1. List of interview questions

1. What is the current picture of door-to-door services in Southern Vietnam?
2. What are the type of container and container consolidation method used in the case of granite transport?
3. Where are the main facilities of granite product in Southern Vietnam?
4. What contract term is commonly used in door-to-door services?
5. Who are the main parties in such contract term?
6. What are necessary documents to be processed?
7. What is the most common means of transport in Southern Vietnam?
8. What are the bottlenecks in hinterland practice in Southern Vietnam?
9. What activities are involved in port operations?
10. How to compile final freight rates to customers?
11. How much is paid for terminal handling at the Port of Singapore?
12. What is the expected price for the direct shipping route?
13. Which port in Ho Chi Minh is the most common choice for overseas shipping?
14. What is the current ocean freight rate from Cat Lai Port?

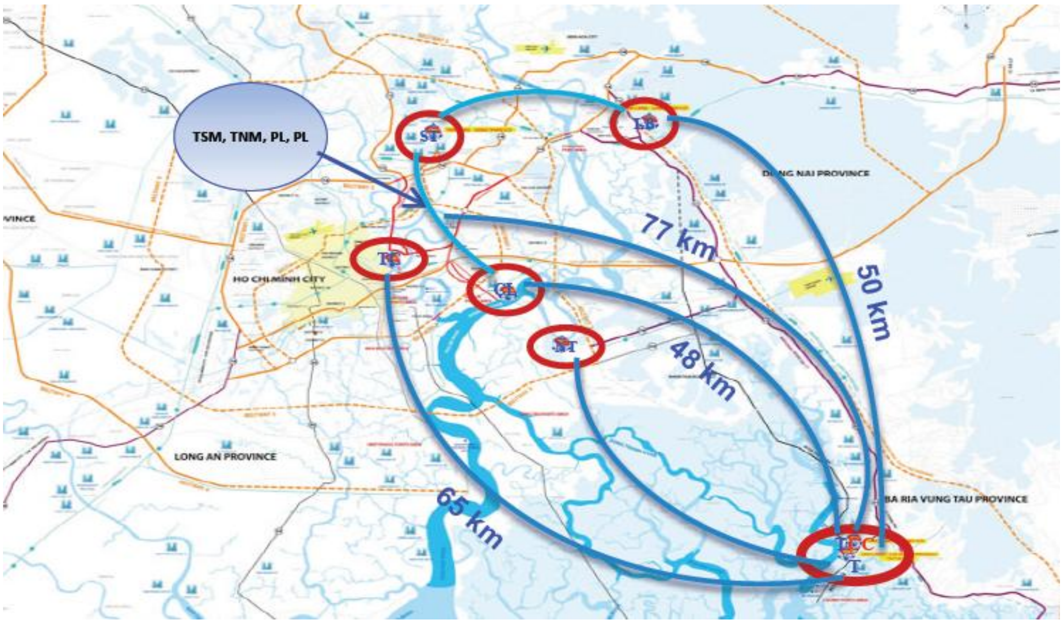
APPENDIX 2. Map of the Southern Focal Economic Area in Vietnam (Sai Gon New Port Corporation, 2010, p. 8).



