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FREIGHT MODE CHOICE ANALYSIS: THE CASE OF ROAD AND RAIL TRANSPORTATION IN MYANMAR

Thesis Submitted for the Degree of PhD of Korea Maritime and Ocean University

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August 2015

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ABSTRACT

Freight transport is considered as essential for being a major industry in itself as well as an integral part of every sector of the economy. Considering its critical role in economy, it is essential to understand the nature of freight transport systems and how the goods are distributed and processed depending on industrial conditions. Understanding mode choice is at the heart of freight transportation planning.

Irrespective of this, freight mode choice and freight transport systems has been untouched and ignored in Myanmar. With the projected growing economic activities and reforms, it is highly essential to study mode choice behaviour. Literature review also highlights that mode choice are different from one context to another.

Noting this, transport geography of Myanmar is first reviewed. After that, the general characteristics of freight users are examined focusing on their attitudes and satisfaction towards the current road and rail system. Then mode choice behaviour of road and rail transport are analysed estimating the parameters for the attributes utilizing binary logit models for certain commodities based on the Stated Preference Survey. Elasticities are also derived from the successful estimated disaggregate models to understand the sensitivity of the changes in those attributes. Then the policy analysis in Myanmar context is conducted. Finally, contributions and future directions of this thesis are presented.

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CHAPTER 1: INTRODUCTION

1.1 Background and Motivation for the Research

Transport sector is an essential component for the growth of nations and is the means for development (Rodigue & Notteboom, 2013). It is widely recognized that there is a relation between the quantity and quality of transport infrastructure and the level of economic development. Freight transportation, part of transport sector, in general refers to an aggregate movement of goods from one location to another and is widely known as one of the major parts driving the global economy forward. The importance of the freight transport can be considered both as being a major industry itself and as being an integral part of every sector of the economy. Efficient and reliable freight transport is critical for the success of the business. Being a derived demand, the increased in economic activities creates a more demand for goods and services in freight transport. Any obstacles to the progress of freight transport systems should be eliminated. In so doing, it is essential to understand the nature of freight transport systems and how the goods are distributed and processed depending on industrial conditions.

On the other hand, compared to passenger transport analysis, few researches have been conducted on freight mode choice. This results in little understanding of the behavior of decision making agents involving in the freight industry. Several factors contribute for this complexity of modeling in freight than in passenger transport analysis. One of the factors is that freight is heterogeneous. As many actors such as shippers, forwarders, carriers and receivers involve in the decision making process, the relationships among those freight agents are also very complex. Despite, a majority of freight transport models have been developed based on the paradigm of passenger transport, in an attempt to understand freight transport. Instead of criticizing little progress in modeling and understanding the behaviour of the freight agents, particular geographical study on freight transport is still essential for a particular nation has to face with the changes in industrial structure and the nature of commodities transported, technological developments; government policy both in terms of infrastructural development and the regulation of the freight transport industry; and finally the development of increasingly sophisticated logistical arrangements and the constraints and preferences which influence shipper's choice between available modal alternatives (Nam,

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1992).

Freight transportation in Myanmar is critically important for economy and for the national integration of the rural public to say the least. Since the election in November 2010, Myanmar's government has taken a series of political and economic reforms as part of the vision to become a modern democratic and developed nation by 2030. With the positive lifting of the international sanctions, Myanmar's economic growth is projected to accelerate at 7% per annum for the next five years since 2013. In order to promote the economic activities, transport sector growth is included in Framework for Social and Economic Reform launched for achieving long term goals of National Comprehensive Development Plan (NCDP). Along with it, Myanmar National Transport Master Plan has also been drafted which is based on "Corridor Based Transportation". In line with the plan, a great number of surface infrastructure projects of all modes have been proposed. Thus freight mode choice study which is important for policy evaluation is called for in Myanmar. With recent economic growth and its strategic location to Asia's largest and fastest growing markets, India and China, the derived demand for transport will be high especially in the domestic transport sector i.e road, rail and inland waterway. Presently however, the transport infrastructure in Myanmar is considerably unsatisfactory when considering a country of its size and population[1].

The country's road and rail connection has played a significant role in Myanmar's border trade and international trade. Road and rail networks lies in competitive position and thus the study on how shippers make to transport their freight is of interest to the author. This will be discussed more in CHAPTER 2:.

[1] Myanmar population is over 50 million; and the area is over 676,000 squares kilometers.

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At the micro level, transport policy aims to make transport system work more effectively and efficiently. As such, an understanding of why shippers/forwarders choose to move freight in a certain manner is critical to the development of appropriate transport policy (Norojono & Young, 2003). In addition, as transportation is related to consumer, producer and production cost, the analysis of modal choice is essential to the decision making process in the transport sector. In the short term, influencing the modal choice can result in an efficient use of existing capacity. In the longer term, there will be implications for any replacement or expansion investments in the transport system.

Regardless of its importance, to the author's best knowledge, only infrastructure and institutional aspects of Myanmar transport have been studied (Asian Development Bank, (2012), JICA (2014), KMPG (2013)). However, there has been no study with regard to modal choice for freight transport focusing on transport users' behaviour and selection criteria in such a developing country. The author strongly agree with Nam (1993)'s argument that compared to the study of passenger demand analysis, the consideration of commodity flows in relatively under-developed is particularly true in the context of a developing country. In addition, modal choice is different for different geography (Kullman, 1973; Roberts, 1977; Gray, 1982). One models' results in one particular study area are difficult to transfer to other geographical area unconditionally (Fries, N & Patterson, Z., 2008). Thus, this research on modal choice is essential for the contribution to the transportation planning in Myanmar.

1.2 Objectives

The overall aim of this study is to evaluate the factors that determine the mode selection in domestic road and rail transport of Myanmar and to achieve an improved understanding of the use of mode choice models for freight transport. Although, inland water transport possesses a certain share, this mode is operational only in the rainy season due to its navigational constraints. Thus, it seems appropriate to focus the study on road and rail transportation, excluding inland water transport.

This aim will be realized through the following specific objectives:

to describe and understand the nature of the freight transport system in Myanmar and its development

to perform a comprehensive literature review on mode choice studies

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to establish the factors that determine the modal selection of the shippers to move their cargo

to estimate the disaggregate model of mode choice for freight transportation in road and rail transport of Myanmar

to apply the model for the analysis of transport regulatory and infrastructure investment in Myanmar

1.3 Methodology

This study focuses on domestic transport of road and rail mode in Myanmar. The conceptual framework of the study is outlined in Figure 1.1 and consists of 5 stages.

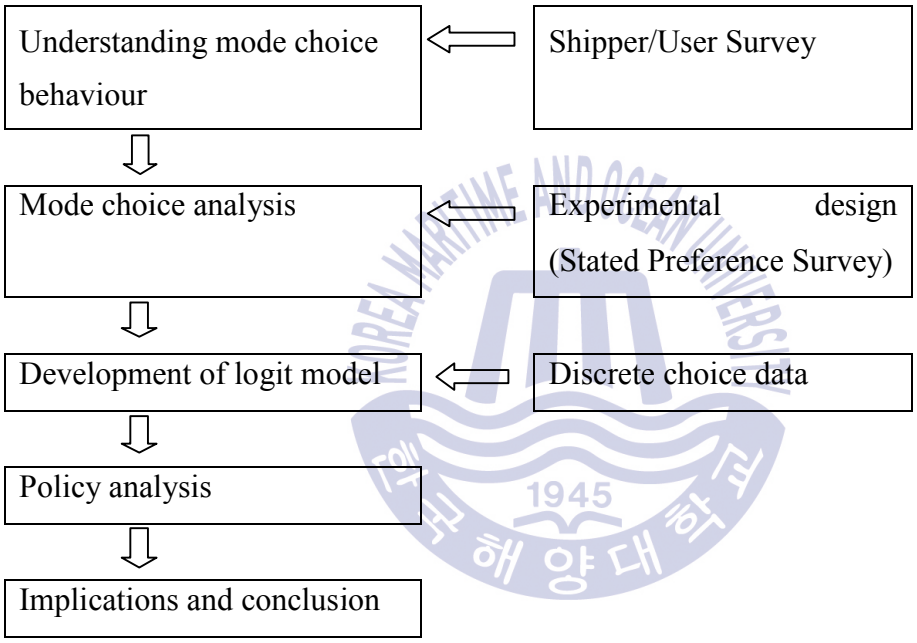

Figure 1.1 Conceptual Framework

Literature on modal choice analysis of freight transport has revealed that some focuses have been on carrier selection and some focuses on transport mode explicitly. Fries and Patterson (2008) suggest combine carrier selection and mode characteristics in Stated Preference design. However, it seems desirable for the author to study the carrier selection criteria with one method and mode choice using Stated Preference method. Triangulation of the methods will contribute a more comprehensive understanding of the mode choice behavior.

In the first part of the analysis, general statistical analysis is applied to support a

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comprehensive understanding of Myanmar freight transport system, the characteristics of the shippers and to establish transport user's satisfaction associated with their perceptions on road and rail transport using rating method. Self-administered questionnaire is adopted for this survey. In the second part of the analysis, the variables and levels for the Stated Preference are determined using interviews to the shippers i.e., the firms which is in line with Jeffs & Hills, (1990). Then SP choice survey is conducted through direct interview so that shippers, forwarders, and transport/logistics service providers clearly understand the choice context. Interviews include the shippers from various industries such as construction, rice, pulses and beans and manufactures, forwarders and transport/logistics service providers. The first two industries represent import distribution within domestic and the latter represent domestic transport usage for export. The collected data is analysed in SAS package. Logit models of freight transport mode choice are developed across the three sectors at a disaggregate level. The sample used in this study is choice

1.4 Content

The remaining chapters of this thesis are organized as follows:

- Chapter 2 provides an overview of freight transportation systems in Myanmar focusing on road and rail transport. It also discusses the infrastructure and regulatory aspects of road and rail transport systems emphasizing the types of commodities transport and their distribution pattern.
- Chapter 3 reviews previous literature on freight mode choice modeling relating to mode choice behaviour. This is discussed in accordance with the factors that determining mode choice and the kind of model applied. It especially focuses on stated preference method and the attributes that have been applied in this method are noted.
- Chapter 4 presents the approach and method that will be used in this thesis considering its relevance to the context of this research. Particular emphasis is given to stated preference methodology.
- Chapter 5 provides analysis on the freight agents' perceptions to transport modes selection using Likert scale and their satisfaction to the usage of these modes. The aim is to have a general understanding of transport users received from the current system and support the result of the analysis in consecutive Chapter 6.
- Chapter 6 presents the analysis and modeling of Stated Preference survey

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using logit models. The detailed mode choice behaviour is presented with the estimated parameters and sensitivities of each factor are discussed though the elasticities generated from the models.

- Chapter 7 provides a summary conclusion of the work carried out in this thesis together with its contributions to freight transport system and transport policy makers in Myanmar. Finally, the directions for further research are presented.

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CHAPTER 2: FREIGHT TRANSPORTATION IN MYANMAR

2.1 Introduction

In this chapter we examine the freight transportation system in Myanmar as an understanding of the conditions pertaining to the freight transport market is fundamental to any mode choice study. The study provides information mainly on road and rail with respect to infrastructure, institutional aspects, types of commodities flow, and major routes are described.

2.2 Transport Geography of Myanmar

2.2.1. Transport Networks

The main surface transport network in Myanmar consists of road, railway and inland waterway. Road transport is the dominant transport mode in Myanmar and the road network underwent a dramatic expansion since 1990s. Before 1998, the total road length of Myanmar was 21943 km. In March, 2012, the road networks extend to 150,816 km (ASEAN-JAPAN Transport Platform Project, Myanmar Road Transport Administration Department). Realizing the social economic development of the country, high way construction was started in 2006-07 along Yangon, Naypyitaw and Mandalay which is about 587 km long. However, the road network quality is mostly in question as the paved and unpaved ratio is quite different_ the former 21% and the latter being 79%. For a country of 676,578 square km, Myanmar possesses only 148690 km, whereas the highway accounts for only 578 kilometers. Road density in Myanmar is 2km per 1000 people where in ASEAN is 11 km (Asian Development Bank, 2012).The extent and shape of Myanmar's primary road network has been dictated by topography (See Figure 2.3). The country is long and relatively narrow, and divided by north-south mountain ranges and large rivers. The primary road runs north-south. Since the late 1980s however, several primary roads and bridges have been constructed to provide east-west linkages.

Myanmar Railways is the sole operator of the country and it is a state owned enterprise. Rail transport policy is to cater for the socio-economic development in the remote areas. Similar to road transport, the rail networks also experienced a great expansion over the last twenty years, expanding by 78% between 1988 and 2010 despite its concern in operability. To date, total of rail network including single lane and double lane covers 5878.14 km and

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the total track length is 7693.44 km (Figure 2.2). The road and rail network is shown in Figure 2.3. According to experts' assessments, the rail network is in poor condition and investment in basic infrastructure, such as truck renewal, replacement of sleepers, and upgrading of signaling and communications systems, has been inadequate (ADB, Oct 2012b).

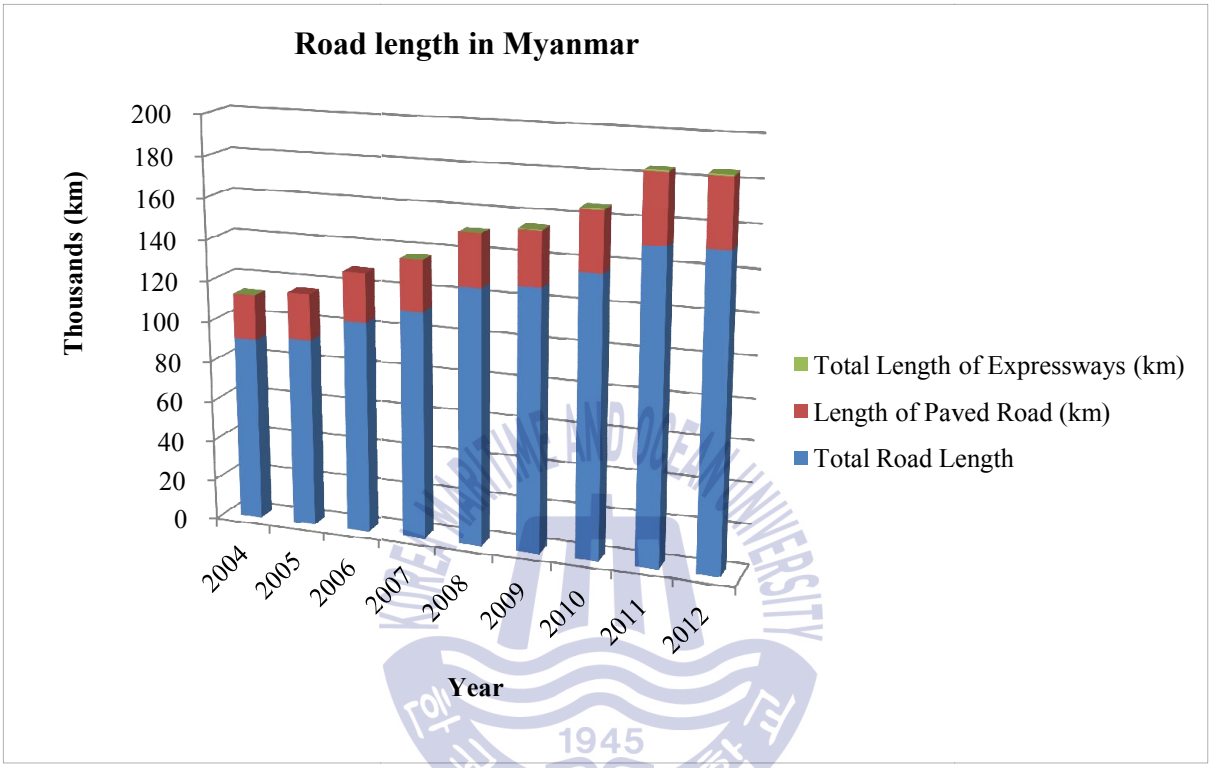

Figure 2.1 Growth of Roads in Myanmar

Source: Drawn from the Data of Ministry of Construction, Public Works Department (2012)

The rail network generally runs north to south with spoke to east and west. In the lower part of Myanmar, Yangon is the central node of the network and Mandalay is the focal point in the upper Myanmar. Recently, Myanmar Railway has expanded the network and the service has been extended along the Taninthayi coast to Mon State and Tanintharyi with Mawlamyaing Station as the southern hub. Table 2.1 and Table 2.2 show the railway lines that have been completed last decades and the one that are expanded.

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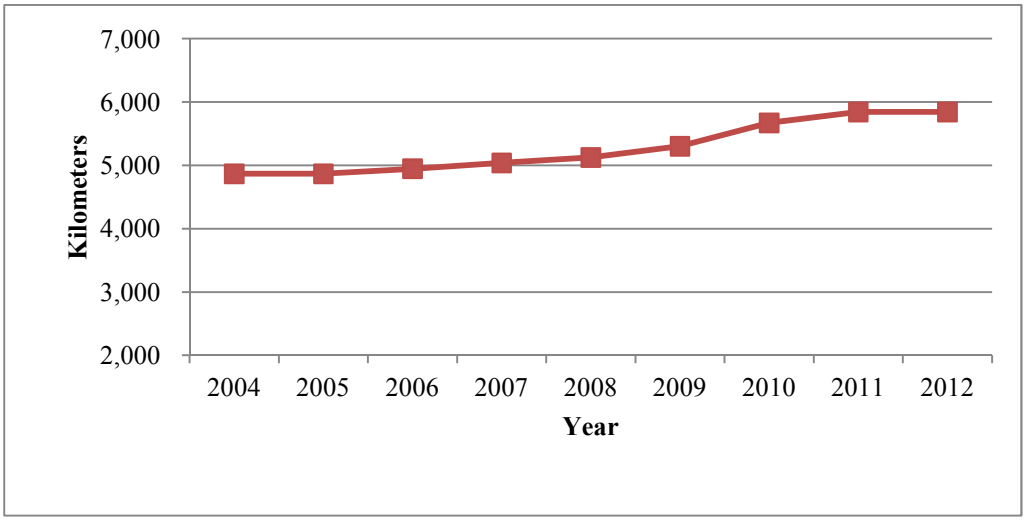

Figure 2.2 Total Rail Route Length in Myanmar

Source: Myint (2013)

Table 2.1 Existing Raillines

Mandalay-Yangon	617 km
Mandalay-Lashio	313 km
Mandalay-Kalay	539 km
Yangon-Bago	74.83 km
Mandalay-Myitkyinar	552 km
Bago-Dawei	507 km
Bago-Thanphyuzayat	270 km

Source: Myint, 2013

Figure 2.4 is the forecast of Oriental Consultants for Myanmar Transport Master Plan. It best describes the distribution pattern of commodities in Myanmar. From which it appears that Yangon Mandalay corridor to China, to Thailand and to India is the most important corridor both for rail network and expressway network. This is because the country's two main cities, Mandalay and Yangon are the centres of agricultural and industrial trade zones. Thus the two cities have to depend heavily on this corridor for the movement of passengers and goods. The route between Yangon and Mandalay which leads to other border trade as well as to the country's maritime and airborne trade centre: Yangon is the principal artery of

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international trade for Myanmar. As the only international gateway port exists there, in the southern part of the country, all the export cargoes except for border trade flow into Yangon and all the import by maritime and air means flow out to the central and the rest part of the country generally thorough big towns like Mandalay. Commodities imported from China, and India are transshipped to cars at Mandalay and forwarded to Yangon.

Table 2.2 Expansion of National Rail Networks

Kyangin-Pakkoku	512.00 km
Katha-Bamaw	156.80 km
Dawei-Myeik	212.00km
Moene-Kyaington	361.60 km
Minbu-Sittway	411.20 km
Pathein-Yangon	142.40 km
Pyawbwe- Magwe	152.00 km
Hinthada-Nyaungdon	76.8 km
Naypidaw-Pinlong	192.00 km
Myitkyinar-Namsam	760.00 km
Monywa-Kalay	216 km
Taungoo-Loikaw	240.00 km
Pyay-Taungoo	192.00 km

Source: Myint, 2013, slide 31.

2.3 The Supply of Freight Transport

In this section, we consider the supply of freight transport for both road and rail modes, including institutional and regulatory aspects, transport infrastructure and fleet of freight vehicles.

2.3.1. Road Transport

2.3.1.1. Institutional and Regulatory Aspects

Myanmar's policy for transport is an element of the national policy for integration of all regions of the country, and promotion of economics activities, particularly trade and tourism with neighbouring countries. Being the dominant mode, road transport has a significant role

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Figure 2.3: Myanmar Transport Network

Source: AJTP Information Center (http://ajtpweb.org/statistics/Myanmar/Myanmar2013/road-transport-of-myanmar)

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to play in achieving these policy objectives.

In institutional and regulatory terms, a number of institutional structures are involved in the transport sector. Out of the concerned ministries, we will deal with only those that administer road and rail transport. Basically two ministries are concerned with road transport: Ministry of Rail Transportation and Ministry of Construction.

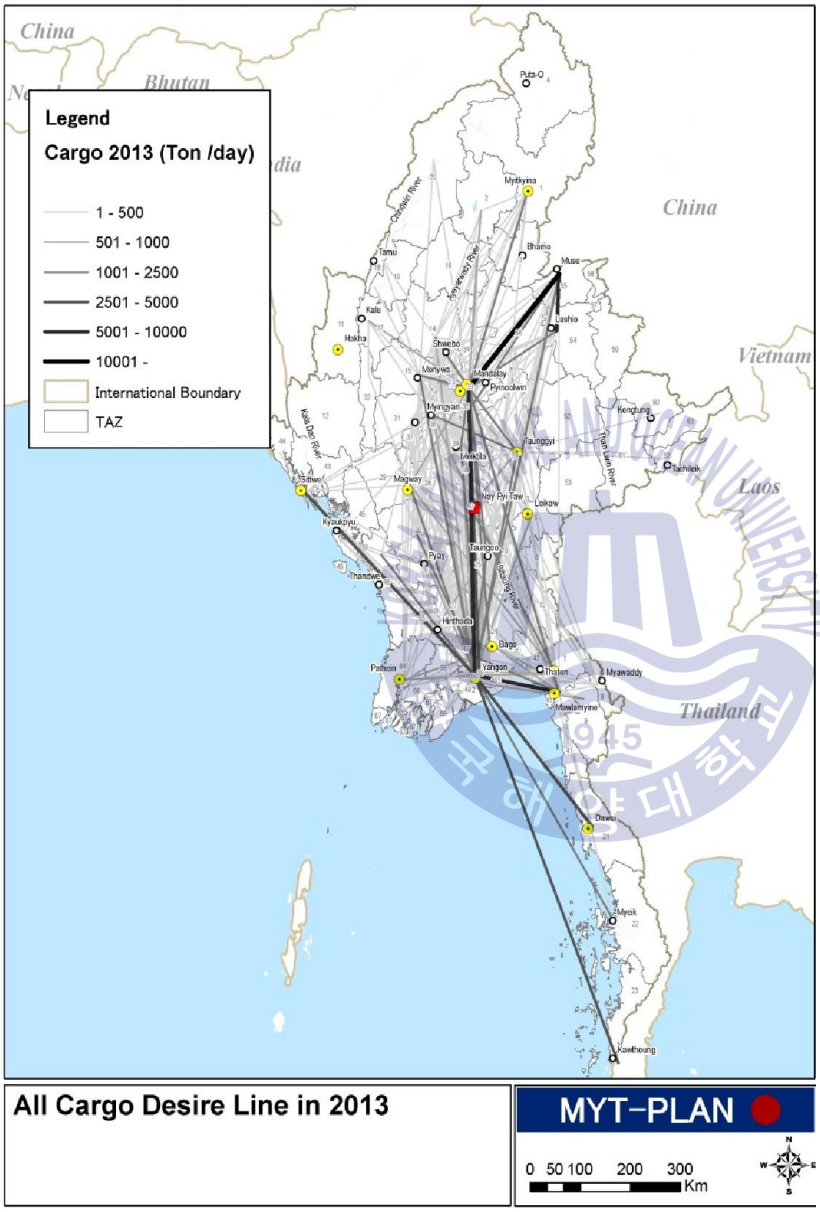

Figure 2.4 Transport Demand-Freight Movement in 2013

Source: Oriental Consultants, 2013, Slides 22.

Figure 2.5 shows the organization chart of Ministry of Rail Transportation. Road Transport Administration Department is mainly responsible for vehicle inspection and

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registration, driver's license testing and issuing, setting traffic regulations and vehicle related taxing. However, for the commercial operation of road vehicles for carrying passengers and freight, business license is required and that will be issued by Transport Planning Department. For the transportation of goods "A license" is issued and for private delivery van, "E license" would be issued.

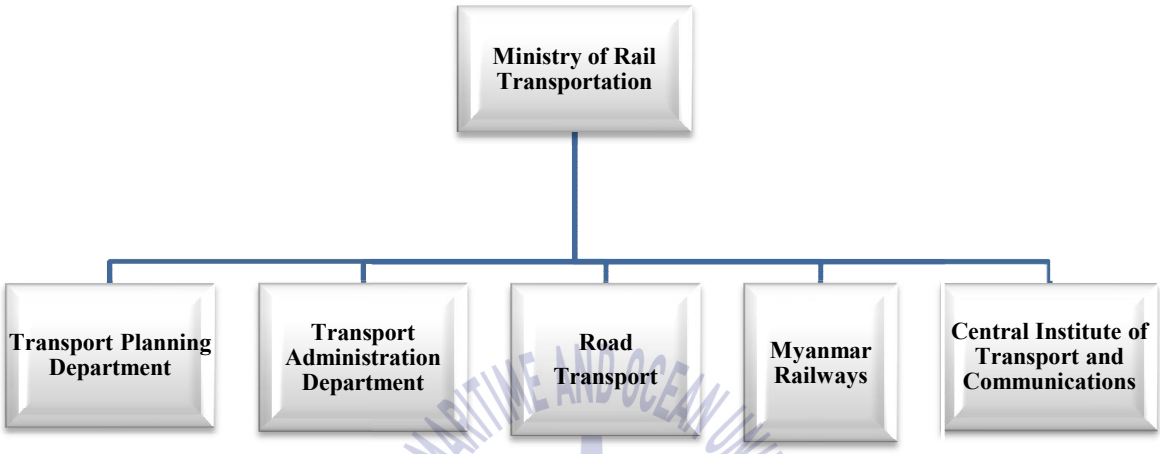

Figure 2.5 Organization Structure of Ministry of Rail Transportation

At the same time, Transport Planning Department is responsible for scrutinizing and coordination plans, budget, and financial matters for the ministry and its agencies. This department is captive in that it arranges and secures transport for state-owned goods, local and international passengers.

The powerful administrative body for road infrastructure can be regarded as Ministry of Construction for the reason that its principal responsibilities for road networks in the country include setting policies for development of roads; setting plans for construction of roads; repair and maintenance of roads; arranging and overseeing joint ventures with other agencies for construction and maintenance of roads, undertaking land acquisition and clearance for construction of roads; importing equipment for constructing and maintaining roads; undertaking research related to construction and maintenance of roads; and overseeing the Public Works Department, that deals with providing resources to accomplish these tasks with the composition of different divisions for roads, bridges, public buildings, and airfields.

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Critiques have consent that Myanmar Transport administration structure needs to be cohesive. The various categories of commercial trucking in Myanmar are classified by Vehicle Transport Business law. Business license is required for trucking operation. Freight rates for transporting commodity are, unlike government operating vehicles, not subject to minimum regulations. Instead, they vary wildly and are strongly influenced by seasonal fluctuations, the weather pattern, the permissible axle load, and the fleet capacity. The permissible axle load is an enforcement of regulations and is shown in Figure 2.6. The axle load enforcement has impacted on the capacity of the fleet. The 22-wheeler trucks are much more cost-efficient compared to the 12-wheeler trucks. The practice of the unit price per freight ton also caused many smaller trucks and truck operators driven out of the market (Christian Ksoll & John Quarmby Consultants, n.d).

Regarding regulations in transport, the concerned authorities have been largely criticized that transport regulations are sporadic and ad-hoc enforcement; lack of transparency as to the exact transport regulations apply make the operators difficult to operate. Operators also attempt to avoid the law in a different way. For example, to avoid the rigorous enforcement of weight limits, transport operators have tried to minimize the tare weight of their trucks by removing superstructure parts from their trailers. As a consequence, box trucks operating as flat reduce the cargo safety as the cargo protection is by tarpaulin and lashing only.

2.3.1.2. Infrastructure

Transport infrastructure has significant impact on the efficiency of transport operation as it determines the level of service qualities (Nam, 1992). Insufficient infrastructure creates a serious constraint on the development of transport system. This subsection explores the situation of road infrastructure, the networks, and examines their significance on the operation of the transport system.

Myanmar is a country comprised of 7 States and 7 Regions. Geographically, Regions are of a type of in the flat land areas whereas States are of in the remote mountainous areas where the access to transportation is rather limited. Extending the road networks to include all of the areas for the purpose of national integration started in the 1990s. The investment comes from the government budget which has been a constraint. As can be seen in Table 2.3, only half of the road networks are of the bituminous and concrete road (0.45). More than half (55%) are

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not good quality for transportation. In addition to the budget, the inability to apply modern technology in construction, road network is still insufficient in terms of either coverage or capacity.

Vehicle Type	Axle Configuration and Axle Weight			Total Weight (national)	Total Weight (ASEAN)
					
Semi-Trailer (6 axles)	5	18	27	50	50.5
					
Semi-Trailer (5 axles)	5	18	18	41	46
					
Semi-Trailer (4 axles)	5	10	18	33	34
					
Single Rigid Vehicle (4 axles)	5	5	18	28	27
					
Single Rigid Vehicle (3 axles)	5	18		23	23
					
Single Rigid Vehicle (2 axles)	5	10		15	15-16
Legend  *Single Wheel* *Double Wheel*					

Figure 2.6 The Current Weight Limits in Myanmar

Source: (Christian Ksoll & John Quarmby Consultants, n.d)*State; # Region

Source: Public Works, Ministry of Construction (2012)

Table 2.4 describes the growth of road network in total and in terms of paved road. Although expansion plan has established it was found that annual average growth of road network is just 6% in total and paved road length increase is 4% annual average growth. Still this percentage remains just the figure as the repair and maintenance for the deterioration cannot

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be matched with due to the quality of the road. Expressway construction connecting the main business hubs such as Yangon, Naypyitaw and Mandalay started in 2007-08. The first portion between Yangon and Naypyitaw, a new capital was finished in 2009 with the length of 324 kilometers. The construction of expressway till Mandalay was completed in 2010 accounting 587 kilometers. So far, this is the only and the longest expressway in the country. It must note that the trucks are not allowed to run on the newly built highway.

Table 2.3 Distribution of Road Length in States/Regions of Myanmar

State/ divisison	Concrete Road (Km)	Bituminous Road (Km)	Gravel Road (Km)	Metal Road (Km)	Earth Road (Km)	Donkey Road (Km)	Total (Km)
Kachin*	18.910	564.075	660.233	1062.167	660.837	774.296	3740.51
Kayah*	0.101	337.560	70.811	186.483	209.718	-	804.672
Kayin*	-	627.041	213.439	208.008	762.829	-	1811.317
Chin*	-	497.287	470.733	7.242	937.035	65.782	1977.079
Sagaing#	-	1888.364	612.959	706.904	965.606	149.065	4322.899
Thanin -tharyi#	-	858.585	433.115	1.609	70.409	-	1363.718
Bago#	263.530	1284.659	160.934	234.964	223.699	-	2167.786
Magwe#	-	2080.278	270.973	504.529	465.302	-	3321.082
Mandalay #	296.924	1813.127	203.180	152.888	48.280	-	2514.399
Mon *	-	604.309	8.047	89.117	32.187	-	733.660
Rakhine*	-	738.287	547.177	229.533	230.136	-	1745.132
Yangon#	61.155	648.465	126.736	73.125	70.811	-	980.292
Shan*	2.213	3958.987	1807.092	1657.223	3350.453	276.807	11052.773
Ayeyar -wady#	17.502	1057.641	335.146	559.750	557.151	-	2457.189
Total	660.334	16958.664	5920.575	5673.541	8603.451	1265.95	39082.52
%	(0.02)	(0.43)	(0.15)	(0.145)	(0.22)	(0.03)	

*State; # Region

Source: Public Works, Ministry of Construction (2012)

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Table 2.4 Growth of Road Network (in Kilometer)

Year	Total road length	Paved Road	Length of Expressway
2004	90,713	22153	-
2005	92859	22830	-
2006	104050	23955	-
2007	111740	24670	-
2008	125355	25553	-
2009	127942	26333	324
2010	136749	28569	587
2011	150816	33014	587
2012	151298	32535	587
%	0.06	0.04	

Note: - indicates data is not available.

Source: Derived from AJTP, 2013.

Figure 2.7shows that different categories of vehicles used in Myanmar ranging from two wheelers carts to heavy truck. As can be seen from Figure 2.7, the categories of truck vehicles are found to be the most in Mandalay and Yangon Regions. In the local states and regions, other small, obsolete vehicles are mostly used for freight transportation. The main vehicle for long distance is 12-wheel, high sided, rigid truck operating at 27/28 tons gross weight. These trucks are second hand and typically imported from Japan. However, the use of 12 wheelers trucks has gradually declined as most of them are now being replaced or supplemented by 22-wheel articulated trucks, largely flat trailers, running at 50 tons gross weight. The majority of 22-wheelers are all brand new since import licensing was relaxed in 2011. For local distribution, a large secondary fleet of 6 and 10-wheel trucks are also running on routes where the shipment volume is low and access to roads is restricted. Being very old, they are no longer competitive on main routes and are laid up about three quarters of the year. In fact, the trucks use in Myanmar has increased from 2005 to 2012 by 34%. (Table 2.5) The trend is likely to increase in the future with the increasing economic activities of the country. It also indicates that policy to promote the road truck should accommodate future congestion problem.

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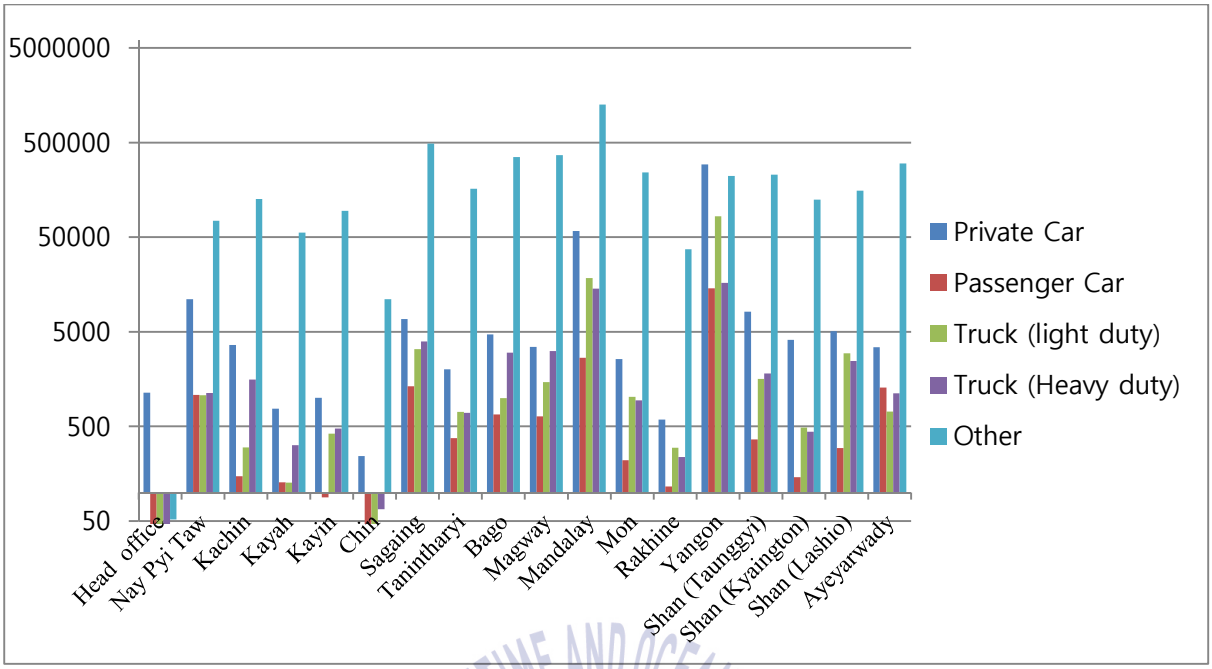

Figure 2.7Distribution of vehicles in States and Regions by Types

Source: (Road Transport Administration Department, Ministry of Rail, 2014)

Table 2.5: Number of Road Trucks (in Thousands)

2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
53	54	55	57	59	60	64	67	71	111	169

Another important association with truck operation in Myanmar is Myanmar Container Truck Association. According to the Association, it is noted that various types of vehicles are used for the distribution of goods over the country. The most popular type is 10 wheeler trucks for 20 ft and 32 ft containers that account for about 45% of all container truck, followed by 14 wheelers and 22-wheeler trucks the second and the third (20.3% and 18.7%) respectively (See Figure 2.8 Types of Trucks Used). The trucking services in Myanmar can be seen at three levels: distribution of cargo between the Yangon Port and the greater Yangon Area; long-haul transport service; and local service.

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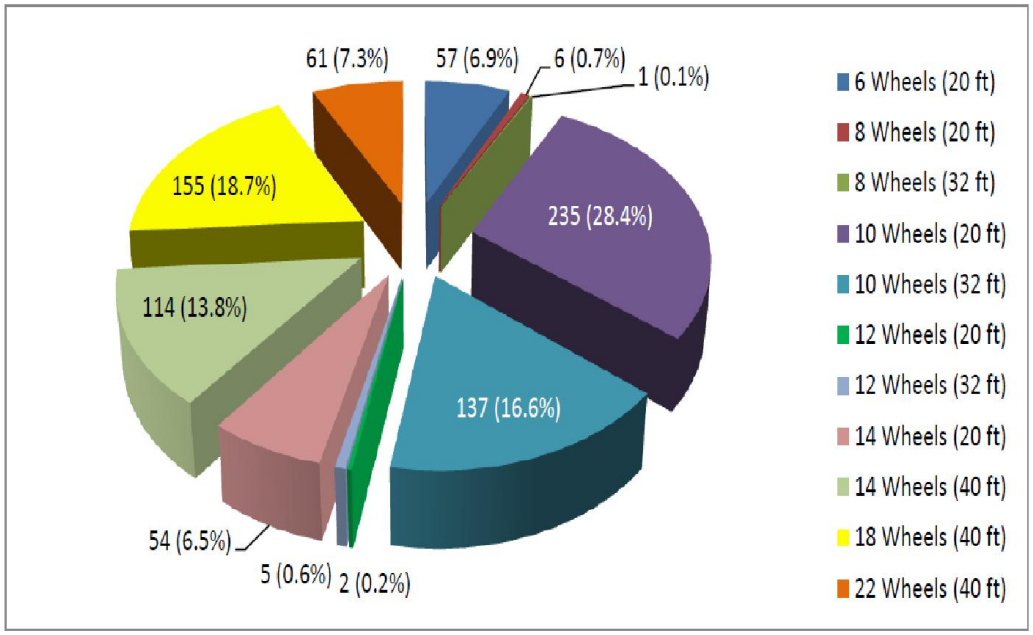

Figure 2.8 Types of Trucks Used in Myanmar

Source: Myanmar Container Truck Association as cited in Christian Ksoll & John Quarmby Consultants, n.d, p.38

2.3.2. Rail Transport

2.3.2.1. Institutional and Regulatory Aspects

Railways in Myanmar have dated back to colonial days in 1877, on Yangon-Pyay route, the first rail line (262 km) constructed by the British Government. In 1988, the rail line length reached to 44 94 kilometers. Historically, the rail service has been government run focusing on the transporting of government's goods. To date, the only player in rail industry has been Myanmar Railways, which is a department under Ministry of Rail Transportation, the government agency. This has lead to relatively low priority being given to customer demand.

2.3.2.2. Infrastructure

One of the significant problems that Myanmar Railways face is the poor condition of its track and obsolete rolling stocks. Being not well maintained, added by scarcity of spare parts and components, there seems to have difficulty in maintaining and operating rail way system, too.

Rail network has expanded considerably over the last twenty years, expanding by almost

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78% between 1988 and 2010, although the focus has been on providing transport services and connectivity to remote areas of the country. The policy is the same as in road transport planning. However, until these days there is no electrified track constructed.

Apart from Yangon-Mandalay route, which is the busiest route, all rail tracks are single track lines. These constraints have caused the railway system suffered from short capacity on certain routes. Regardless of the higher efficiencies and service quality that have been demanded in recent years, Myanmar Railways has been criticized for having remained unproductive and inefficient, which are typical features of state-run corporations (JIFFA, 2012).

Table 2.6 Rail Infrastructure

Description	2004	2005	2006	2007	2008	2009	2010	2011	2012
Route length (km)	4,868	4868	4947	5038	5125	5301	5672	5844	5844
Double track (km)	450	450	482	701	701	701	701	701	701
Railway Stations	775	787	798	812	821	869	915	-	-
Locomotive Fleet	331	336	344	365	380	389	424	431	438

Source: Myanmar Railways

Overall rail transport system, currently, is in poor condition and investment in basic infrastructure such as track renewal, replacement of sleepers, and upgrading of signaling and communication systems, has been inadequate (Asian Development Bank, 2012).In terms of freight rates, it is accepted that rail rate is much cheaper than truck, except that the customers are less reliable and cargo safety is notoriously neglected. Meanwhile, although the main haul freight rate is cheaper, due to multiple manual handlings, additional unnecessary transshipment charges incurred. When it comes to container transportation, proper terminals to handle containers from Yangon to Mandalay have been established yet no container is likely to be transported in Myanmar railways. The most cited reason is poor service and too low reliability as the operator is a state owned enterprise.

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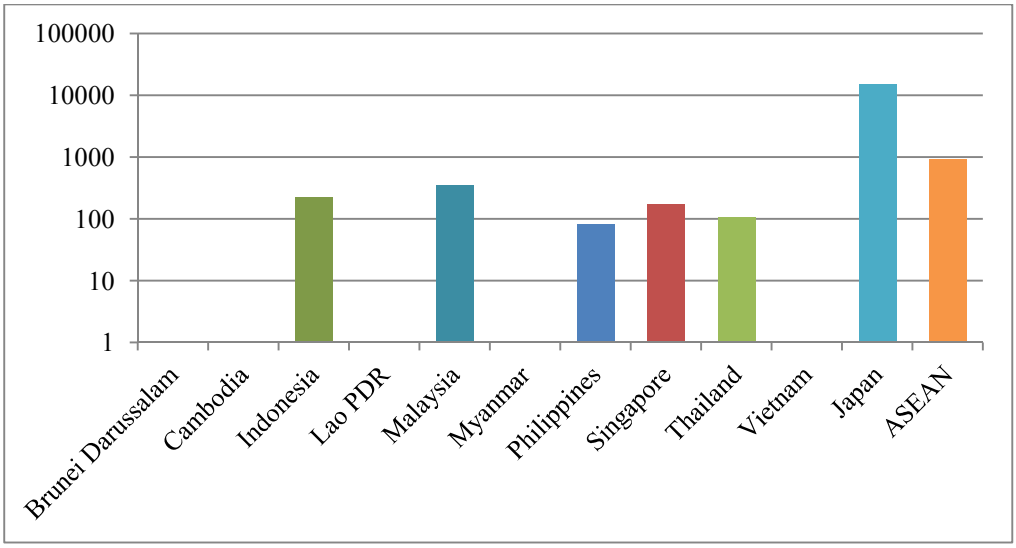

Figure 2.9 Electrified Rail Track in ASEAN and Japan

Source: AJTP, 2013, p.66

Goods for both domestic and exported products are transported in the following kinds of freight trains in Myanma Railways:-

(a) Express Goods

(b) Van Goods

(c) Ordinary Goods

(d) Parcel Express

There are different freight charges based on different kinds of freight trains. Normally, it takes 3-4 days to transport cargo between Yangon and Mandalay due to the poor speed of freight train caused by the poor conditions of the over-aged rolling stocks.

2.4 The Demand for Freight Transport

2.4.1. Traffic trend

Figure 2.10 shows the trend of domestic freight transport in terms of tonne (for ton-kilometer). Road transport has, as with other countries in the world, has a leading role in domestic freight transport, accounting for approximately 70 per cent of the total market in terms of tonne carried throughout the years. The traffic in three modes seems to have just a slight change without any of modes taking much other's share though a slight increase in rail share have experienced during the last three years.

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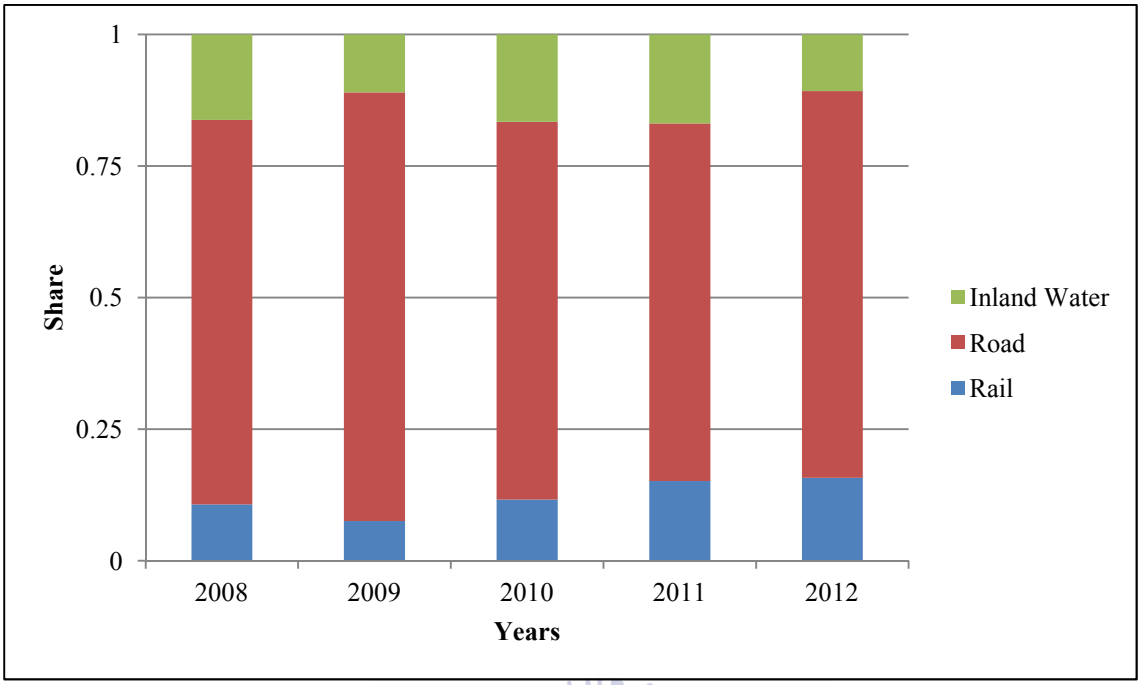

Figure 2.10 Domestic Freight Traffic by Mode (2008-2012)

Source: Derived from CSO (2011).

Although the traffic trend is based on the domestic freight, transport need exists for international and border trade in the infrastructure pattern of Myanmar. Thus, it seems reasonable to explore and discuss the demand for transport of the international and border trade, too.

2.4.2. Freight Composition and Distribution

Myanmar's GDP has surged to 7.8% in 2013 (ADB, 2014) thanks to the economic liberalization over the last three years. When ASEAN Economic Community commences by 2015, the country has an expectation to become a regional hub of ASEAN and the two world's most dynamic economies: India and China, in between Myanmar is strategically located.