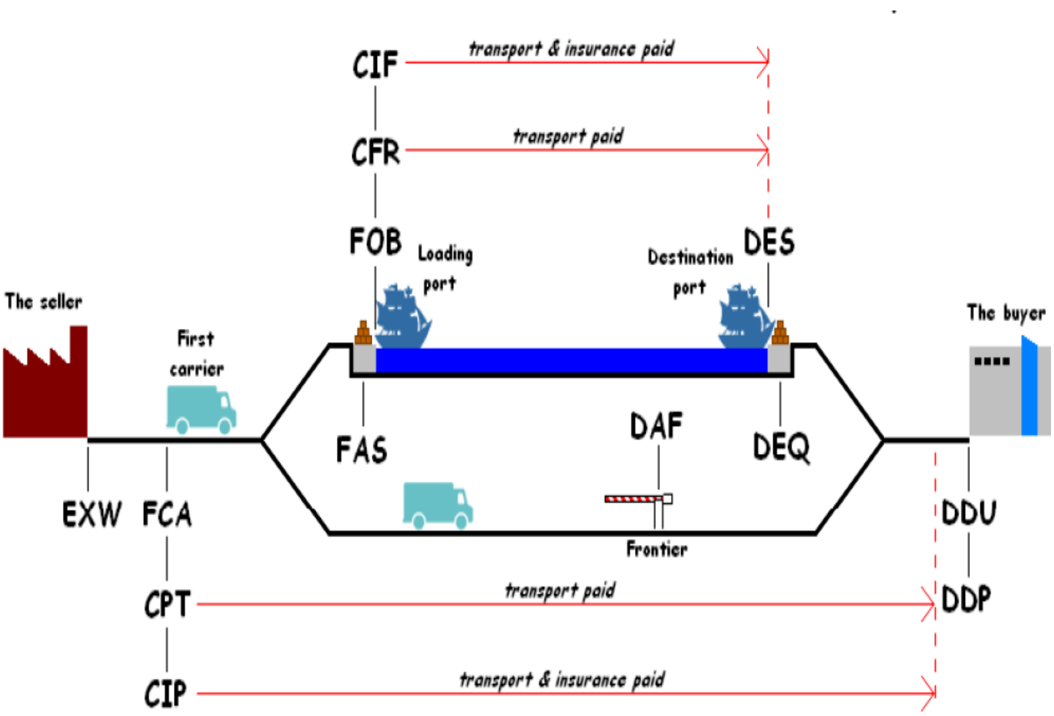
APPENDIX 3. Port site of Cai Mep Port on Thi Vai River (Sai Gon New Port Corporation, 2010, p. 14).



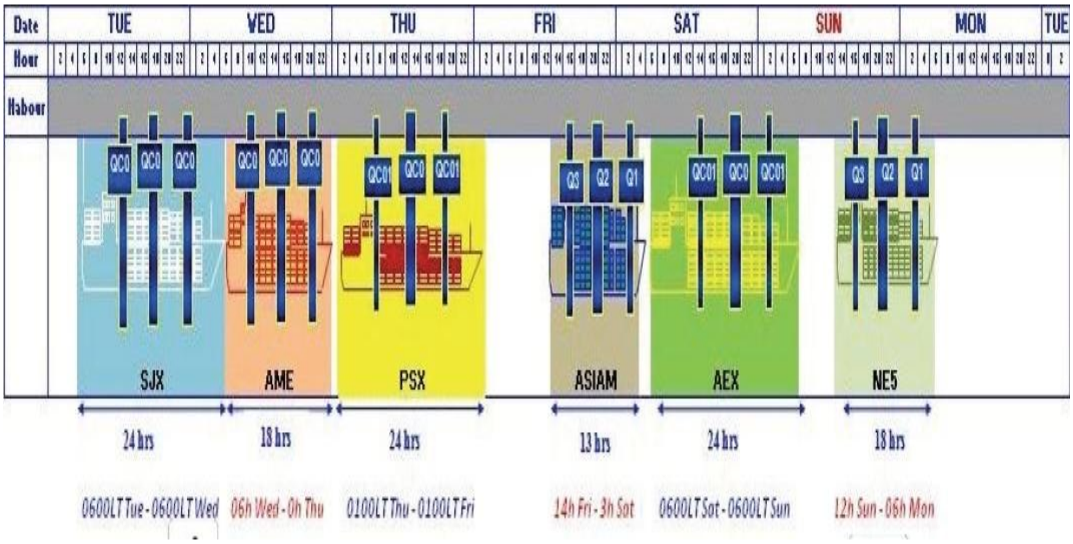
APPENDIX 4. Distance from facilities in Southern Vietnam to Cai Mep Port (Sai Gon New Port Corporation, 2010, p. 17).



APPENDIX 5. Incoterms 2010 (Hans, 2010, p. 29).



APPENDIX 6. Berthing window at Cai Mep Port (Sai Gon New Port Corporation, 2010, p. 22).



APPENDIX 7. Costs and distances in hinterland routing in Southern Vietnam.