Southeast Asian and Asian countries dominate the pattern of trade to and from Myanmar. In 2010/11 the bulk of Myanmar's exports in value (40%) want to countries in Southeast Asia, predominantly Thailand (33%) and Singapore (5%), and to other Asian countries- primarily to Hong Kong (21%), China (14%) and India (10%). There is a similar geographical distribution with the value of import: in 2010/11 imports originates from People's Republic of

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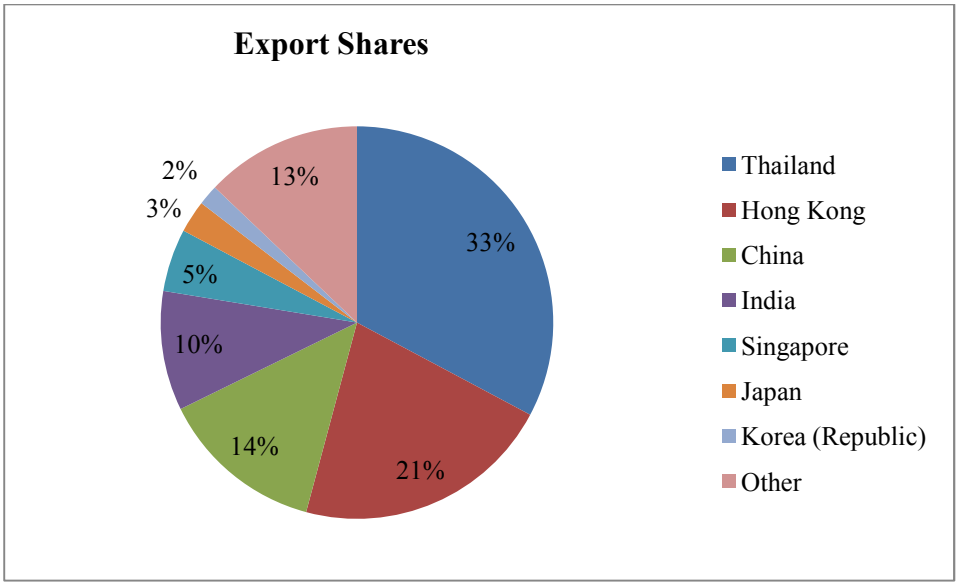
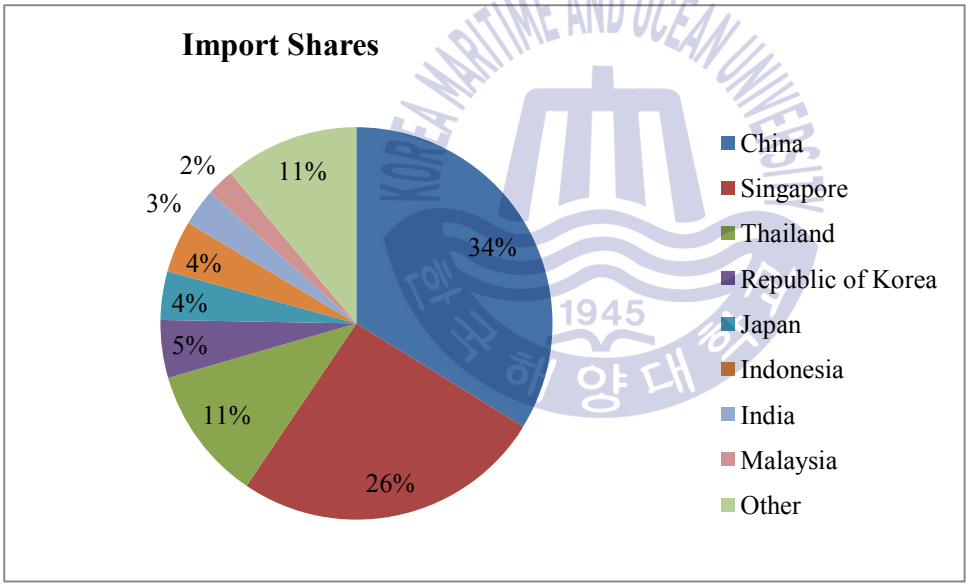
China (34%), Singapore (26%), Thailand (11%), and South Korea (5%).



Source: Own calculations from CSO (2011)



Source: Own calculations from CSO (2011)

In terms of products traded, the export and import structure of Myanmar differs both in terms of type of products traded and in terms of concentration. Myanmar's exports (by value) are dominated by natural resources which account for more than 60% of all trade, such as petroleum gases (38.5%), precious and semi precious stones (24.4%) and dried vegetables (11.7%). In addition, Myanmar exports also rice, rubber, garments, and some other food products. Table 2.7 and

Table 2.8 depicts a more detail overview of the top ten export and import commodities from

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2008 to 2010.

On the other hand, Myanmar's import is more diversified than export. The most dominant import product in value is petroleum (21.9%) of the total value, followed the second product to be transport vehicles and equipment. In categories terms, manufactures takes the largest share in import.

What is indicating from the commodities is that Myanmar's industrialization is very low. Although industrial zones have been established in the upper and lower region of the country as per the economic policy of the country set during the late 1990s, these industrial zones have been inactive and unproductive at all.

Table 2.7 Top Ten Export Commodities 2008 to 2010

Commodities	Value (million US$)	%
Petroleum gases and other gaseous hydrocarbons	2936.0	38.5%
Precious stones (other than diamond) and semi-precious stones	1864.0	24.4%
Dried leguminous vegetables, shelled, whether or not skinned or split	889.9	11.7%
Wood in the rough, whether or not stripped of bark or sapwood	553.9	7.3%
Fish, fresh or chilled, excluding fish fillets	204.5	2.7%
Natural rubber, balata, gutta-percha, guayule, chicle	194.9	2.6%
Rice	156.3	2.0%
Men's or boys' suits, ensembles, jackets, blazers, trousers	85.2	1.1%
Crustaceans, whether in shell or not	79.7	1.0%
Men's or boys' shirts	70.5	0.9%
Other	590.3	7.7%
Total	7652.2	100%

Source: % derived from UN Comtrade (2013)

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Table 2.8 Top Ten Import Commodities 2008 to 2010

Commodities	Value (US$ million)	%
Petroleum oils, other than crude	913.6	21.9%
Self-propelled bulldozers, angeldozers, graders, leveler, scrapers	196.8	4.7%
Light-vessels, fire-floats, dredgers, floating cranes and other vessels	168.9	4.1%
Palm oil and its fractions	167.7	4.0%
Medicaments	160.1	3.8%
Woven fabrics of synthetic staple fibres	129.3	3.1%
Polymers of propylene or of other olefins, in primary forms	106.4	2.6%
Tubes, pipes and hollow profiles, seamless, of iron (other than cast iron)	95.8	2.3%
Portland and cement, aluminous cement, slag cement	91.4	2.2%
Structures (excluding prefabricated buildings)	74.1	1.8%
Other	2060.2	49.5%
Total	4164.3	100%

Source: % is derived from UN Comtrade (2013)

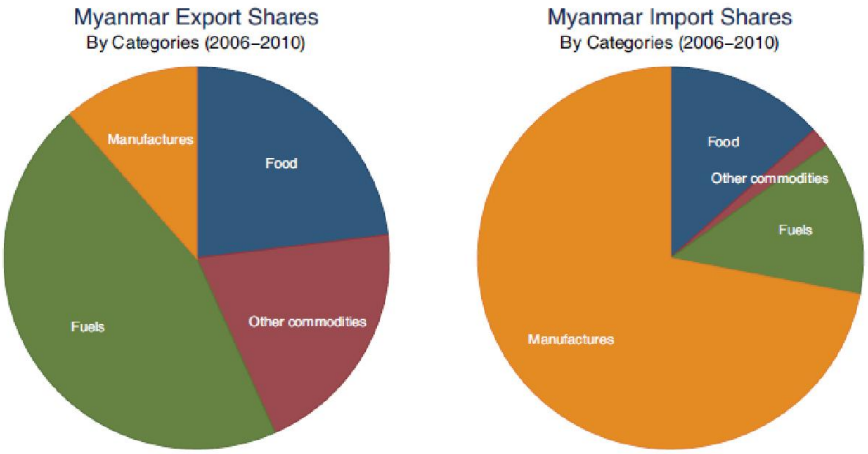

Figure 2.11 Commodity composition of Trade

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Source: as cited in Ferrarini, 2013, p.3

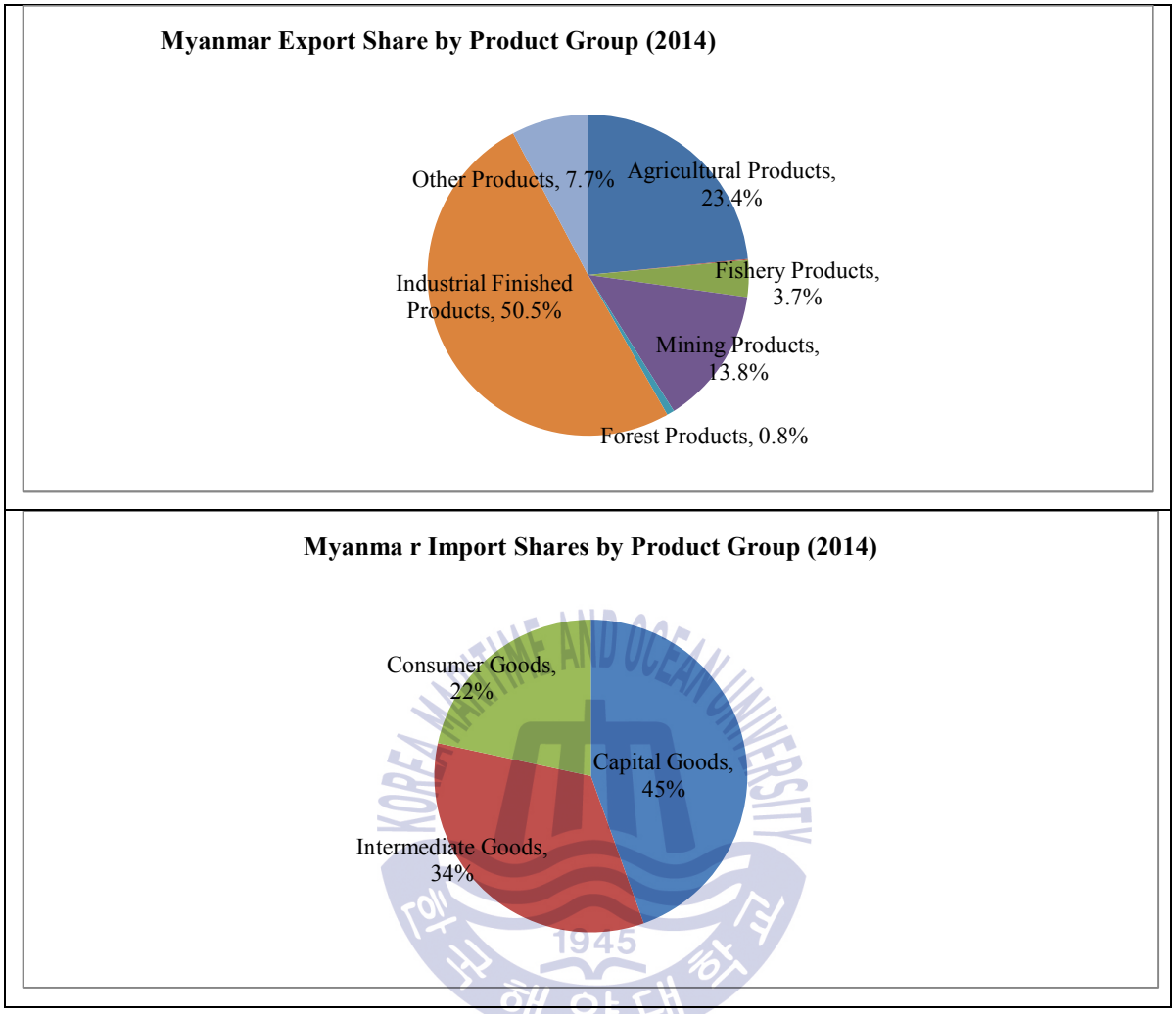

Figure 2.12 Myanmar Trade by Product Group (27.2.2014- 27.2.2015)

Source: Derived from Ministry of Commerce, 2015

2.4.3. Commodity Transported in Road and Rail

In general, the agricultural products, mining, fuels, construction materials, and miscellaneous commodities are transported on both modes. In Table 2.10, the commodity transported in rail mode is presented. The commodities actually range from salt to machinery. However, being the State run enterprise, rail transported is much occupied by military accouterments and stores, railway departmental goods, and bulky timber (CSO, 2011). It is reasonable that rail service level is lower and can accommodate cheap price for bulk cargo only.

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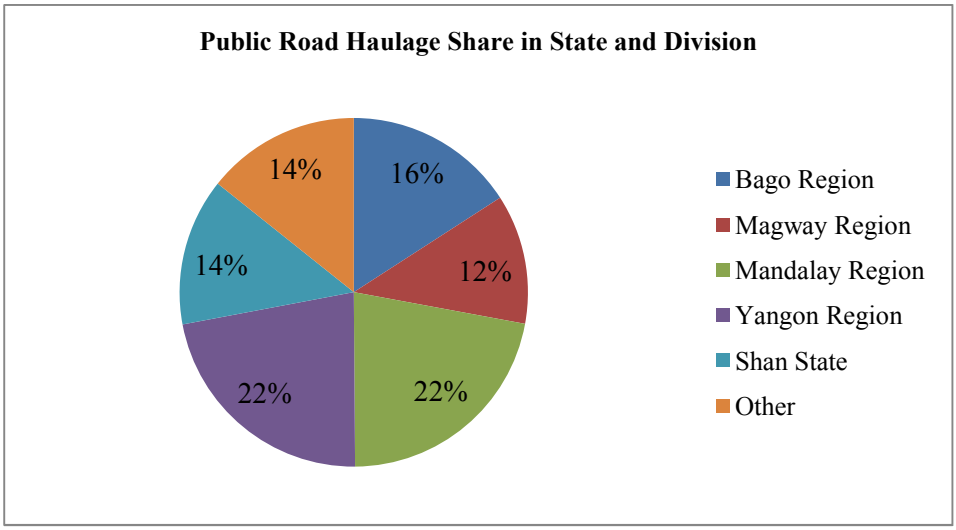

Figure 2.13 Commodity/Goods Traffic Share in States and Divisions

Source: Derived from CSO, 2011.

For truck transport, the commodities carried are derived from Container Associations and Myanmar Highway Truck Associations. As is evident from the export and import of trade and from

Table 2.9, Table 2.10, commodities range from agricultural products to machinery and transport equipment.

Table 2.9 Commodities Transported in States/Regions

State/Division	Commodity Transported
Ayeyardaddy Division	Fertilizer, Marine Products, Rice, Raw Materials for Glass, Glass Factories, Jute
Bago Division	Cotton, Rubber, Plywood, Sugar, Paper
Kachin State	Machines, Iron, Metal, Agricultural Products, Crude Oil
Magway Division	Machines for rice drying
Mandalay Division	Foodstuff, Consumer Goods, Fertilizer, Machines, Gems and Jewellery, Equipment and Products for Industrial Zones
Sagaing Division	Copper, Crude Oil, Cotton, Materials and Equipment for Hospitals
Shan State	Pulses, Beans, Water Melon, Mango, Yellow Maize, Jade, Machines produced for Industrial Zone, Construction Material, Equipment for Metal Machines for Grape wine

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Table 2.10 Commodity Transported on Rail based on BSITC (2010)

Type	Thousand tonnes	%
Food and live animals	165	0.05
beverages and tobacco	17	0.00
crude materials (inedible)	685	0.20
minerals fuels, lubricants and related materials	129	0.04
manufactured goods classified by materials	90	0.03
machinery and transport equipment	4	0.00
miscellaneous manufactured articles	2035	0.60
commodities not classified by kind	242	0.07
Total	3408	1.00

Source: Derived from (CSO, 2011)

2.5 Conclusion

Myanmar is now heading on the track of change from supply driven to demand driven market. Like consumer products, customers would be looking for choice and availability on transport. In a previously closed market, transport choices have been a supply driven. Today is different. Things are already changing.

On the demand side, Myanmar's transport network both in road and rail transport has seen extension due to the policy to integrate all areas of the county and promote economic activities. Instead, the extension has been at high cost and no economic returns are considered nor investment priorities have not been considered. Myanmar's domestic transport network is still in poor condition, yet to be seen progress in the years ahead with the initiation of Transport Master Plan. The two domestic road and rail networks exist in competitive pattern geographically if planned and operate efficiently. The transport services are relatively undeveloped especially in the rail transport and unspecialized. In terms of regulations and institutionally, the transport policies and regulations have experienced inflexibility and evaluation is still lacking.

Domestically, agricultural produce, mining, fuels and raw materials have dominated the export of the country. According to ADB (Oct 2012), Myanmar's economy has been

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dominated by the agriculture sector with around 40-50 percent of GDP. The commodities transported also highlights the low level of industralization in the country. These gives the basis for inclusion of commodities segment in the sample of this thesis. Later in the 2014-15, manufactured products and value added products are seen to have increased. This would change the demand of high service level in transport.

As the road and rail transportation are not only important for domestic distribution for export and import commodities, they are also the important links for border trades with neighbouring countries and international maritime trade. Thus, the efficient transportation planning for these modes are really important.

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CHAPTER 3: LITERATURE REVIEW

3.1 Introduction

This chapter provides a review of previous literature on mode choice modeling and factors that determine the decision process of the shippers when selecting a particular transport mode for a particular consignment. In the era of smooth and free flow of goods being demanded, the importance of mode and carrier choice has become widely recognized in order that the transport cost and transit time can be reduced over the three decades. Early mode choice studies were originated from mode choice analysis in passenger travel demand. It has been studied on several levels, international, national, regional and urban. It is widely recognized that modeling freight demand is more complex than modeling passenger demand due to the facts that freight is heterogeneous; it is also influenced by the physical characteristics of the goods to be moved; many actors such as shippers, forwarders, carriers and receivers are involved in decision making process; geographical factors and shippers-carriers relationships etc. The common characteristics of the major studies is that they all focused on specific geographical areas, probably due to different nature of transport policy each nation practices and different surface infrastructure. Thus, the shortcoming has arisen there that all of these studies have been focused only on either European, US markets and or Developed Asian Countries where the transport infrastructure and related regulations of each mode have been well established and defined (Wong, 2007).

The aims of this research are to extend mode choice literature into the local freight transport market of Myanmar. This study can fill the gap between previous literatures and contribute the transport planning in Myanmar where overall transport planning is in the phase of consideration for it is very likely to be confronted with growing freight volumes.

3.2 Modeling Freight Transport Demand

Freight transport modeling has been studied for many years. The motives for study on freight transport has been contributed by that the awareness of the importance of transport to the economic cycle is growing while the resources for investment in infrastructure has become scarce (Gust Blauwens, Peter De Baere, Eddy Van de Voorde, 2002).

Generally, three different types of models are distinguished in the literature: the classical four stage models which include trip generation, trip distribution, mode choice and

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assignment, the microeconomic approach, and the activity-based approach. Many studies have dealt with reviews on different modeling approaches. A thorough review of econometric freight transportation demand models can be found in Zlatoper & Austrian (1989). A review of (Regan & Garrido, 2002) made a clear distinction between freight demand modeling and shipper behavior modeling. The studies that applied econometric models may be found in Shen, Fowkes, Whiteing, & Johnson (2009). The models for freight transportation based on the levels have been widely discussed. Some models have established on regional, national and international levels to support policy makers and transport planners. (de Jong, Gunn, & Walker (2004) gave a thorough review on freight demand models for forecasting at national and international level. Their finding confirmed that freight transport demand models at the international and national levels are well developed.

3.2.1. Aggregate and Disaggregate Models

In the early studies of freight demand modeling, the models mostly focused on examining elasticities or modal choice based on either cross-section data or time series data (for example (Zlatoper & Austrian, 1989) (Regan & Garrido, 2002) (de Jong, Gunn, & Walker, 2004), in a recent survey of the literature, Mazzarino (1997), identifies two main groups: the macroeconomic models and the microeconomic models. Similarly, Winston (1983) distinguishes freight transport demand models between aggregate or disaggregate models. The simplest aggregate model is the modal split model, where the ratio between the market shares of the two modes is assumed to depend on differences in prices and in non price attributes (e.g., Boyer, 1977). Aggregate demand transport models are first-generation models, according to Ortuzar (2001, p.219) and they are based on observed relations for groups of travelers or on average relations at a zonal level. (e.g level of service attributes such as price, cost, origin, and destination) for a sample of population. An aggregate choice model is beneficial for describing general trends and policy makers for decision making based on general characteristics observed (Shen & Wang, 2012). The main evaluation of these models was that they require sufficient behavioural grounding. Furthermore, they relied on restrictive linear functional forms.

In response to these drawbacks, freight demand models were suggested to be modeled at disaggregate level, in which the behaviour of individual decision making unit (i.e firm) should be modelled (Roberts, 1977, as quoted in Winston (1983) classified two types of

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disaggregate models as “behavioural” and “inventory” for the sake of classification. A disaggregate choice model describes the behavior of individual shipper or carrier who shares the same relative shipping characteristics. The models were based on the observed choice (unit of analysis) made by individual travelers to maximize their utility. Freight demand models of these kinds, on the other hand, were based on the assumptions that transport firms attempt to minimize costs, including through the transport function. The author also stated that the consignment models take into account the characteristics of the commodity and alternative models and alternative modes such as cost, time, weight, value, distance, reliability. From a business logistics viewpoint, the inventory-theoretic approach for modal choice study from the view-point of an inventory manager. Such kind of inventory models paid explicit attention to all costs in the supply chain that are affected by the choice of transport mode (Blauwens, Vandaele, Voorde, Vernimmen, & Witlox, 2005).

The main differences between aggregate and disaggregate models are that (1) the unit of observation in aggregate models is an aggregate share of a freight mode at a certain geographical level; whereas in disaggregate models the unit of observation is the individual decision maker’s choice of a freight mode for a specific shipment. Given that data describing the characteristics of each mode (chosen/not chosen) have to be collected, data requirements are more cumbersome and huge input data are required. This large data requirement can be met by observed Revealed Preference (RP), or Stated Preference (SP) data (Abdelwahab, 1998). Regarding the choice models, however, unclear line of whether the choice is made for mode or carrier has also emerged (Fries & Patterson, 2008).

3.2.2. Revealed and Stated Preference

Modal choice involves in the third steps of determination of modal-split functions. Doing so involves the two steps: identifying the main factors determining transport mode choice and estimating how the demand would change depending on the values of the factors. The basis data for RP is the market data. This means observing choices that people have made in the real world. However, there are drawbacks of RP data. The most important problem with RP is that the RP data are expensive to obtain and take a very long time to collect. The main criticism about RP is that RP data is difficult to understand preferences outside the existing market and technology (Louviere, Hensher, & Swait, 2000).

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Stated Preference is the most commonly method to estimate the demand elasticities by controlling the survey design. These techniques in Stated Preference are described as a family of techniques which use individual respondents' statements about their preferences in a set of transport options to estimate utility functions" (Kroes and Sheldon, 1988).Stated Preference design and surveys are mostly used for the reasons that organizations need to estimate demand for new products with new attributes or features where there are no RP data on which to rely. Explanatory variables have little variability in the marketplace and often explanatory variables are highly collinear; New variables now explain choices; and RP data are time consuming and expensive to collect. Myanmar's case is true in this context. Not only reliability but also the availability of data is so weak. Thus it is quite reasonable to apply stated preference method.

The use of SP data in model estimating has been recognized considerably improved in the 1980s (Louviere, 1988). It is different in analysis from other disaggregate data in that each respondent may contribute more than one observation, and that preferences can be expressed in many forms. Detail explanation can be seen in Ortuzar & Willumsen (2005) and Hensher et al (2005).In SP survey, it is desirable to ensure the responses provided by the subjects are realistic, meaning as close as possible to how they would have responded had these hypothetical options actually existed in practice. The responses can be indicated by three means: ratings, rankings and choices. In this study, simple choice response type is applied, where the individual is only asked to choose his preferred option from the alternatives between road and rail in the choice set.

Both approaches have strengths and weaknesses in (Louviere, Hensher, & Swait, 2000, p.20-25). Thus later on, the pooled approach of SP and RP were explored (e.g (Swait, Louviere, & Williams, 1994).Among disaggregate models that take account of behavioural factors have been developed, a discrete choice model that can accommodate estimates of choice probabilities at the individual level has been the most preferable tool for analysisng choice situations related to freight transport.The most popular discrete choice model includes probit and logit models, which can be binary, multinomial, and nested multinomial (Train, 2002). Discrete choice modeling will be dealt with in CHAPTER 4:.

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Table 3.1 Strengths and Weaknesses of RP & SP

Issue	Stated Preference	Revealed Preference
Range of information	rich in information as an individual respondent provides more observations	Study is limited to the existing market and technology
Variety of observations	Experimental design can control for interactions among attributes	Real-world attributes are often highly correlated, making it difficult to distinguish interactions
Degree of control	Permits tight control over alternatives and information available to the subject	The decision process, including the sales environment and timing, differs from ideal market conditions.
Relevance	Allows distinction between perceptions and taste, and identifies factors that influence perceptions -Choice is unburdened by supply constraints.	-The decision process, including timing and social interactions, differs in real vs. constructed markets. -What people say they intend is not necessarily what they do.

Source: Adopted from (Boomer, n.d)

3.3 Literature Review of Elements Affecting Mode Choice

This paragraph describes the main publications that deal with mode choice in freight transportation which applied various methodologies to determine elements affecting mode choice and shipper behavior.

There have been numerous studies conducted to identify the important carrier/mode selection determinants. Most studies are prevalent in North America, Europe and Australia and in many other countries. The studies differ from each other in terms of methodology applied, geographical limitations, type of carrier and type of industry studied. Furthermore, they also take into account different range of factors and the way the factors are classified. It appears that typically two main typologies of variables can be identified: cost related to the transport of the goods and other service's attributes that play a crucial role in the selection

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(Grosso, 2011). The early comprehensive study that has reviewed on freight transport demand modeling and shipper behavior may be found in (Regan & Garrido, 2002). Their review showed that demand models of shipper mode choice were studied not only from aggregate/disaggregate level, also other areas of research include carrier selection process, shipper-carrier relationships and carrier selection criteria. This means that developing freight mode choice to accommodate the relevant factor is one of the most challenging tasks for representing choice behavior of freight agents.

The Cunningham & Kettlewood (1975) made an analysis of the influence of the suppliers' image on buyer behavior in the British Rail industry. The focus group was manufacturing companies in Scotland. The result of the study showed that the main qualitative variables influencing patronage decisions were the ability of the vehicles, the reliability of the delivery and the ability to load and unload at own convenience.

In the study of Stock & La Londe (1977), companies' preferences have been analysed with 87 companies. In identifying the importance of several procedures used by the companies in evaluating mode performance, the main outcome shows that reliability, freight charges, and transit time are the three most important elements.

McGinnis (1979) developed a field study with a sample of 351 shippers in the U.S.A. the eight topics considered relevant in influencing their choice of transport were freight rates; speed; reliability; loss and damage; inventories; company policy; shipper market conditions; influence of the shipper's customers. Seven main factors were obtained by the method of factor analysis, the three most important of which were related to speed and reliability, freight rates, and loss and damage. Burg and Daley (1985) made an analysis of the mode selection process and marketing impacts on shippers and carriers within the shallow-draft barge transport in U.S.A. The results showed that shippers and carriers had different preferences, namely shippers placed more relevance on non-transportation cost factors, and the main element was the satisfaction of the customers, followed by transit time and freight charges. The study of Jeffs & Hills (1990) analyses the determinants that affect the mode choice of shippers belonging to the printing and publishing sector in U.K. Several attributes were considered and the results of the interviews were analysed by means of factor analysis. The two main factors determining the mode choice were: "control" containing variables such as

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reliability, control over dispatches, avoidance of damages, etc., “doublet” which was related to size of the consignment and length of haul”.

A different approach to the topic was carried out by (Murphy, Daley, & Dalenberg, 1991) in their study about the selection of links and nodes in international transportation. Their focus was on another important group of operators that is the one of freight forwarders with the purpose of investigating which were the important factors for freight forwarders, when selecting carriers. The results showed that their main concerns were about equipment availability, shipment information and the possibility to have loss/damage. Furthermore a factor analysis was performed resulting into two factors: the first more related to the transport itself, the second to the shipment.

The work of Abshire & Premeaux (1991) provides an analysis of the different perception of shippers and carriers in motor carrier selection. The most important criteria that shippers considered relevant were: the reliability of the service, the additional services that the carrier would provide them, the carrier financial stability, etc. The results of the study showed that carriers do not have the same perception that shippers put on specific criteria.

In the study of Evers, Harper, & Needham (1996) the authors try to capture the impact that shippers perceptions of individual transport service characteristics have on the shippers’ general perception of transport modes. The applying factor analysis to the results of the interviews lead to six main factors: timeliness, availability, suitability, firm contact, restitution and cost. With those factors three regression models were performed; where the dependent variable being the shipper’s overall perception of transport modes. The final results of the regression model showed that out of those six criteria the most important for the shippers are availability and timeliness.

Pederson & Gray (1998) attempted to determine whether the perceived importance of direct transport costs has diminished in Norwegian exporters. Their study found out that even in Norway, where modern logistics concepts are well known, direst costs, including transport, are still very high. Based on the literature review of existing literature at that time, the authors categorizes these factors into timing, price, security, and service.

Cook, Das, Aeppli, & Martland (1999) summarizes the key factors for mode choice of

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freight transport in India based on the logistics cost model of shipper behavior. The relative importance of the factors and customer rating of satisfaction for each mode is presented.

The application of content analysis developed by Cullinane & Toy (2000) takes into consideration 75 papers dealing with route/mode choice literature, mostly for Western production. This typology of analysis, developed in various forms, led the authors to report on the most often considered factor categories in freight route/mode choice literature, to rank those attributes. The first five categories, in order, are: cost/price/rate, speed, transit time, characteristics of the goods and service. The list of the criteria considered in the literature taken into consideration is based on 19 criteria and out of them six are considered relevant in most of the papers. The ranking includes reliability and transit time, freight rate and loss/damage; customers services, loading availability, frequency, flexibility and track and trace.

As there are many factors in literature that affect mode choice and it is impossible to list all of them, a concise and inclusive list that can be found in (CUTR, 2004) which is shown in Table 3.2, is presented. The factors were identified from the literature.Table 3.2 Factors that affect freight mode choice.

In the evaluation of relative importance of selection determinants, it is important to emphasize that the factors are interrelated whether the focus is on carrier or mode choice. In addition, the categorization of factors and variables are a matter of the change in the nominal designation showing that there is no common opinion of how the variables be categorized.

3.4 Literature on mode choice using revealed and stated preference (SP)

Stated preference techniques has been applied in the area of freight transportation since around 1990s (e.g (Swait, Louviere, & Williams, 1994). Nam (1997) applied an aggregated binary logit model over heterogeneous commodity types to test the significance of different variables. Shen & Wang (2012) used binary logit model and a regression model to study the cereal grains movement between states by truck and rail in the United States using the Freight Analysis Framework database. (Arunotayanun, 2009) used mixed logit model to investigate the prevalence of observed and unobserved taste heterogeneity influencing shippers' mode choice based on SP and RP survey in Java, Indonesia.

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Table 3.2 Factors that affect freight mode choice

Total Logistics Costs	Order and handling costs
	Transportation charges
	Loss and damage costs
	Capital carrying cost in transit
	Inventory carrying cost at destination
	Unavailability of equipment costs
	Service reliability costs
	Intangible service costs e.g Billing processes
Physical Attributes of Goods	Shipment size
	Package characteristics
	Shipment shelf life
	Shipment value
	Shipment density
Flow and Spatial Distribution of Shipments	Shipment frequency
	Distance of shipment
Modal Characteristics	Capacity
	Trip time and reliability
	Equipment availability
	Customer service
	Handling Quality-Damage Loss Reputation

Source: CUTR (2004)

Bolis & Maggi (1999) applied Adaptive SP experiments to estimate the monetary values of relevant demand attributes of shippers in Northern Italy. Similar study to determine the monetary value of quality attributes in freight transportation using a SP approach has been conducted by (Witlox & Vandaele, 2005). Their study attempted to cover more quality attributes relating to frequency, reliability, flexibility, transport duration and risk of loss or damage.

Wigan, Rockliffe, Thoresen, & Tsolakis (2000) applies contextual stated prefrencee methods and the associated multinomial logit models to estimate the value of reliability, time,

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and damage proxying freight rate from an Australian survey of freight shippers using road freight transport in 1998.

Zhao, Yang, Yang, & Feng (2005) studies the characteristics of choice of transportation mode using disscrete choice theory. The units of observations are shipppers and carriers for choosing the regional transportation mode. The variables used in the analysis includes cost, time, obtainable factor, reliability, trade contract, frequency, cargo volume, cargo value, distance, and accessibility.

Brooks et al (2011) studies the Australian domestic freight transport market, focusing on the decision making process by which cargo interests and their agents make mode choice allocation decisions between land-based transport and sea by using stated choice experiments. Their study confirmed that shippers' mode choices had presence of meaningful trade-offs by shippers involving costs and perceived benefits of reducing transit time, improving on-time arrival reliability and mitigating the risk of long arrival delays.

Feo, Espino, & Garcı´a (2010) undertakes SP survey to model the moda choice between door-to-door road transport and short sea shipping in South-West Europe. They identified the critical areas that should be addressed by future policy action in order to promote SSS on Spanish's Mediterranean coast. Then estimates for subjective values of transport attributes i.e value of time, value of reliability and value of frequency etc were provided.

Studies on literature that have used SP, RP and other methodologies is shown in Table 3.3 They have shown that determinants of transport mode choice factors in each study area are different from another. For example, differences in analysis results were found out in Ralph Buehler (2011) when the author compared the mode choice factors of Germany and the USA. The outcome of the review presented relatively homogenous results. It appears that some of the criteria hold the same ranking. For instance, reliability and transit time are the most important elements considered in the reviewed literature. From the literature, much has shown evident that a shipper's modal choice is not based solely on the out-of-pocket transportation costs. Otherwise, rail and inland water transport would contribute to a larger share of the total freight transport market than they do it today (Blauwens, Vandaele, Voorde, Vernimmen, & Witlox, 2005).

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A combined study of SP and RP may be found in (Swait, Louviere, & Williams, 1994). Each advantage of SP and RP are explored in the North American cities. Shinghal & Fowkes (2002) used the Leeds Adaptive Stated Preference for the main survey on Daily to Bombay corridor. The survey results showed that frequency is the most important factor in mode choice determination and with the prevailing cost, the intermodal services can be viable only for high value and finished goods. Norojono & Young (2003) studied the mode choice between rail and road in Java, Indonesia, using Stated Preference disaggregate model. The results indicated that safety, reliability and responsiveness are major attributes influencing rail/road mode freight mode choice.

3.5 Conclusion

This review of relevant studies found that many factors affect freight mode choice. Researchers have examined freight demand characteristics, cross elasticities, freight costs, commodity characteristics, modal characteristics and customer characteristics, and all have shown potential to influence mode choice. Various methodologies for different context have been applied. The first group of literature can be said to be related to decision making of shipping agents. This group studies factors determining transport mode choice. On the other hand, revealed preference, stated preference and a mixture of both RP/SP approach, which can compensate the pros and cons of each method, can be used for estimating the importance of those factors determining mode choice and their relative importance to trade-off.

From the review, it is also seen that in the beginning of SP application, only a few main factors such as cost, time are included in the design. However, in the later period, qualitative attributes are attempted to be quantified through the use of SP. It is interesting to note from the literature that while recent freight studies in applying stated preference techniques, the overall scope is often limited to specific transport alternatives. Still there is no common opinion as to the manner in which lots of qualitative attributes be incorporated in the SP design.

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Table 3.3 Literature on freight mode choice using different methodology

Author	Variables	Modes	Method	Study segmentation
McGinnis et al (1981)	Value/ease of handling/special services/weight/speed&reliability/rate/loss &damage	TL/LTL/rail/parcel/private	RP (MNL)	Modal usage pattern: TL/LTL/rail/parcel/private (piggyback/air)
Wilson et al. (1986)	Transport system (cost/time/loss &damage/reliability)/Shipment frequency/value/size)/-carriers (tracing capability/cooperation/geographical coverage/pickup services)/-shippers (mode reviewed/experience)	Hired truck/ private truck/rail	RP (MNL)	
Vieira (1992)	Total Logistics Costs containing eight attributes			
Nam, K(1997)	Length of haul/weight/transit time/rate/frequency/accessibility	Road/Rail	RP (MNL)	Commodity grouped 19 types
Fridstorm and Madslien (1998)	Freight cost/transport time/late delivery risk/damage risk	Own account/for hire	SP	-
Golias Yannis (1998)	Cost/time/company's profit/operator's investment/computer communication	Road/combined	SP	Firm: carriers/forwarders Destination: Milan/Cologne
Nuzzolo and Russo (1998)	Shipment(weight/value)/firm (annual shipping weight)/transport cost/time/loss and damage	Owned lorry/ hired lorry/rail/combined	RP (MNL)	-
(Picard & Gaudry, 1998)	Cost/time	Road/rail	Box-cox Logit	-
Abdelwahab and Sayed (1999)	Shipment/size/value/density/state/special requirement/shelf life/cost/distance/reliability/transit time/loss &damage	Road/rail	RP (Neural Networks)	
(Bolis & Maggi, 1999)*	Price/stock in warehouse/frequency/flexibility of services/documents/factoring/tracking/routing/insurance/	Road/rail/intermodal transport	Adatpted SP	
Jiang et al (1999)	Firm characteristics (type/structure/location/size/truck owner/information system) Goods physical attribute (type/weight/value/packaging) Spatial and flow characteristics (frequency/distance)	3 types of commercial vehicles	Nested MNLRP	-
(Wigan, et al, 2000) *	Freight rate/time/reliability/damage	Road freight transport	SP (MNL)	shippers
Catalani (2001)	Cost/time	Road/rail-road/ferry-road	SP	

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Shinghal and Fowkes (2002)	Cost/time/reliability/frequency	Current road/new road/rail/intermodal	Adaptive SP	Firm and commodity:exporters/ forwarders
Holguin-Veras (2002)	Cost/shipment size/distance/commodity types/flow types	3 types of commercial vehicles		
Norojono and Young (2003)	Cost/time (delivery/reliability)/quality (safety/truck condition/travel route/access to rail/train formation)/flexibility (frequency/departure time/problem responsiveness)	Road/rail	Hierarchical SP	-
Kang-Soo(2002)	Cost/time/reliability	Ferry/new/ferry	MMNL	-
Beuthe, et al (2003)	Cost/time/reliability/frequency/flexibility/loss	Road/rail/waterway/shortsea/intermodal/multimodal	SP(Utility Additive)	
Haugen and Hervik (2004)	Crowding cost (road)/transport cost (road/sea)	Road/Sea	RP (Game Theory)	
(Witlox & Vandaele, 2005) *	Frequency/reliability/flexibility/transport duration/risk of loss or damage		SP	
Nijkamp et al (2004)	Cost/time/distance	Road/rail	RP(Neural Networks	
(Banomyong, 2000)*	Product related/decision maker related/service related factors	General mode choice determinants factors	Ranking Statistics	Lao PDR
(Arunotayanun, 2009)*	Cost, time, delay + other RP data	Road and rail in Java Indonesia	RP/SP (Mixed logit model)	
Brooks, M.R et al (2011)	Frequency, transit time, freight distance, direction, reliability measured by delivery window, reliability measured by delay, price	Land-based transport and sea	Stated Preference	Australia
(Shen & Wang, 2012) *	Weight/value/distance/time/fuel cost	Cereal grain movements by truck and rail	SP (Binary Logit and GIS)	The US
(Wang, et al, 2013)*	12 commodities; export, import; time; distance; weight value; fuel cost; milage ratio	Truck and rail in Maryland, US	RP (binary logit and probit)	,

Source: (Arunotayanun, 2009) and Author's addition
Note: * is the author's addition

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CHAPTER 4: RESEARCH STRATEGY AND METHODS

4.1 Introduction

The purpose of this chapter is to present the design and different research methods involved in the author's research in freight mode choice modeling in Myanmar. First, a framework for research method is presented with a particular emphasis on Stated Preference method (same as Figure 4.1). Then discrete choice models derived from random utility maximization will be discussed.

4.2 Approach to the Study

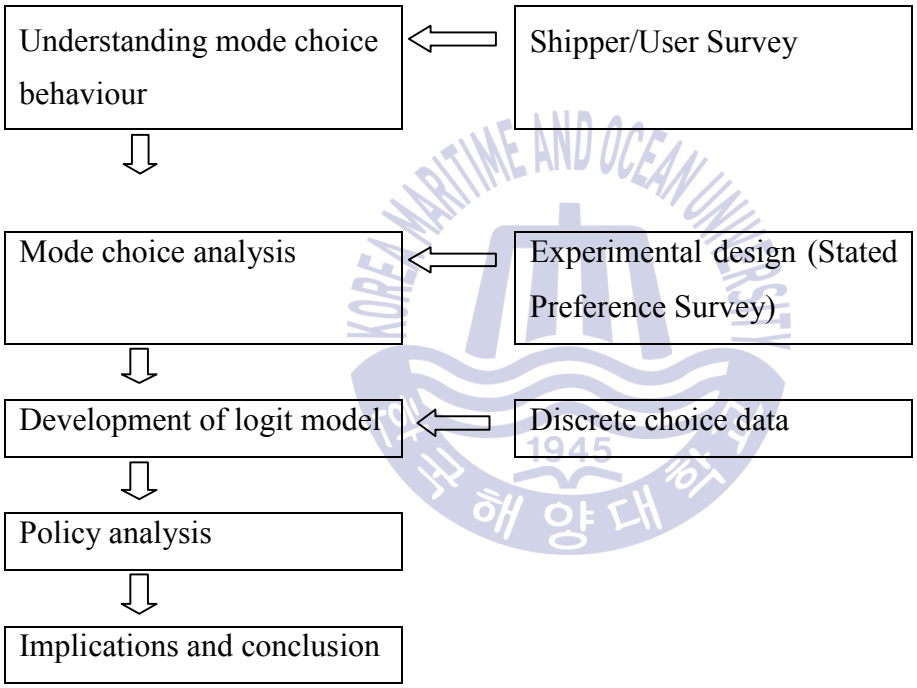

Figure 4.1Flow Chart of the Study

The study will first attempt to understand the mode choice behavior of the various actors: shippers, forwarders and transport service providers. To achieve this goal, various descriptive analyses will be conducted as in CHAPTER 5:.

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As is demonstrated by (Vieira, 1992), mode preferences are the results of the interaction of shippers' attitudes and perceptions, representing the desirability of using each available alternate (Figure 4.2). Thus, it is essential to elicit information on perceptions, attitudes and preferences from shippers, in this study, shippers, forwarders and logistics or transport service providers. In general, attitudinal and perceptual indicators are represented by the level of satisfaction or importance of attributes on a semantic scale. Most of the mode choice studies, are thus, include transport users' perceptions in their research (e.g (Banomyong, 2000); (Wong, 2007); (Cook, Das, Aeppli, & Martland, 1999). In line with this approach, the freight transport related parties' perceptions to mode choice between road and rail transport and their satisfaction will be explored in this paper.

Literature has shown evident that there are so many factors that determine mode or carrier selection. As is discussed in CHAPTER 3:, a broad range of factors determines mode choice. According to Bierlaire et al (as cited in Witlox & Vandaele, 2005) and also due to numerous factors it is impossible to incorporate all relevant elements into a single experimental design of stated choice method, which this study is applying in the analysis, let alone to analyse and control them. However, quality attributes such as reliability, frequency, loss and damage, flexibility, connectivity, information etc are all important factors that plays a critical role in the decision making process of shippers and/or consignees. In addition, the study into these factors will support in insight into mode choice modeling results.

Such being the case, it was decided to follow the factors applied in Cook, Das, Aeppli, & Martland (1999). The factors are relevant as there are similarities between the two studies in that both studies are based on mode choice between road and rail; and the contextual study is not quite different.

Stated Preference surveys (SP) have been employed for the purpose of non-existing market situations for more than twenty years in transportation and market research more generally (see for example Louviere, Hensher and Swait, 2000). It is commonly used with to estimate the demand for new transport services or new attributes to the existing services; to examine how the choice made by individuals differ by age, gender, income and class etc. It can be used if the scenario in question does not exist in real life to examine if the situations were real, how this would impact upon the market. As has been described in CHAPTER 2:,

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Rail transportation system in Myanmar is deteriorated and requires a significant revitalization (development) for the sake of modal shift, otherwise the transport systems as a whole is likely to be confronted with congestion in the road transport. On the other hand, very little data was available on those freight modes in such a developing country. Thus, it is assumed that the market is hypothetical. Also, in such a country where database is limited, it is impossible to use Revealed Preference (RP) methods for this study, as RP requires the real market data. Instead it was decided to use Stated Preference (SP) methods. Thus Stated Preference data will be collected from the related freight agents. Then the data will be analysed using logit model. Then, the implications and directions for future research will be discussed.

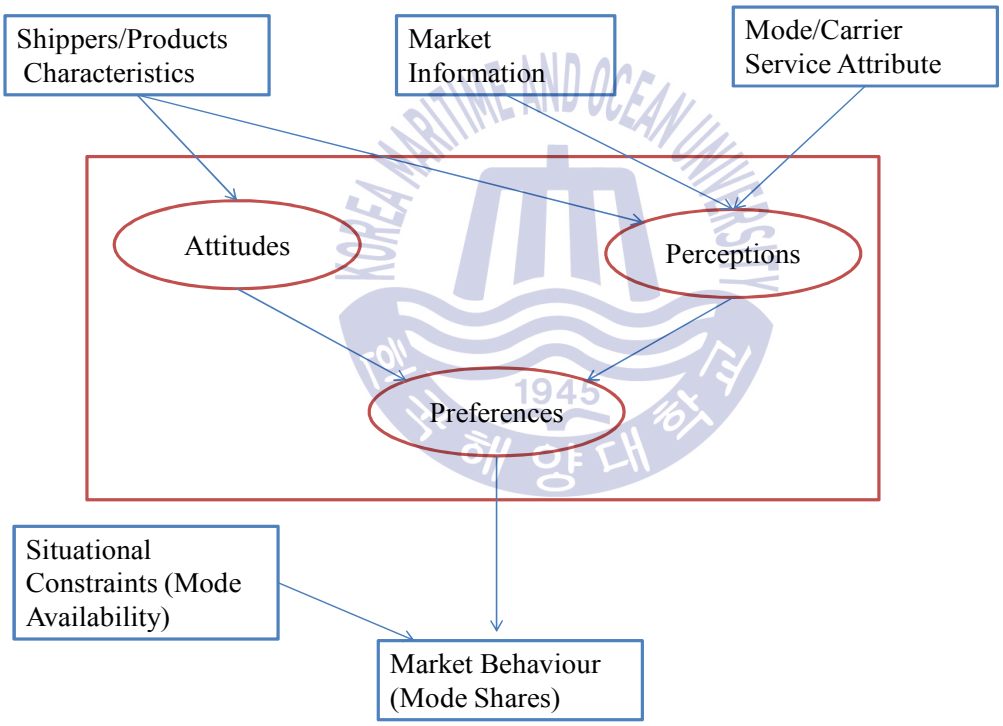

Figure 4.2 The Shippers' Behaviour Model

Source: (Vieira, 1992, p. 9)

When designing SP survey, the following design process is followed as in Figure 4.3. For the identification and determination of levels and attributes, preliminary in-depth interviews with managers who are concerned with transport in the firms were made.