Origin	Distance (kilometer)		Trucking Cost USD/TEU		Time (hour)	
	Cat Lai Port	Cai Mep Port	Cat Lai Port	Cai Mep Port	Cat Lai Port	Cai Mep Port
Southern Ho Chi Minh City	35	125	150	290	2.5	3
Northern Ho Chi Minh City	30	55	130	180	2	3
Central Ho Chi Minh City	25	100	120	270	1	3
Average	30	93	133	246	1.8	3

APPENDIX 8. Combined transport of truck and train from Hamburg to Munich (European Intermodal Association, 2010, p. 31).

Price of "terminal-to-terminal" main haulage	EUR 450- per 40' Container
Price of post-haulage (from terminal to consignee)	EUR 150- per container in average
Transshipment/ handling costs	EUR 30- for Handling and agency fee
Other costs/fess	EUR 6- per TEU and day storage at inland terminal

APPENDIX 9. Combined transport of truck and train from Hamburg to Budapest (European Intermodal Association, 2010, p. 12).

Price of "terminal-to-terminal" main haulage	EUR 850,- until 900,-for 1 x 40Ccontainer
Price of post-haulage (from terminal to consignee)	EUR 260- per container in average
Transshipment/ handling costs	EUR 54- for two handlings ab Bilk Kombiterminal in Budapest
Other costs/fess	EUR 50- per TEU for storage fees, agency costs and Customs ops.

APPENDIX 10. Combined transport of truck and train from Hamburg to Warsaw (European Intermodal Association, 2010, p. 31).

Price of "terminal-to-terminal" main haulage	40' Unit with less than 16,5 tones 740,-EURO
Price of post-haulage (from terminal to consignee)	150- EURO for first ring of 35 kilo-meters
Transshipment/ handling costs	Included in rail cost
Other costs/fess	Interchange TEU in Poland 50,- EUR

APPENDIX 11. Surcharges by Hanjin shipping line in Westbound Asia- Europe routes from Cai Mep Port to the Port of Hamburg (Surcharge, 2011).

Charge	Code	Per	Currency	Rate or Percentage	Cargo Type	Effective	Expired
ADEN PIRACY RISK SURCHARGE	APS	20	USD	44.00		04Jan10	
B/L CORRECTION CHARGE	BCC	BL	USD	15.00		07Aug10	
BUNKER ADJUSTMENT FACTOR	BAF	20	USD	600.00		01Mar11	31Mar11
CURRENCY ADJUSTMENT FACTOR	CAF	PC	USD	16.31%		01Mar11	31Mar11
DESTINATION DOC HANDLING FEE	DDF	BL	EUR	15.00		18Oct08	
DIVERSION CHARGE	DVC	BL	USD	100.00		01Jul09	
DOCUMENT HANDLING FEE	DHF	BL	VND	400,000.00		15Oct09	
ENTRY SUMMARY DECLARATION SURCHARGE	ENS	BL	USD	25.00		01Jan11	
FUEL RECOVERY CHARGE	FRC	20	USD	320.00		01Mar11	31Mar11
GARMENT ON HANGER CHARGE	GOH	D2	USD	415.00		01Jan11	
GARMENT ON HANGER CHARGE	GOH	D2	USD	471.00		01Jan11	
HITCHMENT BILLS OF LADING CHARGE	HBC	BL	USD	20.00		01May09	
LATE BL PICK UP	LBP	BL	VND	500,000.00		20Nov10	
MANIFEST CORRECTION FEE	MCF	BL	USD	40.00		01Jan11	
OBL SURRENDER CHARGE	OBS	BL	VND	200,000.00		07Aug10	
OBL SURRENDER CHARGE	OBS	BL	USD	15.00		07Aug10	
OVER WEIGHT SURCHARGE	WSC	D2	USD	100.00		01Apr08	
OVER WEIGHT SURCHARGE	WSC	T2	USD	100.00		01Apr08	
SEAL FEE	SLF	BX	USD	3.80		24Jan11	
SUEZ TRANSIT FEE	STF	20	USD	10.00		18Oct08	
TERMINAL SECURITY CHARGE DESTINATION	DTS	BX	EUR	13.00		18Oct08	
THC AT DESTINATION.	DTH	BX	EUR	200.00		01Oct08	
THC AT ORIGIN	OTH	20	USD	75.00		01Aug08	

APPENDIX 12. NE5 routing via Suez Canal (Sai Gon New Port Corporation, 2010, p. 29).