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4.3 Methodology

4.3.1. Discrete Choice Method

Discrete choice models are econometric models that describe the behaviour of decision makers when making choices between alternatives. Sometimes it is referred to as Discrete Choice Experiments (DCEs). Various types of discrete choice models have been developed and applied in a wide variety of choice situations in various fields such as in transport and in health, and marketing. It is an attribute-based measure of benefit. They assume that individual decisions relating to a good or service are determined by the attributes or characteristics of that good or service. For instance, in transport mode choice, mode of travel, cost of travel, travel time, and comfort etc have been studied as to how they determine the transport choices. They can be used to analyse and predict a decision maker's choice of one alternative from a finite set of mutually exclusive exhaustive alternatives. Another purpose is to determine the relative influence of different attributes of alternatives and characteristics of decision makers when they make choice decisions. The other is to predict willingness to give up for improvements in other attributes.

Basically, all of these models include the common elements as decision makers, alternatives, attributes, and decision rules. (Ben-Akiva & Lerman, 1985; Bierlaire, 1998; Train, 2002).

The Decision Maker

Discrete choice models falls under disaggregate models. It means that the models represent the choice behaviour of individual decision makers. Depending on the specific choice situation, the decision maker can be a person, an individual, a household or an organization such as a firm. What is common in any choice study, however, is different decisions makers face different choice situations and can have different tastes. Thus, it is important to include variables which represent differences among the decision makers.

The Alternatives

Individuals make a choice from a set of alternatives available to them. The number of alternatives present to them must be finite and can be explicitly listed. The alternatives must also be mutually exclusive i.e a single alternative from the choice set is chosen and the choice

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set must be exhaustive.

Attributes of Alternatives

The alternatives in a choice process are defined by a set of attribute values. The attributes may be generic i.e they apply to all alternatives equally or alternative-specific i.e they apply to one or a subset of alternatives.

The Decision Rule

By decision rule, an indivudual processes the information of each attributes and evaluates the alternatives to determine a choice among two or more alternatives. In discrete choice models, the decision rule is based on utility maximization. This utility maximization provides a sound description of the choice behaviour even if individuals use somewhat different decision rules.

4.3.2. Random Utility Model (Logit Model)

Statistical analysis of DCE data is based on the random utility model. In random utility theory, individual *n* is assumed to choose between *j* alternative modes, and opts for the one associated with the highest utility. Thus , individual *n* will choose mode *i* over *j* if and only if

$$U_{in} > U_{jn} \quad \text{all } j \neq I \in A$$

Where *U* is the utility for a given alternative (alternative mode in freight transport context). The random utility models assumes that the utility (U) associated with a particular alternative is made up of two components: the observed (deterministic, representative or systematic) and (V_{in}) and an unobserved (random or error) components (ε_{in}). Thus,

$$U_{in} = V_{in} + \varepsilon_{in}$$

Where U_{in} is the utility of the i^{th} alternative for the n^{th} individual.

The choice probability that an individual will select alternative *i* can now be written as

$$U(i/Cn) = Prob[(U_{in} > U_{jn}), all \quad j \neq i, j \in C_n]$$

Which can be expressed as

$$P(i/Cn) = Prob[(e_{jn} - e_{in} < V_{in} - V_{jn} \ , all \quad j \neq i, j \in C_n)$$

Where, P_i= probabilit that alterntive *i* will be chosen

Prob = denotes “probability”

Cn = Choice set for an individual decision maker *n*

To estimate the probability in terms of logit model, two assumptions have to be made (1) is

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about the distribution of the error term ε_{in} – in logit model approach assumes a logistic distribution. Also it is assumed that the terms are independent (uncorrelated) across the alternatives. Therefore, the choice probability of alternative i is only a function of the differences of observable components of the total utilities. The linear-in-attributes and/or linear in parameters utility function

$$V_i = \sum \beta_k X_{ik}$$

becomes the standard linear logit form

$$P_i = \frac{\exp V_i}{\sum_{j=1}^{N} \exp V_j}$$

Thanks to the flexibility of the logit approach, it has become the preferred approach in the discrete choice modeling.

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4.3.3. Designing Stated Choice Experiments

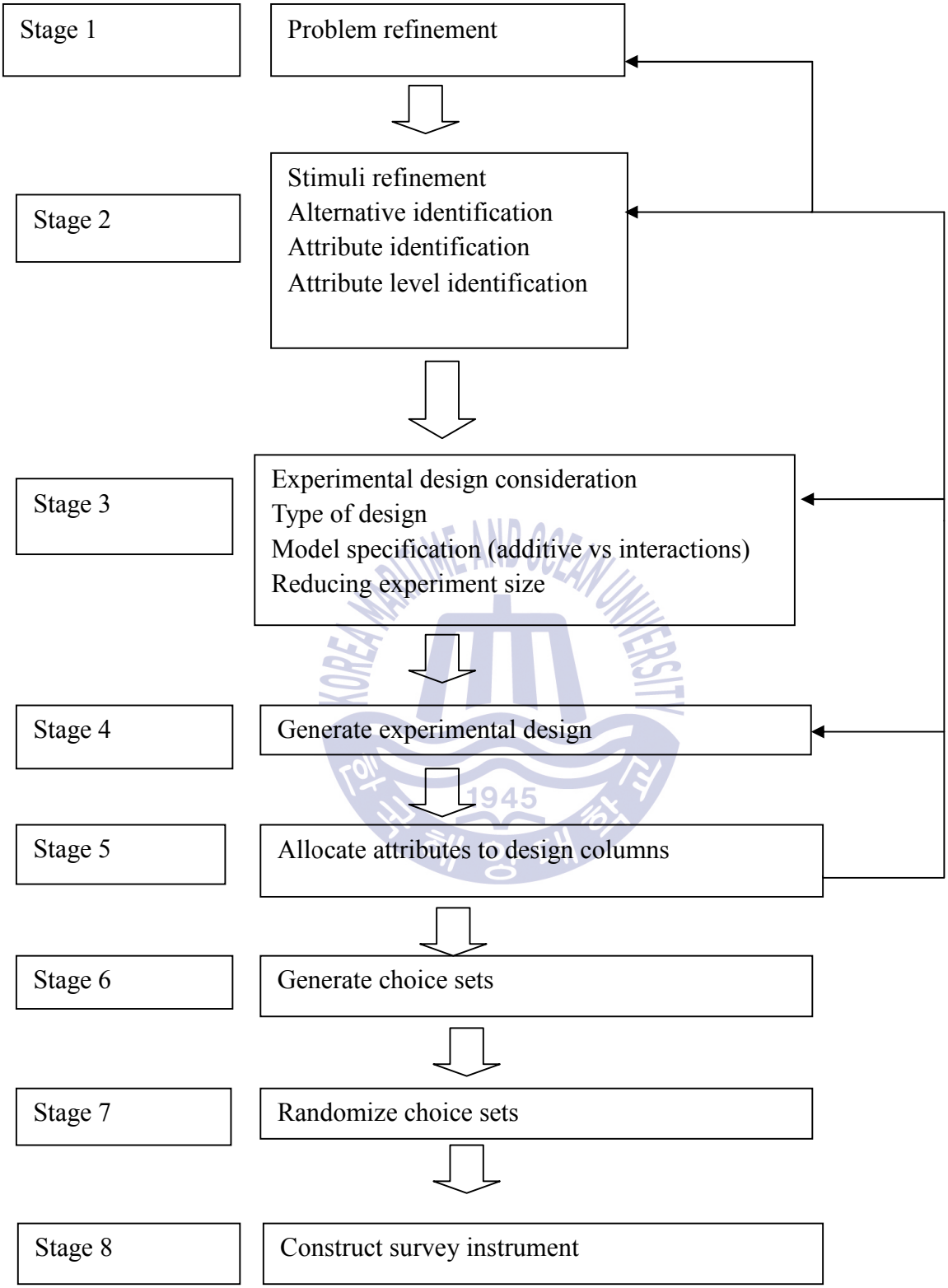

Figure 4.3 the Experimental Design Process

Source: Hensher, Rose, & Greene (2005, p.102)

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4.3.3.1. Identifications of Attributes and Levels in the Stated Choice Experiment

Designing stated choice experiment is shown in Figure 4.3. First the number of attributes (sometimes referred to as factors) to include in the experimental design is important. It is important that individuals are considering all the attributes, and making trade-offs among them, when they respond to choices. If too many attributes and levels are included, probably individuals will not consider all the information.

Thus it is important to investigate the acceptable number of attributes before the designing choice sets. That is to say, it is not often possible to present respondents with all the choices of hypothetical choice scenarios (the full factorial design). If the full factorial design is too large for respondents, fractional factorial designs for respondents are used for the purpose of reducing sample of choices. In that case, the following three things are important:

- There should be minimal correlation between different attribute levels as they appear in the design of choice experiment (orthogonality)
- Each attribute level should appear roughly an equal number of times in the DCE (level balance)
- Tow choice scenarios that appear together in a choice set should rarely have the same attribute levels (minimum overlap).

For the identifications of attributes, a number of literature reviews was made because this will inform the subsequent formulations of mode choices.

Discrete choice models permit the construction of a very general utility function incorporating many freight demand characteristics and transportation service attributes. Freight modal choice depends on transportation demand and infrastructure as well as service supply characteristics. On the supply side, the principal explanatory variables that have been included in previous disaggregate models are alternative-specific transportation service variables, such as transportation costs and transit time, frequency, and damage rates (Daugherty, 1979) (Gray, 1982) (Fowkes & D.Tweddle, 1988) (Wildert & M.Bradley, 1992).

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Table 4.1Factors/Attributes in SP Methodology

factors	Bardi (1973)	MacGinnis(1989)	Bolis &Magi(1999)	Cullinane and Toy(2000)	Cook et al (1999)	Swait et al (1994)	Wigan et al (2000)	Feo et al(2010)	Zhao et al (2005)	Beuthe et al	Arutonayanun	Norojono & Yong (2003)
Reliability												
Security												
User satisfaction												
Availability												
Capability												
Transit time/time												
Business practice												
Transport costs												
Freight rates												
Over/short supply, damaged												
Shipper market considerations												
Carrier considerations												
Product/goods characteristics												
Service												
Frequency												
Distance												
Speed												
Flexibility												
Inventory												
Loss/damage												
Sales per year												
Controllability/traceability/tracking												
Previous experience												
Connectivity												
Products suitability												

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Customer information												
Adaptability												
Customer friendly attitude												
Negotiability												
Access to decision makers												
Ease of payments												
Claim processing time												
Pick up												
Safety												
Truck condition												
Travel route/routing												
Access/accessibility												
Train information												
Responsiveness to problems												
Direction												
Time of departure												
Coverage												
Delivery and condition												
Terms/contract												
Cargo volume												
Cargo value												
Delay												

From the literature, it was found out that factors/attributes like reliability, transit time/time, transport costs, frequency were essentially used for the design experiments in Stated Preference Method. The most applied attributes in SP design are listed in Table 4.1.

Thus, in the design of this study, it is appropriate to use these variables: transit time, transport cost, frequency and reliability as these are general utility function and can be ease for incorporating in the design. Also to include such factors as the firms' characteristics and goods' physical attributes, there is difficulty in collecting the necessary data. Also, the firms

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are very reluctant to disclose the data and thus it is only possible to collect non-confidential data.

Levels determination

After the attributes (factors) have been decided to incorporate in the experimental designs, in-depth interviews with the managers of the shipping and forwarding companies were conducted. In the discussions, the following attribute levels were discussed. The focus groups consist of fifteen managers from different companies. They were asked the current cost, time and frequency and reliability (in terms of stated delivery time window). "Transport cost" refers the total costs of transportation from the factory to the delivery point. Regardless of the distance, in Myanmar, the freight rate, collected as per ton mile is still the norm. "Transit time" was defined as the time taken from the factory to the delivery point. "Frequency" was defined as the number of departure times available in the two modes. And finally, "reliability" was defined as the delivery window on which the cargo to be delivered arrived on time. These definitions were understood by the discussion groups as well as the respondents.
The average values at present levels are shown in Table 4.2.

Table 4.2 Current attribute values

Attributes	Minimum at present	Maximum at present
Transport cost (Road)	150 Kyats/mile/ton	200 Kyats/mile/ton
Transport cost (Rail)	80 Kyats/mile/ton	150 Kyats/mile/ton
Transit time (Road)	1day	3 days
Transit time (Rail)	1.5 days	4-5 days or more
Frequency (Road)	Once a week	daily
Frequency (Rail)	Once a week	Two times a week
Reliability (Road)	80% (consistency with stated delivery time)	100% (consistency with stated delivery time)
Reliability (Rail)	80% (consistency with delivery time and delivery)	90% (consistency with stated delivery time)

From the discussions and considering the two modes to be in fully competitive in the future, the levels are determined as shown in Table 4.3.

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Table 4.3 Attributes and levels withithin a (labeled) DCE

Attributes	Levels		
	Low	Medium	High
Transport cost	100	200	300
Transit time	5	3	1
Frequency	Once a week	Twice a week	Daily
Reliability	80%	90%	100%

4.3.3.2. Design considerations and generating experimental design

Considering the attributes and levels involved in this study, the full factorial design will be L^{MA} for labeled choice experiment: L is the level in each attribute; M is the number of attributes and A is the number of alternatives. Here in this study there are 4 attributes with 3 levels each and 2 alternatives, road and rail. Thus, In this case, the full enumeration of the design will be $3^{4\times2} = 6561$ choice sets. It is impossible to present all these choice set into the respondents. The normal practice is to generate the smallest fractional factorial design. For the smallest fractional factorial design, considering the main effects only design, the smallest is 3 x 4 x 2 = 24 choice set. However, in SPSS, 27 choice sets are generated which is orthogonal and balanced.

Interactions and Main Effects:

In discrete choice modeling many potential forms of the utility function can be transformed into additive linear forms of the type: The main effects are defined as the response to passing to the next level of the variable when the rest of the attributes remain constant (all other things being equal); it is normally postulated that these are the main determinants of changes in choice. However, Louviere (1988b)'s findings showed that

- The main effects explain 80% or more of the data variance.
- Two-term interactions rarely explain more than 2% or 3% of the variance.
- Three-term interactions rarely explain even smaller proportions of the data variance, normally of the order of 0.5% to 1% and rarely over 2% or 3%
- Higher-order effects explain a minuscule proportion of the data variance.

This provides the basis for reasons of considering only main effects in the experimental

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designs in practice as well as in this study.

Considering the main effects only design, the utility that will be estimated in this study is as follows:

$V_{truck} = \beta_0 + \beta_{1\,truck}$* truck cost + $\beta_{2\,truck}$ * truck time +$\beta_{3\,truck}$* truck frequency + $\beta_{4\,truck}$* truck reliability + ε

$V_{rail} = \beta_{1\,rail}$* rail cost + $\beta_{2\,rail}$* rail transit time + $\beta_{3\,rail}$* rail frequency +β_{4rail}* rail reliability + ε

Designs can be generated using a number of software and expert design. Orthogonal design or efficient designs are used. In this study orthogonal design is generated using SPSS[2]. Being labeled alternatives that is road and rail, the choice sets are generated directly. There are 27 choice sets which are enough for estimating main effects only (Table 4.4). After generating choice sets, they are rearranged to present to respondents. Considering the fatigue, and unmotivated of the respondents, each respondent is presented 9 choice sets each out of 27 choice sets.

[2] Other SP designs such as D-efficiency designs has been initiated by (Rose & Bliemer, 2004)

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Table 4.4 Orthogonal Choice Sets

Card ID	Transport cost (Truck)	Transport cost (Rail)	Transit time (Truck)	Transit time (Rail)	Frequency (Truck)	Frequency (Rail)	Reliability (Truck)	Reliability (Rail)
1	300 kyats	100 kyats	3 days	3 days	Once a week	Twice a week	90%	90%
2	200 kyats	300 kyats	1 days	5 days	Once a week	Daily	80%	80%
3	100 kyats	300 kyats	1 days	3 days	Twice a week	Daily	90%	90%
4	300 kyats	300 kyats	5 days	1 day	Twice a week	Twice a week	80%	90%
5	100 kyats	100 kyats	1 days	5 days	Twice a week	Once a week	90%	100%
6	300 kyats	100 kyats	5 days	3 days	Twice a week	Daily	80%	100%
7	200 kyats	300 kyats	5 days	5 days	Daily	Twice a week	90%	100%
8	300 kyats	100 kyats	1 days	3 days	Daily	Once a week	100%	80%
9	200 kyats	100 kyats	3 days	1 day	Twice a week	Twice a week	100%	100%
10	100 kyats	200 kyats	5 days	1 day	Once a week	Once a week	100%	100%
11	300 kyats	200 kyats	3 days	5 days	Once a week	Daily	90%	100%
12	200 kyats	100 kyats	5 days	1 day	Daily	Daily	90%	80%
13	100 kyats	100 kyats	5 days	5 days	Once a week	Daily	100%	90%
14	200 kyats	200 kyats	5 days	3 days	Daily	Once a week	90%	90%
15	200 kyats	300 kyats	3 days	5 days	Twice a week	Once a week	100%	90%
16	100 kyats	300 kyats	3 days	3 days	Daily	Once a week	80%	100%
17	200 kyats	200 kyats	1 days	3 days	Once a week	Twice a week	80%	100%
18	200 kyats	200 kyats	3 days	3 days	Twice a week	Daily	100%	80%
19	300 kyats	200 kyats	1 days	5 days	Daily	Twice a week	100%	90%
20	100 kyats	200 kyats	3 days	1 day	Daily	Daily	80%	90%
21	300 kyats	300 kyats	3 days	1 day	Once a week	Once a week	90%	80%
22	100 kyats	300 kyats	5 days	3 days	Once a week	Twice a week	100%	80%
23	100 kyats	200 kyats	1 days	1 day	Twice a week	Twice a week	90%	80%
24	200 kyats	100 kyats	1 days	1 day	Once a week	Once a week	80%	90%
25	300 kyats	200 kyats	5 days	5 days	Twice a week	Once a week	80%	80%
26	300 kyats	300 kyats	1 days	1 day	Daily	Daily	100%	100%
27	100 kyats	100 kyats	3 days	5 days	Daily	Twice a week	80%	80%

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4.3.3.3. Sampling, Data Collection and Method

Two common sampling strategies for choice models are simple random sampling (SRS) and exogenously stratified random samples (ESRS) (Ben-Akiva and Lerman (1985, chapter 8). Louviere et al (2000) guided that minimum SP random samples should follow the following formulas

$$n \geq \frac{q}{rpa^2}\Phi^{-1}\left(\frac{1+\alpha}{2}\right)$$

Where a proportion p_n, obtained by an SRS of size n, is normal with mean p (the true polulation proportion); Variance $\frac{pq}{n}$ where $q = 1 - p$. (If we wish to estimate the true proportion within a per cent of the true value p with probability α or greater)

Hensher et al (2005, pp 193-196) provide an overview of the reality (as opposed to the theory) of sampling practices within studies of choice. For SP choice data, the most commonly used criteria for establishing a minimum sample size is the number of observations (choice sets) to estimate robust models (Hensher et al, 2005, p.195). It is because variability is less of an issue in collecting SP choice data if any analysis is intended for the attributes used as part of the experimental design. This is because variability is induced within the attributes as part of the experimental design employed. Even these authors are unsure of practical defined rules to guide the analyst of SP choice sampling. Their best suggestion is to apply 50 observations for the least popular alternative for cut-off.

This study has a lot of constraints on the budget and resources available. However, the respondent number of 85 with 9 choice sets makes a total of 765 (with two alternatives1530) observations. This is quite enough for the level of accuracy required. This method requires all respondents be at a senior, expert, and decision making level. This study offsets the sampling weakness by the fact that majority of respondents were real and operational freight shipping managers who frequently involved in freight transportation decisions for their organizations.
Survey was conducted using traditional paper and pencil surveys. It must be noted that there are more advanced computer aided personal interviews and internet based surveys. However, paper and pencil survey is thought to be appropriate in this context. This survey included interviewer administered interview and self-administered interview. However, in both interviews, the context of SP and its nature were well explained. At the first interviewer-

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administered interview, there were 30 respondents were directly interviewed. 55 respondents were gained through the self-administered interview.

The survey participants consisted of mainly shippers, forwarders and logistics/transport service providers. The participants were focused on all three types because as it argued by (Murphy, Daley, & Dalenberg, 1991) intermediary parties are also possible to actively be involved in transportation choice, particularly for small shippers. Myanmar has small shippers and most of the border trade they rely on forwarders and agents. Moreover, being the freight market renovation in rail, it is assumed that all the parties concerned with freight usage are relevant for the surveying.

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CHAPTER 5: FREIGHT TRANSPORT USAGE AND TRANSPORT USERS' PERCEPTIONS TOWARDS THE NATURE OF TRANSPORT CHARACTERISTICS IN MYANMAR

5.1 Introduction

This chapter examines the transport practices, usages in freight transportation, and attitudes and satisfaction of freight shippers and agents towards road and rail transportation in Myanmar. The purpose is to provide a comprehensive understanding to the freight transport systems and thus the result could be a supplement to the modal choice in the following stated preference analysis. First the general survey is presented. Second the transport usage is discussed. Finally, the attitude towards transport mode and their satisfaction is reported.

5.2 Sample and Method

The sample includes shippers, freight forwarders and transport/logistics service providers. Some studies focused either on shippers or receivers. However, this study assumes that for the modal shift from road to rail at the national level, it is reasonable to consider all the parties concerned. Imagining the multimodal transport or combined transport, shippers, freight forwarders and transport/logistics service providers are widely concerned with freight mode choice. Thus the sample of respondents was primarily taken from the majority of shippers, freight forwarders and transport/logistics service providers through interviews and self-administered questionnaires. Descriptive analysis was used for this part of the study and the questionnaire survey was designed as below.

5.2.1. Questionnaire Design

Questionnaire survey in the first part consisted of 3 sections: general information section (Section 1); transport usage (section 2), and rating of transport mode importance and satisfaction towards modes (section 3, APPENDIX 1).

In Section (1),

- Question 1 concerns the nature of the establishment.
- Question 2 asks the respondent's position.
- Question 3 asks the main business (commodities) that the establishments deals with.
- Question 4 concerns the number of employees in the company

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- Question 5 asks the respondent to indicate the amount of transport spent per annum by the company.
- Question 6, 7, 8 and 9 focuses to elicit the transport decision making by asking to state the number of people in the firm/company who are concerned with transport and/or distribution; the person responsible to make transport decision making; if the decision requires the approval of the Board of Managing Director; and the frequency the firm/company revises transport and/or logistics strategy.

In Section (2),

- Question 1 asks the modes usually chosen.
- Question 2 asks the reason why the mentioned mode in Question 1 is selected.
- Question 3 asks the average consignment size per shipment.
- Question 4 asks the value of consignment per shipment.
- Question 5 asks the weight of consignment per shipment in terms of m3 or cubic feet.
- Question 6 enquires shipper's habit on employment of the freight mode.
- Question 7 considers their knowledge on transport mode i.e., whether they know they have choices for their shipment.
- Question 8 concerns with the transport cost bearers.
- Question 9 and 10 concerns the usage of container transport.

In Section (3)

- Attitudinal questions on the general level of importance of modal choice fifteen selected factors and general level of satisfaction perceived from the current transport system of road truck and rail transport in Myanmar.

5.3 Research Findings

There were 58 shippers (68% of total respondents), 13 forwarders (15% of the total respondents) and 14 transport/logistics service providers (17% of the total respondents) (See Figure 5.1). In total there were 85 respondents. About 84 % of the respondents were in high positions in their respective companies, which are well fit for the stated preference survey. Table 5.1 illustrates the types of position held. In terms of the nature of firm/company, about 79% of the companies are domestic and independent. About 21% of the companies are mostly in Joint Venture with other companies and/or subsidiaries of foreign companies, or branches of big domestic companies (Table 5.2).

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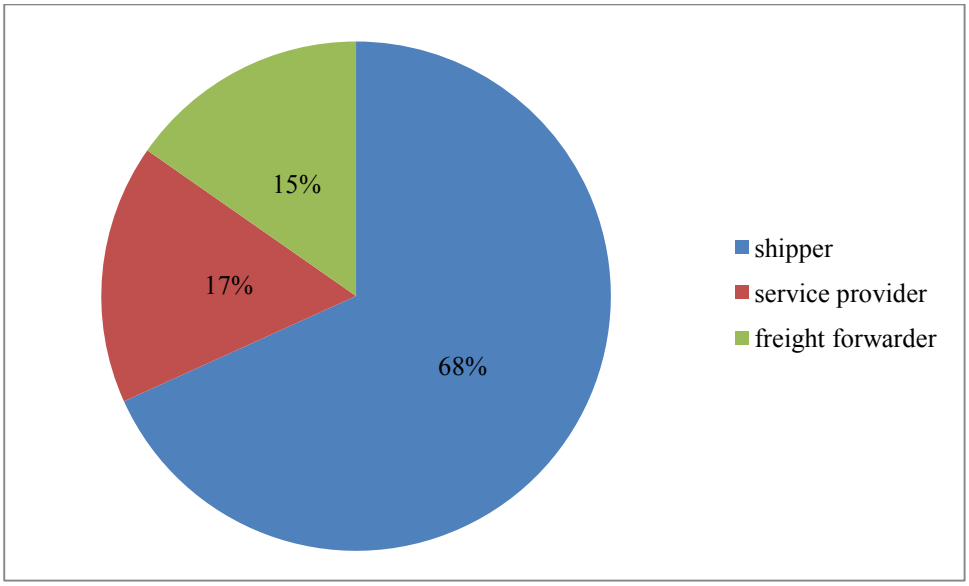

Figure 5.1 Respondents Ratio

Table 5.1 Respondents' position held in the companies

Position	No.	%	Valid %
CEO level	2	2.4%	2.4%
Executive level	10	11.8%	12%
Director	13	15.3%	15.7%
Manager	45	52.9%	54.2%
Staff	13	15.3%	15.7%
Total	83	97.6%%	100%
Missing	2	2.4%	
Total	85	100%	

Table 5.2 Nature of Firm/Company

Nature of Firm/Company	No.	%
Dependent	18	21.2%
Independent	67	78.85
Total	85	100%

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Important things when considering the type of commodities was the freight traffic that was transported in both modes of road and rail. In rail transportation, the share of manufactured goods and other miscellaneous goods, agricultural produce are the most transported goods. Noticeably most of the goods transported belong to the governmental department and military.

Low value cargoes such as sugar, tobacco, jiggery, salt etc and bulk cargoes like ores, iron and steel, charcoal, coal and coke are normally transported in rail transport although these cargoes may be transported competitively with inland water transport. As inland water transport is ignored in this case, those commodities transported are assumed not to be competitive with road transportation.

Table 5.3 Top commodities transported in Rail Transportation (2010-11) (in '000 tonnes)

Rice, flour & atta, grains and pulses, corns	139
Timber	198
Salt	82
Cement	45
Military accouterments and stores	78
Railway departmental	944
Miscellaneous (miscellaneous manufactured goods)	963
Other	430
Total	2879

Calculated from (CSO, 2011)

Another consideration is that agricultural produce are part of exports and manufactured goods are imports (although some are produced domestically). Thus selecting those commodities reflects the domestic transport usage. Other included machinery, transport equipment, agricultural equipment etc. In the survey, there were 26% of manufacturing and agricultural shippers each, miscellaneous commodities accounted for 30% of the respondents. In the survey, freight forwarders and transport/logistics service providers did not specify the commodities for the reason that they handle various commodities. Construction companies included about 6% of the respondents and other commodities like transport machinery,

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agricultural transport equipment etc included 11.8% of the respondents (Table 5.4). Depending on the commodities types of the respondents, the respondents are reclassified as shipper, freight forwarders, and transport/logistics service providers for the sake of analysis in logit model (Figure 5.1).

Table 5.4 Commodities (business) handled at the respondents' companies

Commodities/Business	No.	%
Manufacturing	22	25.9%
Miscellaneous	26	30.6%
Agriculture	22	25.9%
Construction	5	5.9%
Other	10	11.8%

The company size can be found in terms of the number of employees in their companies. Nearly half of the companies belong to small category company with employees of 10 to 49. One third of companies are medium size companies with 50 to 249 employees. Micro companies with 1 to 9 employees account for 10% and large companies with more than 250 employees are only 8% of the total respondents.

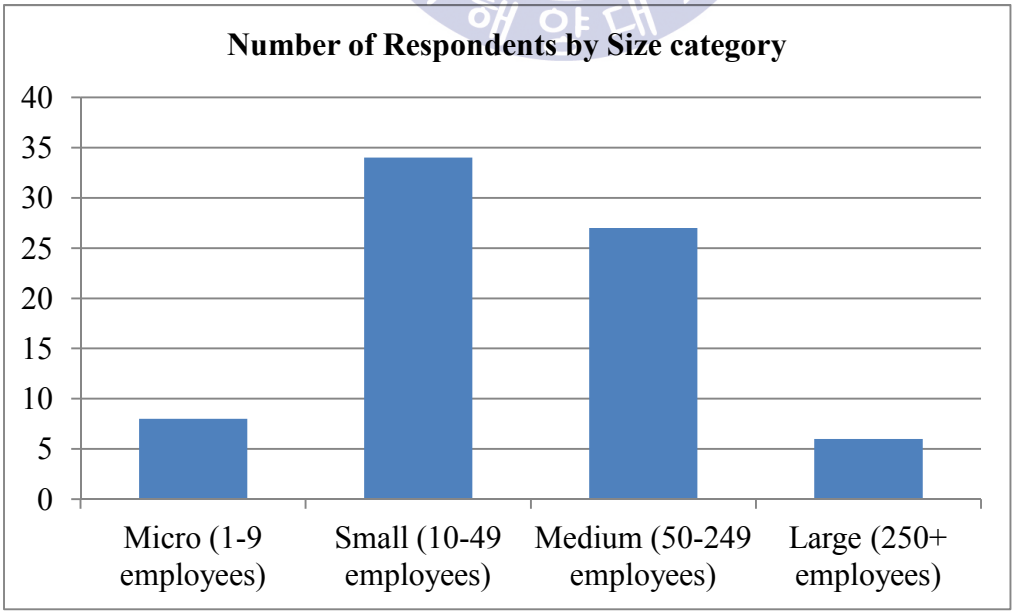

Figure 5.2 Number of Respondents by Size Category

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5.4 Transport usage

Table 5.5 shows the usage of transport modes by the companies surveyed. From the total respondents, it can be seen that some of the respondents make mode choices more than one option. Road truck is, as in most other countries, the most dominant mode than others accounting 52% of the total responses. Railway and inland waterway despite less use than road truck, they seem to be alternatives for transport users. Private cars use by responses from the sample is about 11% and is the second most minimal. The least usage is other accounting only about 8%. Other includes less popular transport like parcel service and air transportation. Air transportation is expensive and domestic air cargo service is at the progress stage. It is also apparent that respondents are really thinking of mode choice by the 40% of the total respondents stating that the same mode is not always employed. The responses of 87.3% stating that they think they have choices and the rest stating they have no choices in freight transport may infer that regardless of the modes existence, they are posed by many challenges to select.

Table 5.5 Ratio of Transport Mode Usage by Respondents

Mode Use	Responses		Percent of Cases
	Number	Percent	
Private Car	13	10.9%	15.7%
Road Truck	62	52.1%	74.7%
Railway	17	14.3%	20.5%
Inland Waterway	17	14.3%	20.5%
Other	10	8.4%	12.0%
Total	119	100%	143.4%

Regarding transport cost bearers, 51% of the sampled respondents stated that the consignee pays; 29% manufacturers, 9% agency, and 8% wholesaler respectively (Figure 5.3). According to Nam (1992), it implies that for the small consignment market, the consignee as well as the consignor has similar influence on the choice of transport mode. However, in this study, as the consignment size was not considered, this implication could not be confirmed.

Average consignment size ranges from about 1 metric ton to about 30 tons. As can be

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seen in Figure 5.4, consignment of about 0 to 9 and 10 to 19, both categories accounts for one third of total respondents. About 22% of the respondents stated that their consignment is in the 20 to 29 ton category. About 13% falls under the category of 30 ton and above. The mean ton with 14 ton can be said the average size is not small. This can be attributed by the bulky characteristics of the commodities like rice, beans and pulses, and cement.

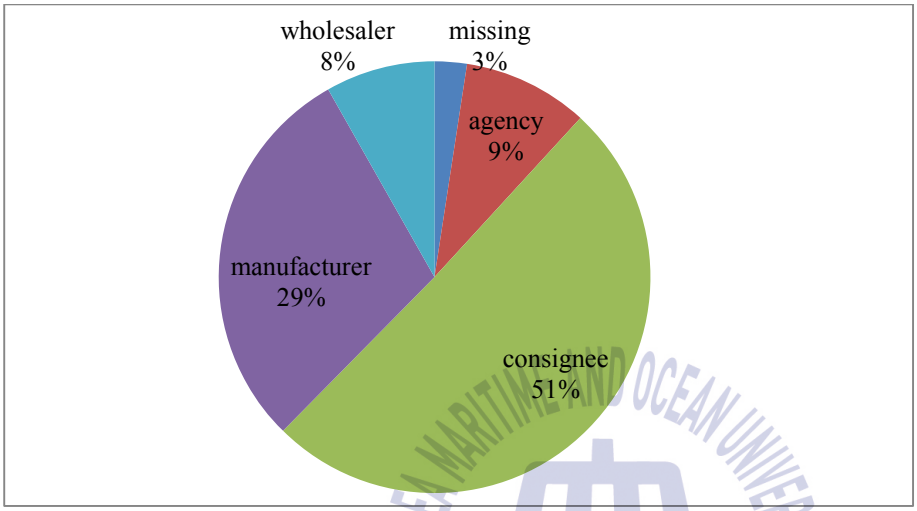

Figure 5.3 Transport Cost Bearer

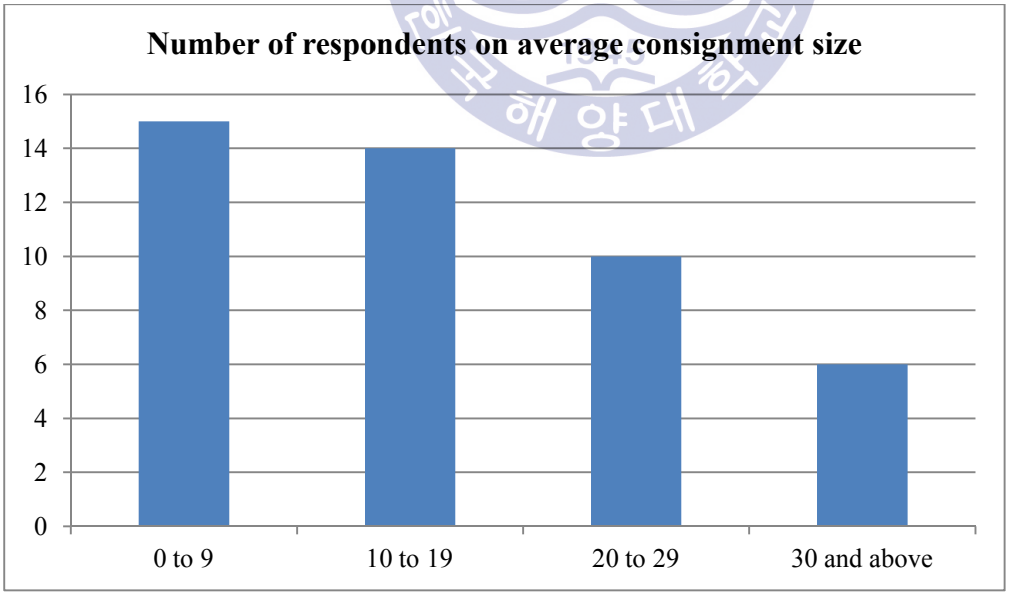

Figure 5.4 Number of Respondents on Average Consignment Size

(Note: 45 valid cases; 40 missing; mean= 14.18; Std deviation= 9.56)

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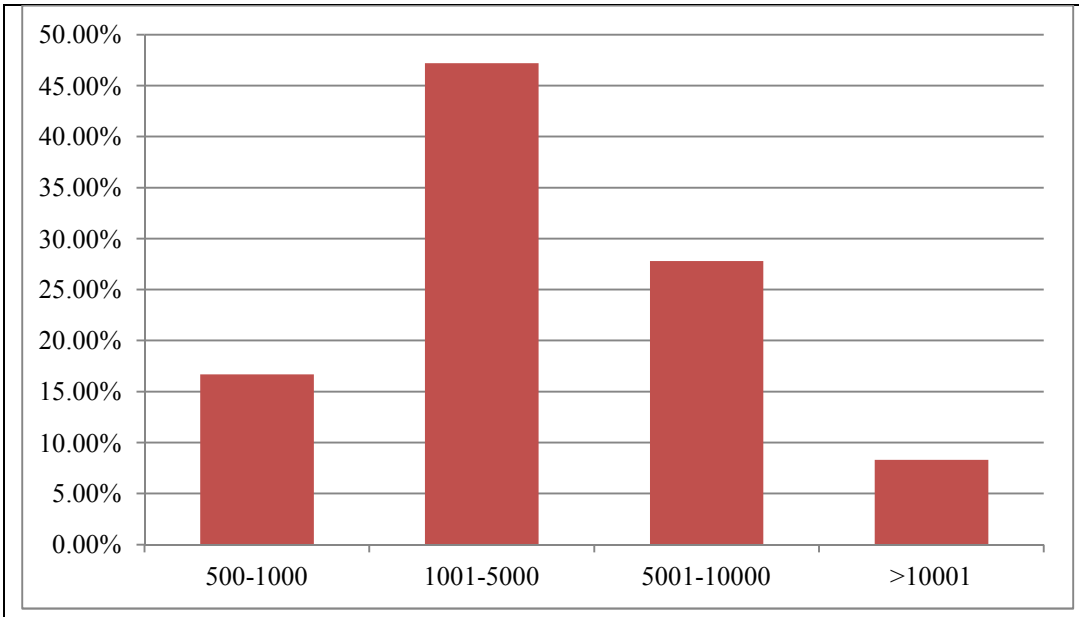

Figure 5.5 Consignment Value of Respondents

In order to know containerization in the Myanmar's Transportation System, container usage was asked. Out of the 76 responses, only about one third of respondents use container always. Sometimes group account 42% and 25 % still do not use container at all. However, according to some respondents, container usage is still seen only on road transportation especially for export. It seems that 61% of respondents on FCL usage meant to refer to export usage only. In rail transportation, it was heard that even though container handling terminal was built, it is not usable at all as the handling equipment is unavailable (.
Table 5.6&Table 5.7).

Table 5.6 Container Usage

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Always	25	29.4	32.9	32.9
	Sometimes	32	37.6	42.1	75.0
	Not at all	19	22.4	25.0	100.0
	Total	76	89.4	100.0	
Missing	System	9	10.6		
Total		85	100.0		

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Table 5.7 FCL/LCL Usage

		Responses		Percent of Cases
		N	Percent	
FCLLCL multipleresponse[a]	FCL	38	61.3%	67.9%
	LCL	24	38.7%	42.9%
Total		62	100.0%	110.7%

a. Dichotomy group tabulated at value 1.

5.4.1. Attitudes towards Transport Modes

Stated Preference survey has limitations to include many factors relevant in this study. On the other hand, as has been evident from literature, many qualitative attributes are also attributable to mode choice. Thus attitudes towards transport modes particularly road truck and rail transportation and satisfaction to those modes were asked. First, the respondents were asked to rate the general level of importance of the factors attached road truck and rail transport when their commodities were transported using five-point Likert scale 1 to 5. Although there are numerous factors available, this study followed Cook et al(1999). These factors covers transport mode characteristics as well as carrier related service characteristics.

A ranking of from the most important to the least important factors in each category is presented in

Table 5.8 The top five important factors were ‘price’, ‘transit time’, ‘reliability’, ‘frequency’, and ‘loss and damage’. The respondents ranked ‘price’ as the most important attribute when considering mode choice followed by ‘transit Time’. This is probably due to the characteristics of the commodities transported and the context of transportation. Generally, price and time are important when shippers have options to choose. In the studies of transport selection criteria, they are most important factors for sea transportation and for long distance carriage. In many studies of road and rail, the importance of cost has shown diminished. However, in a country where modern logistics concepts are not well known added by high transport cost, it is not surprising price (transport cost) is concerned most. Additionally, the commodities in this study involved reasonably low value and high volume cargoes which are sensitive to transportation cost.

‘Transit time’, was ranked the second important attribute by the respondents. Generally, transit time is the concern for time sensitive high value cargo and small shipment. However,

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in the context of Myanmar freight transport users, possible reason is that there are physical and non-physical impediments when transporting for export, import including border transport. Their fear to overcome these impediments and delays caused by could have made give high score. The finding is consistent with some results in literature. For instance, the results of Jeffs & Hills, (1990), and Brooks (1990) have found 'transit time' to be the most important attribute.

Meanwhile, it must be noted that service attributes come into play in the scene of mode choice in Myanmar. The high ranking on 'reliability', 'frequency', and 'loss and damage', implies that service concerns not less than transport cost. A number of studies had found out that 'reliability' and other service attributes were as important as cost although there may be a little differences in ranking. In the empirical study of Mwase, (1986), the shippers' decision as to where to ship and which mode to select will depend on the service-induced costs greater than the (direct) transport charges. According to Whyte (1993), service remains the most important factor, but price also become the most important factor. In the same study 'cost' is only ranked twelve out of eighteen while 'Transit Time' was ranked sixth. The importance of 'reliability' has also been demonstrated in the literature where many authors (Pederson & Gray, 1998; Matear & Gray, 1993) agreed that 'reliability' in service seems to be the overall most important factor, in contrast Hayuth (1985) ranked 'reliability' last in the list of factors that may affect freight modal choice.

'Availability', 'connectivity', 'product suitability' ranked the sixth, seventh, and eighth respectively. This is consistent with Cook et al (1999) that a mode will be considered to be chosen only when there is an option at the point of consumption/need. Generally speaking, these three attributes would be related to infrastructure for the transportation system. Other factors 'negotiability', 'customer information', 'access to decision makers', 'ease of payment', 'claim processing time', 'customer friendly attitude', and 'adaptability' were ranked behind the above mentioned criteria (
Table 5.8)

The perceptions towards road and rail transport mode choice were also examined by asking the respondents to rate the level of satisfaction on the criteria. The same criteria on importance were applied. The average score for each attribute in road is given in

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Table 5.9 and that for rail is given in rail Table 5.10.

Table 5.8 Importance of Attributes Perceived by Freight Shippers and Agents

Factors	Mean	Standard Deviation	Rank
Price	4.17	0.695	1
Transit Time	4.05	0.810	2
Reliability	3.81	0.788	3
Frequency	3.80	0.712	4
Loss and Damage	3.61	0.746	5
Availability	3.57	0.799	6
Connectivity	3.34	0.703	7
Product Suitability	3.04	0.671	8
Negotiability	3.01	0.890	9
Customer Information	2.86	0.885	10
Access to Decision Makers	2.84	0.881	11
Ease of Payment	2.73	0.700	12
Claim Processing Time	2.67	0.767	13
Customer Friendly Attitude	2.67	0.977	14
Adaptability	2.66	0.801	15

Table 5.9 Average Score on Level of Satisfaction on Road Transportation

Factors	Mean	Standard Deviation	Rank
Availability	6.63	1.323	1
Frequency	6.45	1.140	2
Negotiability	6.4	1.306	3
Ease of Payment	6.37	1.400	4
Access to Decision Makers	6.32	1.449	5
Reliability	6.24	1.534	6
Product Suitability	6.24	1.178	7
Customer Information	6.23	1.196	8
Transit Time	6.10	1.572	9
Customer Friendly Attitude	6.02	1.259	10
Connectivity	5.98	1.388	11
Loss and Damage	5.77	1.586	12
Adaptability	5.73	1.116	13
Claim Processing Time	5.66	1.223	14

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Price	5.51	1.243	15

With road transportation, ‘availability’ was the most satisfied factor for the respondents with the average score of 6.63. The second most satisfied attribute was ‘frequency’, followed by ‘negotiability’. The least satisfied factor in road was revealed as price. By relating to the importance, ‘price’ was ranked as the first. However, the fact that respondents were satisfied least in ‘price’ attribute and that a large market share of road truck, may imply that the road truck is being chosen due to many other attribute. One explanation is the highest score in the satisfaction on ‘availability’.

In rail transportation, the most satisfied attribute was rated as ‘price’ at the score of 7.13. Other attributes were rated below 5. The least satisfied attribute was ‘connectivity’. It seems that in rail transportation, it is often stated that manual and multiple handlings incur and the transshipping from truck to rail is unlikely to be favourable for the shippers. Moreover, poor infrastructure seems to affect the choice of rail for the shippers.

In overall, the satisfaction level in road transportation is above average but not that so high level. The highest score is 6.65 and the lowest score is 5.51. This means that not all factors are fully satisfied. In the rail transportation, the highest satisfaction level is scored 7.13 whereas the lowest satisfied level score is 4.1. The gap between the highest and the lowest is much wider than in road transportation. However, except that highest level score, all the other factors score below average 5.

Figure 5.5 illustrated the comparison of road and rail satisfaction level. The important factor of ‘price’ can be said to meet by the satisfaction level in rail. But other than ‘price’ all the other factors in rail were supposed to be unfulfilled by the attributes in the rail transport. Otherwise, if ‘price’ only matters, the market share of rail could have been higher than road transport. For the road transport, most of the important attributes such as frequency, availability can be said to fulfil to some extent. One thing to be notable is that respondents could have considered the fact that ‘price’ in rail main haul alone is considerably cheaper than the road transport as the rail transport is the State Run Enterprise, and subsidized by the government. Thus it does not reflect the market price. On the whole, all the satisfaction level received in rail transport is lower than the level in road transport apart from ‘price’.

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Table 5.10 Average Score on Level of Satisfaction on Rail

Factors	Mean	Standard Deviation	Rank
Price	7.13	1.531	1
Product Suitability	4.95	1.319	2
Ease of Payment	4.89	1.330	3
Availability	4.67	1.286	4
Loss and Damage	4.59	1.691	5
Customer Information	4.54	1.412	6
Adaptability	4.53	1.338	7
Frequency	4.51	1.439	8
Transit Time	4.44	1.328	9
Claim Processing Time	4.24	1.443	10
Reliability	4.24	1.434	11
Negotiability	4.23	1.450	12
Customer Friendly Attitude	4.15	1.292	13
Access to Decision Makers	4.13	1.362	14
Connectivity	4.10	1.392	15

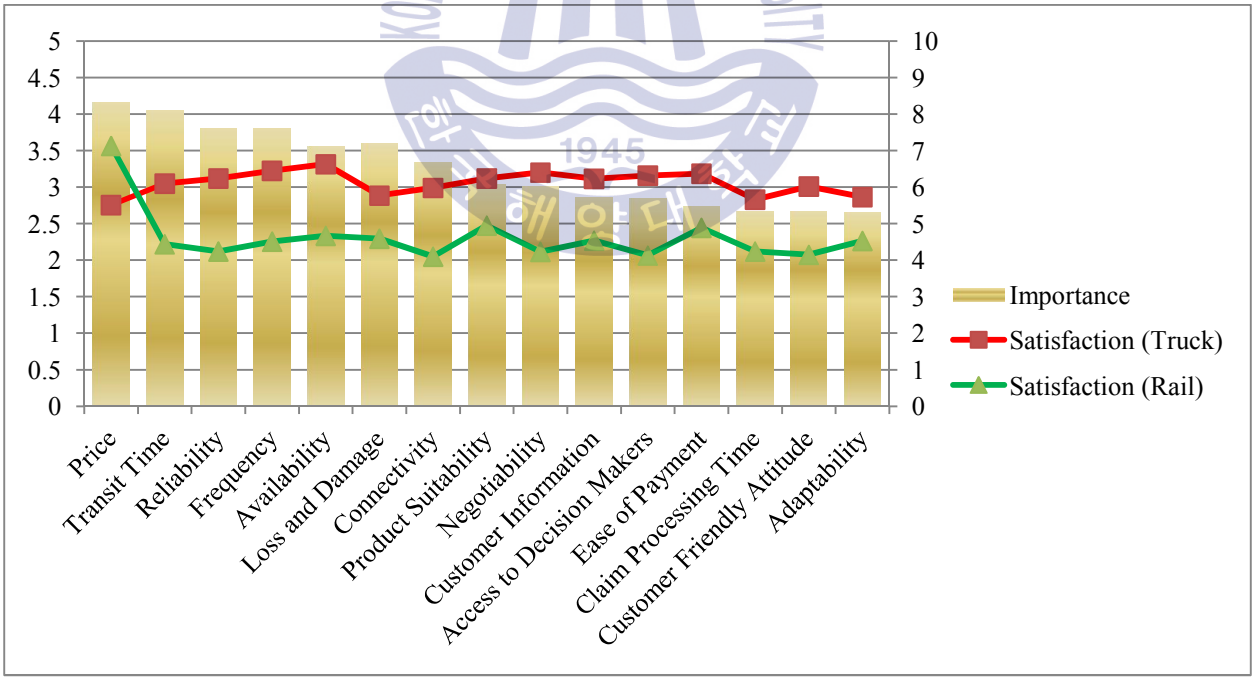

Figure 5.5 Comparison of Importance and Satisfaction Level on Attributes of Road and Rail

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5.5 Conclusion

Domestically, freight transportation system has options available for modal choice. However, road transportation has been the dominant mode and rail transport has been distorted. Surprisingly, the freight transportation in rail is preoccupied by the governmental and departmental goods. The majority of respondents felt that there are choices for their shipment. However, more than half of the respondents are still employing the same mode. It must be appreciated that the condition can vary depending on the characteristics of the products/commodities shipped. Still, it can be inferred that there are challenges posed to the modal choice.

The results of rating on the level of importance attached to the road and rail mode choice, the main attributes 'price', 'transit time', 'reliability', 'frequency', and 'loss and damage' were ranked the top most important attributes. Following these attributes were 'availability, 'connectivity' and 'product suitability' which, if categorized, are related to infrastructure. It might be an odd result compared to the others in the literature. However, it must be appreciated that local conditions particularly infrastructure can affect their decision factors.

From the satisfaction level received from the current road and rail transport system, it can be inferred that road transportation to some extent are perceived as satisfactory rather than rail transportation. Almost all preference level in rail is lower than the average score of 5 except 'price'. As mentioned earlier, the cheap in 'price' is mainly attributed by the State Run Enterprises and by the subsidies. It must be noted that running the business by the State can have impact on the service level. Perhaps, respondents regards 'price' as only for the major rail haulage. That is to say, all the attributes in rail, mode characteristics, service characteristics, and infrastructure are beyond the satisfactory level. It may indicate that rail transport in Myanmar is in a bad image and need to fix up on almost all dimensions to be competitive with the roadways.

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CHAPTER 6: MODELING MODAL CHOICE USING STATED CHOICE

6.1 Introduction

This chapter analyses the data obtained by means of stated preference techniques. A binary logit model is applied. The experiment is based on 27 choice sets defined by various levels of the four main attributes. It will focus on the main effects only of the attributes and their interactions effects are set aside.

6.2 Estimation and Results

6.2.1. Development of the questionnaire, presenting and data collection

Attributes and levels considerations are already discussed in Section 4.3.3. In addition, the importance factor ranking in CHAPTER 5:, the most important factors were found to be cost (price), transit time, reliability and frequency. Thus the attributes can be said to be reasonably included in the Stated Preference design. After the design has been generated as in Section 4.3.3, the linear design is converted into choice sets. An example of choice sets has been shown as below in Figure 6.1.

6.2.1.1. Pilot Testing

Before the actual collection of the data, all the DCE are pretested with 30 Shipping Management Students at the Logistics Training Centre. These students did not participate in the main data collection. They were interviewed about

- the formulation of attributes and levels that is if the attributes and levels are clear and if they had an acceptable range;
- were any important attributes lacking for the choices to be meaningful
- were any included attributes perceived not relevant when making choices
- was the task understood? Were instructions good enough?
- Were all attributes traded off for each other?
- How did the students experience the exercise: were there too many choices to make?
- Was it fun, boring, etc?

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As a result of the pilot, the formulation of some of the attributes and the attribute levels was changed to make them clearer to the respondents and to get the right level. At the first, reliability was first intended to include 'reliability in terms of delivery time window'. However, the majority of respondents stated that their perception on 'reliability' is more than delivery time window. It means loss and damage, and safety as well. So it was decided to refer 'reliability' to cover 'reliability in terms of delivery time window and service that is stated'. Moreover, some of the choice situations were explained in detail ahead of the actual participation in Stated Preference survey.

6.2.1.2. Main data collection

From them, the levels and the definitions are well understood to the respondents by the interviewer before the self-administered questionnaires are filled by the respondents. This support the respondents understand the hypothetical market situations taken into more realistic situations. The survey is conducted by using Paper and Pencil Survey. 9 choice sets are presented to a respondent.

The following are the scenarios if your cargo is shipped using domestic transport means: Road (truck) and Rail Transportation. In these scenarios, "transport cost, transit time, frequency, and reliability will all three levels are presented". Kindly make your choice in each situation shown below. (Mark in the square).

Card ID 1	**Truck**	**Rail**
Transport Cost (Kyats per mile per ton)	300	100
Transit time	3 days	3 days
Frequency	Once a week	Twice a week
Reliability	90%	90%
If I had to ship my consignment, I would choose	☐	☐

Figure 6.1 Example of a Choice Set and Scenario Presented to the Respondents

The data were collected from October 2014 to March 2015. The shippers, forwarders and

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transport operators' contact information was obtained from Yellow Pages (2014), Myanmar Beans and Pulses Association, and Myanmar Freight Forwarders Association. The direct interviews at the companies were done with after the indication to participate in the survey by phone contact. 30 responses were secured through direct interviews. Another 55 responses were collected at the Logistics Development in Myanmar Forum (December, 2014), where a number of shippers, forwarders and transport/logistics services providers attended. Among 100 attendees, 55 responses were obtained through self-administered interviews after the first session of the Forum. This has reduced the burden of logistical challenges on reaching the respondents especially the travel time required. It takes about 45 minutes to complete the questionnaire survey so respondents could return it after the end of the Forum.

6.2.1.3. Data input

First data was entered in Excel Spread Sheet. SAS package was used to estimate the model. The maximum likelihood method was used to estimate the model, with 756 random draws being made to calculate simulated likelihood. Table 6.1 shows the explanatory variables in the experimental design and their expected signs.

Table 6.1 Explanatory Variables and Expected Signs

Variable	Definition	Value	Expected Sign
Transport Cost	Total Cost (Kyats per mile/per/ton)	Continuous	-
Transit Time	Total Transit Time (in days)	Continuous	-
Frequency	Number of Departures Per Week	1=Once a week 2=twice a week 7=Daily	+
Reliability	Percentage of Delivery (time window, reliability of services)	% (continuous) 100% (Fully consistent as per stated delivery time & service); 90% (less consistent as per stated delivery time and service) 80% (lesser consistent as per stated delivery time and service)	+

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6.2.1.4. Estimation Results

The specified utility of the model estimated for this research is given by the following equation (mentioned in Section 4.3.3.2):

V_{truck} = β_0 + $\beta_{1\,truck}$* truck cost + $\beta_{2\,truck}$ * truck time +$\beta_{3\,truck}$* truck frequency + $\beta_{4\,truck}$* truck reliability + ε_{truck}

V_{rail} = $\beta_{1\,rail}$* rail cost + $\beta_{2\,rail}$* rail transit time + $\beta_{3\,rail}$* rail frequency +β_{4rail}* rail reliability + ε_{rail}

Where V_{truck} represents the utility the decision maker n assigned to using truck alternative and V_{rail} that assigned to the use of rail transportation. ε is the random component identically and independently distributed. The maximum likelihood estimation method was used to estimate the parameters.

Maximum likelihood estimation

Maximum likelihood estimation is the most commonly used procedure for the estimation of the parameters from a sample of observations. It is based on the idea that "a given sample could be generated by different populations, and is more likely to come from one population than another" (Louviere, Hensher, & Swait, 2000,p.48). The procedure is to derive the value of the parameters for which the observed sample is most likely to have occurred. The following briefly describes the method of maximum likelihood. Considering a random sample of N observations, the likelihood function of the entire sample occuring is the product of the likelihoods of the individual observations, written as

$$L = (\beta_1, \beta_2, \ldots, \beta_k) = \prod_{n=1}^{N} P_{ni}^{Yin} \; P_{nj}^{Yjn} \qquad (1)$$

Where, P_{ni} and P_{nj} are the probabilities that an individual *n* will choose mode *i* and *j* respectively

Yin is 1 if an individual *n* choose mode *i*, otherwise 0

Yjn is 1 if an individual *n* choose mode *j*, otherwise 0

$\beta_1, \beta_2, \ldots, \beta_k$ are parameter estimates

The likelihood function can be evaluated for different β and, the larger the value obtained for a particularβ, the more likely it would be considered that β represents an appropriate estimate of the parameters for the probability function for the population from which the

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sample was drawn.

Very often, it is more convenient to maximize the logarithm of the likelihood function, rather than the likelihood function itself. Thus, the function is presented as

$$\text{Maximise } L^*(\beta) = \text{Ln}\,(\text{L}(\beta)) = \sum_{n=1}^{N}[Yin \log P_{ni} + Yjn \log P_{nj}] \qquad (2)$$

The maximum of $L^*(\beta)$ can be found identification of its stationary points, through solution of the set of simultaneous equations:

$$\frac{\partial Ln}{\partial \beta_k} = \sum_{n=1}^{N}[Yin \frac{\partial P_{ni}/\partial \beta_k}{P_{ni}} + Yjn \frac{\partial P_{nj}/\partial \beta_k}{P_{nj}}] = 0 \text{ for k= 1,…,K} \qquad (3)$$

In many situations, an iterative gradient search technique is used for maximization. In SAS, Newton-Raphson method is used for a gradient search. A gradient search and the Newton-Raphson method is detailed in Louviere, Hensher, & Swait (2000, p.67).

The *goodness-of-fit model* is given by the following three measures: the log likelihood ratio test, the rho index and the adjusted rho index.

The log likelihood test confirms the overall significance of the model that subsets of the βs are significant. The generalized likelihood ratio criterion is written as

$$L^* = \max L(\omega)/\max L(\Omega)$$

Wher L^* is the likelihood ratio, max $L(\omega)$ is the maximum of the likelihood function in which K elements of the parameter space are constrained by the null hypothesis. The statistic--2ln L^* is approximately chi-squared distributed with K degrees of freedom for large samples if the null hypothesis is true. (L^* is the difference between the log-likelihood, $(\ln(0))$ of the model with all the coefficients set to zero (the null log-likelihood), and the log-likelihood ($\ln(\hat{\beta})$) of the estimated model. If the calculated value of chi-square exceeds the critical value for the specified level of confidence, the null hypothesis that the particular subsets of βs estimates equal to zero is rejected.

Another test of disaggregate modeling based on the likelihood function is the Rho-squared test. In logit model, it is termed as pseudo- R^2. In this test, a likelihood-ratio index is calculated which is analogous to R^2 in ordinary regression. This statistic can be expressed as:

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$$\rho^2 = 1 - \frac{(\ln(\hat{\beta})}{(\ln(0))}$$

In the above formula, $(\ln(\hat{\beta})$ should be a smaller negative number, such that the ratio $(\ln(\hat{\beta}) / (\ln(0))$ lie between 0 and 1. The smaller this ratio, the better the statistical fit of the model. Values of ρ^2 between 0.2 and 0.4 are considered to be indications of good model fits (Louviere, Hensher, & Swait, 2000, p.54). As cited in them, Domencich and McFadden (1975), equivalenced this range to 0.7 to 0.9 for a linear function.

However, if different models are aimed to be compared, the corrected or adjusted ρ^{-2} (Rho-bar squared) is used. This can be expressed as:

$$\rho^{-2} = 1 - \frac{(\ln(\hat{\beta}) - K}{(\ln(0)}$$

For this model, the true choice proportions are ignored assuming as if the choice or market shares are equal across the alternatives. The dependent variable is choice, where binary coding 1 for truck and o for rail is set. The overall results of the estimation are presented in Table 6.2, Table 6.3, and Table 6.4.

Table 6.2 shows the parameter estimates derived from the logit analysis for overall commodities. The model includes transport cost, transit time, frequency and reliability. Information includes the corresponding t-values, the likelihood ratio and the pseudo R^2 statistics. The number of observations is 756. The likelihood ratio of 262.39 is significant at the 0.5% level, and thus we are able to reject the null hypothesis. Pseudo R^2, here (McFadden's LRI), also shows the fit of the model. The constant here is the Alternative Specific Constant. That is to say the value of rail alternative specific constant is normalized to 0, because with J alternatives, at most J-1 alternative-specific constants can be entered, with one constant normalized to 0. In this model, it is impossible to estimate two constants in a two-alternative scenario. This is because an infinite number of values of the two constants produce the same difference and hence the same choice probabilities.

Regarding the contribution of particular variables to the overall fit, all the four variables- transport cost, transit time, frequency and reliability- turn out to be statistically significant determinants of mode choice at one per cent level. Therefore, all the four variables have an

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impact on the probability of choosing an alternative. The coefficients for transport cost and transit time are negative and significant means that we can be quite confident that the respondents will be less likely to choose truck mode as the cost increases and transit time increases while they will be more likely to choose truck as frequency and reliability increases.

Table 6.2 Estimation for overall commodities

(SAS System, The MDC Procedure; Conditional Logit Estimates)

Parameter	Estimates	Standard Error	t-Value	Approx Pr>|t|
Truck	0.5879	0.0889	6.61	<.0001
Transport Cost	-0.006778	0.000844	-8.03	<.0001
Transit Time	-0.3733	0.0412	-9.07	<.0001
Frequency	0.1466	0.0254	5.77	<.0001
Reliability	0.0321	0.007960	4.03	<.0001
No. of observations	765			
McFadden's LRI	0.2474			
Likelihood ratio	262.39			
-2Log L	1060.515			

Table 6.3 describes the coefficients estimated for the different attributes for five types of commodities considered. The pseudo R^2 values are all around 0.2 and 0.4 in all the segments. The coefficients estimated for transport cost for all commodities were significant at the one percent level. For the transit time attribute, the coefficient was not significant in the other commodity group, while the estimates were significant at one percent level for manufacturing, miscellaneous, and agriculture and at the 5 percent level for construction. Coefficient estimates for frequency are most significant at one percent level for miscellaneous and agriculture whereas that of manufacturing was significant at 5 percent level and 'other' was significant at 10 percent level. Except the estimated coefficient for reliability for manufacturing, all the parameter estimates for the rest of commodities were significant and in the expected directions. This could be due to the manufacturing industry characteristics in the country which is different from other contexts. Normally, the manufacturing goods needs faster transit time and higher reliability. The plausible explanation can be that Myanmar has been in long isolation from international markets and as

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a consequence there is narrow understanding of supply and value chains on the suppliers as well as on the consumers. Therefore, distribution and transportation are lack of international standards. Moreover, rarely very few foreign firms are investing in Myanmar. Thus there has been simply no demand for high quality service for manufacturing goods. However, taking the rapid economic development and the kind of investors the country is attracting, the demand of such business can be expected to emerge.

All the four factors seem to have impact on the choice of mode for miscellaneous commodities and agricultural group. As the miscellaneous commodities include those handled by forwarders and logistics/transport service providers, it implies that not only the cost but also the service factors comes into equal importance for freight users' mode choice decision.

Table 6.4 shows the parameter estimates based on shippers, logistics/transport service operators and forwarders. From the analysis, all the coefficients estimated were all significant and showed the expected signs. The three segments of shippers, logistics/transport service providers and freight forwarders show a high degree of broad agreement. Transit time is the most significant parameter to all three segments. This indicates that the probability of choosing road (truck) transport is less for all three segments for longer transit time, *ceteris paribus*. The lower significant levels for cost in logistics/transport service providers and in forwarders relates to the fact that most costs in the freight industry are passed on to the consumer. Cost is the most significant for the shippers at the 1 percent significant level. The higher the transport cost, the shippers are less likely to choose road transport. Reliability for logistics/transport service providers and forwarders segments are highly significant than the shippers could mean that the formers care about the service to the customers. Above all, transit time and frequency reveal the most significant at 99% for all the transportation concerned parties except 90% significance for the forwarders in frequency.

For the positive signs in frequency and reliability, each indicates, *ceteris paribus*, that the probability of choosing road transport is greater for higher frequency and reliability for all the respondent shippers, transport/logistics service providers and forwarders. The higher significance of transit time and frequency for shippers could have meant that most of the respondents from agricultural commodities seem to manage their freight to meet the demand

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at the time of peak selling.

Elasticities of choices

In order to gain further insight into freight agents' behaviour, the elasticity analysis for mode choice was calculated. Elasticity is a useful measure of sensitivity of the predicted responses of shippers/suppliers to changes in the model's explanatory variables. Direct and cross elasticities can be estimated. Direct elasticity is the percentage change in the probability of choosing a particular mode in the choice set with respect to a given percentage change in one of the attributes of that same mode. Cross elasticity however, is the percentage change in the probability of choosing a particular mode with respect to a given percentage change in one of the attributes in the utility function of a competing alternative. The elasticity of any variable Y with respect to another variable Z is $(\Delta Y/Y)/(\Delta Z/Z)$, which reduces to $\partial Y/\partial Z)(Z/Y)$ as ΔZ becomes very small. Therefor, direct point elasticities in the logit model can be written as follows:

$$E_{X_{ikq}}^{P_{iq}} = \frac{\partial P_{iq}}{\partial \mathrm{X_{ikq}}} . \frac{X_{ikq}}{P_{iq}} \qquad (4)$$

Where, $E_{X_{ikq}}^{P_{iq}}$ = the elasticity of probability of choosing mode *i* for observation *q* with respect to a change in the *k*th variable describing the utility of the *i*th mode for observation *q*.

P_{iq} = Probability of choosing mode *i* for observation *q*.

X_{ikq} = *k*th attribute describing mode *i* for observation *q*.

The direct elasticity in (equation2) may be written as

$$E_{X_{ikq}}^{P_{iq}} = P_{iq}\beta_{iq}\,(1 - P_{iq})X_{ikq}/P_{iq}$$

$$=\beta_{ik}\,X_{ikq}(1 - P_{ikq}) \qquad (5)$$

Detail derivation for the direct point elasticity estimated for each individual observation the logit model is shown in Louviere, Hensher, & Swait (2000) .

Cross point elasticity can be evaluated as follows:

$$E_{X_{jkq}}^{P_{iq}} = \frac{\partial P_{iq}}{\partial X_{jkq}} . \frac{X_{jkq}}{P_{iq}}$$

$$= -P_{iq}P_{jq}\beta_{jk}X_{jkq}$$

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$$=- \beta_{jk} X_{jkq} P_{jq} \quad (6)$$

As revealed in equation (6) the cross point elasticity is calculated for alternative *j* independent of alternative *i.* As such, the cross-point elasticities with respect to a variable associated with alternative *j* will be the same for all *i.*

The elasticities described in equation (5) and equation (6) yield elasticity for each individual decision maker. Simple calculation for sample elasticity is generally done either by utilizing the sample average X_{ik} and average estimated P_i for the direct point elasticity and X_{jk} and average estimated P_{j} for the direct cross elasticities. Another aggregation method is by "naïve pooling". However, Louviere, Hensher, & Swait (2000) warn that this method of aggregation may result in errors of up to 20% overestimations in elasticities. Thus, a preferable approach is suggested which is using the probability weighted sample enumeration (PWSE) technique. The aggregate elasticities are calculated using the following:

$$E_{X_{jkq}}^{\bar{P}_i} = \left(\sum_{q=1}^{Q} \hat{P}_{iq} E_{X_{jkq}}^{P_{iq}}\right) / \sum_{q=1}^{Q} \hat{P}_{iq} \quad (7)$$

Where, $\hat{P}_{iq}$ is an estimated choice probability, $\bar{P}_i$ refers to the aggregate probability of choice of alternative *i.*

Utilizing the weighted sample enumeration method, the elasticities of probabilities with respect to transport cost and transit time, reliability, and frequency are presented in Table 6.5and Table 6.6. Although the percentage change in probability of choosing alternatives with the change in cost and time attributes were calculated, it is worth noting that they should be taken as mere indicators of whether shippers, logistics/transport service providers and freight forwarders are more or less sensitive to variations in the attributes of mode of transport. The interpretation of the elasticity is straightforward__ for a unit per cent increase in variable, all other things held being equal, there will be a corresponding change in the share equal to the value of the elasticity. Both the signs and magnitude can be interpreted. The higher the absolute value of the elasticity relating to any variable, the more sensitive is the choice of mode to the value of that variable.

The results of the estimations of direct point elasticities with respect to all the sample,

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shippers, logistics/transport service providers and freight forwarders are presented in Table 6.5. All the estimated direct elasticities of demand for the aggregate and all freight concerned parties have shown the correct signs. For the three categories, the direct elasticities of Table 6.5 indicate that reliability is by far the most influence on shippers/suppliers mode choice and that the demand for both road and rail is highly sensitive to reliability. The cost, time and frequency are all inelastic for both modes across the respondent types. Cost has a low influence on both road and rail except a moderate influence for the rail mode for shippers. It implies that shippers using rail mode are more sensitive to unit change in cost than are truck mode users. Transit time can also be interpreted the same way but a moderate influence of time for rail for logistics/transport service providers. Frequency elasticity is very low for both modes across the three categories. Shippers using rail mode are moderately sensitive to changes in cost whereas, logistics/transport service providers using road are more sensitive to changes in reliability than changes in other attributes. Finally freight forwarders are more sensitive to changes in reliability both in road and rail mode.

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Table 6.3 Estimation results according to types of commodities

Commodities / Parameters	Manufacturing		Miscellaneous		Agricultural		Construction		Other	
	Estimates(S.E)	t-value	Estimates (S.E)	t-value	Estimates (S.E)	t- value	Estimates (S.E)	t-value	Estimates (S.E)	t-value
Truck	0.5189 (0.1744)	2.97***	0.6675 (0.1702)	3.92***	0.9248 (0.2200)	4.28***	0.5744 (0.4793)	1.20	0.6881 (0.3111)	2.21*
Transport Cost	-0.006637 (0.001629)	-4.07***	-0.004062 (0.001546)	-2.63***	-0.0123 (0.00222)	-5.52***	-0.0162 (0.005873)	-2.76***	-0.008661 (0.002988)	-2.90***
Transit Time	-0.3921 (0.0854)	-4.59***	-0.4542 (0.0827)	-5.49***	-0.4209 (0.0918)	-4.59***	-0.5953 (0.2374)	-2.51**	-0.4756 (0.1658)	-2.87
Frequency	0.1110 (0.0515)	2.16**	0.2129 (0.0503)	4.23***	0.1667 (0.0632)	2.64***	0.0631 (0.1338)	0.47	0.2365 (0.1058)	2.24*
Reliability	-0.00032 (0.002546)	-0.13	0.0750 (0.0163)	4.60***	0.1256 (0.0228)	5.51***	0.1427 (0.0524)	2.73***	0.0977 (0.0334)	2.93***
No.of Observations	189		243		207		45		81	
McFadden's LRI	0.2121		0.3022		0.4404		0.4181		0.325	
Likelihood ratio	55.58		101.8		126.38		26.085		36.499	
-2Log L	262.01		336.87		286.96		62.383		112.29	

*ρ<.1; ** ρ<.05; *** ρ<.01

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Table 6.4Estimation results according to types of respondents

Parameters	Shippers		Logistics/Transport Service Operators		Forwarders	
	Estimates (S.E)	t-value	Estimates (S.E)	t-value	Estimates (S.E)	t-value
Truck	0.5929 (0.1076)	5.51***	0.6299 (0.2498)	2.52**	0.7376 (0.2401)	3.07***
Transport Cost	-0.007845 (0.001028)	- 7.63***	-0.004097 (0.002290)	-1.79*	-0.003772 (0.002185)	-1.73*
Transit Time	-0.3624 (0.0501)	- 7.24***	-0.5348 (0.1306)	-4.10***	-0.3909 (0.1081)	-3.62***
Frequency	0.1306 (0.0308)	4.24***	0.2959 (0.0782)	3.79***	0.1368 (0.0675)	2.03**
Reliability	0.0157 (0.009516)	1.65*	0.0780 (0.02782)	3.27***	0.0784 (0.0231)	3.40***
No.of Observations	523		125		117	
McFadden's LRI	0.2443		0.3394		0.2858	
Likelihood Ratio	177.14		58.81		46.349	
-2Log L	725.03		173.29		162.2	

*ρ<.1; ** ρ<.05; ***ρ<.01

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Table 6.5 Direct Elasticities

		Cost	Time	Frequency	Reliability
Overall	Road	-03811	-0.3189	0.1378	0.8275
	Rail	-0.452	-0.3493	0.1629	0.9420
Shippers	Road	-0.449	-0.305	0.1280	0.0045
	Rail	-0.5327	-0.3378	0.0437	0.0052
LTP	Road	-0.194	-0.415	0.2317	1.7838
	Rail	-0.229	-0.4267	0.2726	1.8680
Freight	Road	-0.188	-0.2188	0.1054	1.777
Forwarders	Rail	-0.310	-0.3506	0.1349	2.0219

Table 6.6 Cross Elasticities

	Cost	Time	Frequency	Reliability
Road	0.394	0.3044	-0.1420	-0.8211
Rail	0.4129	0.3455	-0.1493	-0.8968

The cross elasticities in Table 6.6 are high for both road and rail with respect to reliability. The absolute values of all variables for the road mode are lower than for the rail mode. This means that although not huge in magnitude, a change in a certain attribute relating to the truck mode can have more influence on demand of the rail mode than the same proportionate change in the attributes of the rail mode on the demand of the truck mode.

6.3 Policy Analysis

In this section the potential impact of government intervention on modal choice, available policy scenarios with respect to deregulation and infrastructure development of road and rail in Myanmar are developed. The possible consequences of policy decisions are described based on the currently available related policy and plans.

6.3.1. Policy Development in Myanmar Context

Transport policy overview:

To make a policy overview, it is best to refer to the ADB (2012) assessment. Accordingly, the brief description of Myanmar's transport policy background is excerpted from ADB (Oct

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2012b). Myanmar transport sector failure dated backed to 1962, when the Socialist Government was started. The transport network fell sharply caused by the budgetary constraints. The infrastructure investment severely affected by the international sanctions and suspending of the international development agencies in the 1980s when the open market system was began. Despite the continuous support for investment in the transport sector by the PRC, India, and Japan, there was little investment or reform in the transport subsector agencies. Once autonomous agencies had become mere departments within their parent ministries- their revenues had to go the central treasury and budget was allocated like other government department. This has resulted in a seriously inadequate and inefficient transport system.

Extension of road and rail networks in the late 1980s based on the policy to integrate all the remote areas of the country had also unproductive and excessive due to lack of economic considerations and low quality. Many have reported that this has resulted in parts of the roads and railways which are more productive and economically important have been underfunded. Meanwhile, expensive and underutilized networks have been continuously extended. In reviewing the policy to help quantify the possible effects of policy on the variables, it is impossible to observe the effects nationwide. Thus the policies that can have effects mostly on major domestic corridor, Yangon-Mandalay are explored.

Institutional and regulatory aspects: Problems relating to road and rail transport have been described in Chapter 2. To discuss the possible consequences further illustration is made in detail in this part. One significant problem in road is its institution. Constructions are mainly done by the Public Works Department of Ministry of Construction while regulating the industry is by the Road Transport Administration Department. Also, Ministry of Border Affairs takes part in the construction and maintenance of roads and bridges in border areas. It has been pointed out that being fragmented and overlapping in institutional structure is difficult for managing and planning for the transport planning. Recently to address the lack of overall strategy, Myanmar Transport Master Plan has been drafted with the assistance of JICA.

Liberalization in road transport: In the commercial trucking sector of Myanmar, most of the vehicles have been old second hand 10-12 wheeler trucks. Entry to the market is not

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restricted. However, as the operators are small and midsize, the focus is on local and none of them cannot provide service nationwide, meaning services are not punctual and reliability is low (JIFFA, 2012). The trucks are operating with low average speed and high fuel consumption and high tear and wear of trucks and tires. With the import liberalization after 2011, the newly 22 wheelers trucks are more to enter which will increase the capacity of the fleet and more efficient. The truck fleet has increased by 34% from 2005 to 2012 (in Table 2.5). Thus cost reduction is expected. Imposing challenges to 22 wheelers is the weight limit regulations caused by the weight limits in bridges below 50 ton capacity. In addition the registered truck companies have also increased from 600 in 2012 to 797 in 2014, which is about 32% increase. Increase in supply will create more competition in the market consequently to better services for customers. Larger trucking companies will become specialize in broad-based or network services and less successful companies are likely to be driven out of business.

Private sector both national and international companies have been allowed to invest in road infrastructure in 1996. The schemes are based on BOT with long contract period of 30 to 40 years. The toll fees and other gate charges in BOT road can increase the cost of the truck operators and traffic can be lost to rail transport. Regarding deregulation, much cannot be noticed as the laws are sporadic and ad-hoc.

Infrastructure in road: After 2011, Myanmar has increasingly directed investment towards infrastructure development. Currently, the paved road length in Myanmar is 39082.52 km in 2012. Overall road length increase in 2012 compared to 1988 is figuratively about 84% (Public Works, 2012). However, more than half (55%) are stated not to be suitable for transportation. Irrespective of the 587 km long expressway on Yangon-Mandalay corridor, there cannot be a significant change in transit time due to the continued restriction of trucks on expressway. The investment lists for road and bridges construction in 2013 include the amount of USD 1926.5 million (Derived from Public Works, PPT, p.47-48).On the other hand, repair and maintenance cannot catch up with the deterioration of the roads. Thus privatization of maintenance service is also expected. Moreover, a number of infrastructure investments are planned more for the road transport than the rail transport. In 2015-2020, the required investment for road is projected as 35% of the total investment in the transport sector (JICA, 2014, p.23), for the rail 23% which are the first and the second largest percentages

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respectively of all transport sectors.

Liberalization in railways: Myanmar Railways have more problems than road transportation in terms of institution and regulations, and infrastructure. It has been the only rail operator in the country and it is state-owned. Like many other state-run railways, it has been drifted in the state subsidies and run at lost, giving low priority to customer demand. The obsolete rolling stocks, no electrified tracks, less double track rail lines and poor handling facilities have resulted in inefficient poor service condition. Although private sector participation can be seen for the passenger transport which is also a joint venture with Myanma Railways, it is not the case for freight transport, yet. Probably a plan to convert a public corporation is likely to be introduced which many countries have done for rail rationalization.

Infrastructure in rail: Recently, the important plan for rail transport is rehabilitation and modernization of Yangon-Mandalay Railway: It includes three phased improvement plan- (1): Yangon-Taung Oo (267km, 44 stations); (2) Taung Oo-Yamethin (174km, 27 stations); and (3) Yamethin-Mandalay (179km, 27 stations) and is main priority. Total Yangon-Mandalay rail length is about 640km, 98 stations. The investment is about USD 1.7 billion with loan from Japan. It can help the transit time improve by reducing the current 3-4 days to 1 day. Other upgrading projects – upgrading Mandalay-Myitkyinar track (552 km), Bago-Dawei (501km), and Yangon-Pyi (259 km) are estimated to cost USD 175.82 millions with the loan from Korea and ADB (Swe, 2013). The ongoing new railway line projects account for 632 km (591.09 miles), of which about 30% have completed. The plan covers only the trunk portion and it is long term plan. Thus the impacts of certain factors will occur in the long term only. Approximately 32% of freight wagons are 40 years old losing operating efficiency. Still the increase in accessibility is very low as the rehabilitation accounts only a part of the corridor that is about 10% of the total rail length of 5844 km. As a part of the Singapore-Kunming rail Line (SKRL), a high speed rail line used for the mostly freight transport is planned to link Kunming, China. Another railway project proposed by China is the link from Kunming, China to Kyaukphyu, Myanmar. Total length of the rail link is 868.262 km. The project is to be fully funded with the estimated cost of 20 billion USD. High-speed trains will carry up to 4,000 tons of goods running at speeds of up to 170 km per hour. The investment is BOT scheme with 50 years of contract. The link is the new route and will help reduce the transit

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time in the existing Mandalay-Muse route (450 km) about 50% and can attract traffic from truck route.

Thailand-Myanmar rail link rehabilitation includes 420km but this plan is to attract tourists. There are plans for the expansion of rolling stock and replacing wooden sleepers with precast concrete sleepers (PC sleepers). This will result in speed increase which in turn will improve faster transit time and higher frequency. Presently it is difficult to quantify the improvement as the exact plan cannot be known.

Overall, it can be seen that future infrastructure of railways and road focuses on the connecting the international links and various economic corridors. Even the Transport Master Plan is the Corridor Based Transport Infrastructure Development. Therefore, the accessibility to lower level networks will not increase that much in the short term. Anyway, it is apparent that significant investment on both road and rail system will take place in the near future and thus the changes in prices or other attributes of modes are likely to be brought about by infrastructure rather than liberalization and deregulations.

The possible consequences on Yangon-Mandalay Corridor

To quantify the whole impact of policy in terms of infrastructure is impossible as there are many limitations in data availability and rural transportation is involved. Thus the policy impacts are limited to the major freight corridor of the domestic distribution as is stated in Chapter 2, Yangon-Mandalay Corridor. Along this corridor, it has seen that transport supply has increased to 34%, and the truck companies also increased to 32%. Increase in supply will improve the services and cost will be reduced. However, the BOT schemes of the infrastructure will limit the decrease in cost for truck transport.

In terms of infrastructure, a number of infrastructure investments projects are occurring along the major freight corridor. For instance, despite of the fact that the Yangon-Mandalay 587 km long expressway was built, the truck cannot use this expressway thus the services cannot be expected to increase higher. In the near future, the highway currently using by truck between Yangon and Mandalay are planned to improve into a 4-lane highway. This will help reduce the transit time for truck. On the other hand, the rail infrastructure in this corridor is likely to be improved due to rehabilitation. The possible effects are shown in Table 6.7.

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Table 6.7 Indication of expected effects of Policy Scenarios

Policy Aspect	Cost (decrease)	Transit time (decrease)	Frequency (increase)	Reliability (increase)
Liberalization (Road)	Δ O ●	Δ	Δ	Δ
Infrastructure (Road)		O ●	O	
Infrastructure: Rehabilitation (Rail)	-	Δ O ●	Δ O ●	

Δ=low; O= moderate; ●=high

6.3.2. Sensitivity Analysis

Examining alterations in freight mode choice behaviour resulting from changes in the level of services (LOS), fares, or other attributes of a particular mode requires estimations of both demand functions and of changes in mode variables. Most well known methods are incremental elasticity analysis and pivot-point modeling. In this case, as it is not possible to establish detailed measures of level of service variables for each policy, and as the calculated aggregate elasticities from the previous section are going to be applied, incremental elasticity analysis is taken to be appropriate. We assume that this elasticity is constant (although not very likely) and that everything else remains the same. The elasticity of demand with respect to a variable is written as

$$\frac{\Delta D}{D} = \sum_{\mu} E_{\mu} \frac{\Delta Z_{\mu}}{Z_{\mu}}$$

where the left hand side of the equation is the change in demand for the mode to be achieved by a relative change in the level of service size ($\frac{\Delta Z_{\mu}}{Z_{\mu}}$)

The scenarios are quantified in Table 6.8. The impacts of liberalization are supposed to have lower effects than the infrastructure in truck. In simulating the effects, the two effects are combined so that the range from the low impact of liberalization and the high impact of infrastructure are included. In addition, ranges of changes are considered not to be too optimistic in the scenarios.

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Table 6.8 Quantified Scenarios

	Transport Cost (Decrease)	Transit Time (Decrease)	Frequency (Increase)	Reliability (Increase)
Liberalization (Truck)	5% 10% 20%	10%	10%	5%
Infrastructure (Truck)		20% 50%	20%	
Rehabilitation (Rail)		10% 20% 30%	10% 20%	

Liberalization and infrastructure investment in road transport are assumed to decrease transport cost from 5% to 20%, transit time from 10% to 50%, to increase frequency from 10% to 20% and reliability at 5%. In rail transport, only the rehabilitation effects are included, supposing the changing levels from 10%, 20% and 30% in transit time and from 10% to 20% in frequency. Assumptions are arbitrary but attempted to be logical.

In interpreting the results, it is important to note that the results are not absolute or general rather than addressing the hypothetical questions. The analysis results for the impacts of liberalization and infrastructure on truck is presented in Table 6.9.The results show that liberalization can bring the sum of share changes of 10.62% for truck at the lowest level of decrease in transport cost. At 20% decrease in cost, the total share change of truck due to liberalization can lead to 16.33%.

At the moderate level, the assumed changes due to infrastructure can lead to change in share of 9.14% for truck at 20% assumed change in level of transit time and frequency each. At the assumed 50% change in transit time caused by infrastructure alone can lead to the share change of 16% for truck transport. Combining the two impacts of liberalization and infrastructure, the sum of share increase for truck can be 26.56% in the least optimistic scenario.

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Table 6.9 Effects of Liberalization and Infastructure Scenarios

	Transport Cost	Market Share	Transit Time	Market Share	Frequency Increase	Market Share	Reliability Increase	Market Share
Liberalization (Road)	-5% -10% -20%	1.91%% 3.81%% 7.62%	-10%	3.19%	10%	1.38%	5%	4.14%
Infrastructure			-20% -50%	6.38% 15.94%	20%	2.76%		

Table 6.10 Effects of Rail Rehabilitation Scenario

	Transport Cost	Transit Time Decrease		Frequency Increase		Reliability
Rehabilitation (Rail)		10% 20% 30%	3.49% 6.99% 10.48	10% 20% 30%	1.63% 3.26% 4.89%	

The results in Table 6.10 show that at the minimum level of the changes in transit time and frequency lead to a negligible (about 5%) change in modal share. Rehabilitation is assumed not to have impact directly on the reliability. Transport cost and reliability are assumed to remain unchanged. At the assumed 30% change in transit time and frequency, the maximum share change rail can attract is about 15% only.

The scenario analysis shows that supposing the assumed conditions occurring, changes in truck share are more likely to occur than those in rail share. In truck, the possible sum of impacts brought about by liberalization is almost equal to those by infrastructure. Of all the impacts on each attribute by liberalization and infrastructure, on the other hand, the impacts of infrastructure have been assumed the most intense on impacts. This means that both regulatory measures and infrastructure plans will have impact on mode choice. Meanwhile, it must note that impacts of infrastructure tend to have stronger effects on mode choice. This may imply that constraints caused by infrastructure have more significant impacts on modal choice rather than those that are affected by regulatory aspects.

In simulating scenarios it is notable that road transport can be put into wider aspects of

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liberalization and infrastructure investment. For rail transport, only the effects of rehabilitation could be configured. This reveals that the conditions to occur changes in mode share for truck outweigh those for rail transport. Moreover, note worthy point from this configuration is that the standalone rehabilitation will not help attract market share as much as for the plan of infrastructure together with regulatory reforms.

6.4 Summary and Implications

In summary, the analysis in this part presents the findings of freight mode choice behaviour of shippers, transport/logistics service providers and freight forwarders in the freight industry of Myanmar. The study is based on the SP data collected from them. A binary logit model has been used to estimate the parameters of the attributes in the SP design. The use of the logit model appears to gain model fit. This study has disclosed relatively similar mode choice behaviour across the commodity groups. This reflects the relatively homogeneous characteristics of the freight transport of Myanmar. However, when separate models for shippers/suppliers groups are developed, the results show that there are some levels of heterogeneity across the categories with respect to mode choice between road and rail.

For the aggregated model, the variables are mostly highly significant and should therefore be considered as important factors in the modal choice between road and rail transport. As the transport cost and transit time increases, it is less likely to choose truck mode whereas as the reliability and frequency improve, it is more likely to choose truck mode. After separate models for commodities have been developed for 5 commodities, transport cost is found to be significant for all the commodities types. This result is similar to that of Pederson & Gray, (1998) that the price/cost was evaluated as the most important factor but is contradictory to the recent trend of results that the importance of rate has declined.

The possible inference can be that as the domestic transport cost is unnecessarily high partially explained by the poor infrastructure and connectivity, the cost factor influences the mode choice. Additionally, the commodities are in a way mostly cost sensitive export ones. Moreover, it must be noted again here that transport cost means the total cost. To relate from the previous section, it should not be forget that the unreasonably cheap price in rail haul alone is very likely to be contributed by being the State run entity. Higher satisfaction on

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price/ rate of rail transport, and the greater explanatory power of transport cost for all commodities have implications for the transport planner to identify the areas of services with lower total cost can be offered. However, after the different models for shippers, logistics/transport service providers and freight forwarders have been developed, transport cost for logistics/transport service providers and freight forwarders has shown lower significance at 90%. The lower significance relates to the greater tolerance in transport cost. This implies further study for whether the tolerance in cost is related to own-account vehicles and/or the long-term contract with the suppliers and/or is related to who bear the transport costs.

Transit time is highly significant to manufacturing, miscellaneous and agriculture while construction is little significant and other group is not significant at all. However, separate models for shippers, logistics/transport service providers and freight forwarders show significant for all. The plausible explanation of transit time being significant in shippers can be that being seasonal in characteristics of some products transport time seems to be important for those respondents in agricultural sector. Frequency is most significant for miscellaneous and agriculture, and at 95% for the manufacturing. In the latter separate models, shippers and logistics/transport service providers are more significant than freight forwarders with respect to frequency. Reliability is not significant at all for manufacturing. In separate models for logistics/transport service providers and forwarders, reliability significance is higher than the shippers.

Some odd results in manufacturing and agricultural sectors reflected the developing and traditional context dictated by the limited logistics and supply chain knowledge. Manufacturing goods are not time sensitive and need not be highly reliably delivered simply due to there is no demand for high-quality service. After 2010, however, the country's inviting foreign investment and active participation in regional integration would bring international standards in the transportation sector especially in the cross –border coordination plans, like GMS, ASEAN Highway, and Asian Highways. While encouraging the cost reduction measures it would be appropriate to develop strategy that foster the quality service. A review on State Run enterprises is critical and private public partnership would be a beneficial option. Knowledge about logistics and supply chain should be widened through various capacity buildings both for short and long term programs.

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The findings according to the respondent types, on the other hand, revealed that quality mode attributes are important for mode choice. While transport cost is of concern for shippers, logistics/transport service providers are of more concern to transport cost, frequency and reliability, particularly reliability. This implies that the transport users' perceptions have started to change. The importance of transportation management in the global logistics and supply chain management has been initiated together with the economic liberalizations. The country's commitment in ASEAN multimodal transport and logistics improvement and proposing multimodal transport law in recent years has signified the good sign in awareness. It presumably can bring increasing awareness and knowledge in the fields of transportation management, logistics and supply chain. Thus preparatory policy accommodating sophisticated and complex transportation management system would be highly beneficial.

The results of elasticity analysis add the understanding to mode choice, and show implications for the policy maker for the modal shift. Transport cost is found to be moderately elastic for shippers using rail. According to Nam (1992)'s finding, it reflects the characteristics of the small consignment. Although this study is not focused on the small consignment market, the finding could be inferred in this context too. Thus further study applying SP should include consignment size. Transit time's moderate elasticity for logistics/transport providers and reliability highly elastic for lotistics/transport providers and forwarders imply that rail transport in Myanmar has rooms for improvement to attract market share from road transport if competitive conditions can be created as all the attributes are of paramount for mode choice between road and rail. By 'competitive conditions', we mean all the attributes determining mode choice. Changes in mode attributes will occur when there are changes in freight transport environment. Reliability has shown to be close to elastic meaning that the possibility for modal shift through changes in reliability appears to be significant than other attributes. This implies the possibility for modal shift to focus the changes in quality measures.

Compared to road transport, many facets of rail transportation have been deteriorated in Myanmar particularly in terms of infrastructure and services. However, as each mode will exhibit certain benefits, the rail transport is to focus providing services that can be well traded-off with road option. Nowadays, Myanmar Transport Master Plan has been drafting in consultation with the experts and incorporating the results into the policy setting will be of

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beneficial for the transportation planners.

The policy analysis also reveals that the current policy measures for road outweigh those for rail transport. For the rail transport, to increase or attract market share, policy measures focusing only on infrastructure seems insufficient. Thus as is stated above, railway needs overhauling its infrastructure, regulatory and institutional aspects.

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CHAPTER 7: CONCLUSIONS AND DIRECTIONS FOR FUTURE RESEARCH

7.1 Introduction

This chapter presents the summary and conclusions of this thesis. In Chapter (1), the aims of this research are stated. Overall aim is to evaluate the factors that determine the mode selection in domestic road and rail transport of Myanmar and to achieve an improved understanding of the use of mode choice models for freight transport so that it help contribute towards the design of effective freight transport policy focusing on road and rail transport system of Myanmar. Specific objectives are described to describe and understand the nature of the freight transport system in Myanmar and its development; to perform a comprehensive literature review on mode choice studies; to establish the factors that determine the modal selection of the shippers to move their cargo; and to estimate the disaggregate model of mode choice for freight transportation in road and rail transport of Myanmar. It is believed that the principal research aims of this thesis have been achieved.

In the following sections the contributions of the research are considered in greater detail and recommendations for future research directions relevant to the findings of this thesis are also provided.

7.2 Contributions of the Research

7.2.1. Transport Geography of Myanmar

In an effort to understand the nature of the freight transport system of road and rail in Myanmar, the current transportation traffic, infrastructure and commodities types transported in road and rail has been studied. This provides the background to modal choice analysis in Chapter (5) and Chapter (6). Road transport system is found to be relatively much better than the rail system in terms of infrastructure and flexibility in supply side.

7.2.2. Literature and Methodological Review

In order to identify the research gaps and to establish guidelines for freight mode choice modeling, Chapter Three was dedicated to reviewing literature concerning the theoretical and applied aspects of modal choice modeling. From the reviews, conclusions are reached as to the ways mode choice is studied. Studies are different in focusing to identifying the factors

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that determine mode choice. It is found out that the first typology of mode choice falls under that study with respect to decision making of freight users and attempt to determine factors determining mode choice. The second typology can be said to be related to determining the influencing factors and forecasting the sensitivity of those attributes for modal share depending on the method use such as RP or SP or RP/SP etc.
After literature review, methodology and approach to the studied has been determined and described in Chapter Four.

7.2.3. Freight Transport Usage and Perceptions towards Transport Modes in Myanmar

As described in Chapter 5, to provide a comprehensive understanding to the freight transport usage and users' perceptions to transport mode of road and rail, a general analysis concerning with the attitude towards mode and their satisfaction to these two modes have been conducted. The results contribute to identifying the factors that play roles in their transport decision making.

The results of rating on the level of importance attached to the road and rail mode choice, the main attributes 'price', 'transit time', 'reliability', 'frequency', and 'loss and damage' were ranked the top most important attributes. Following these attributes were 'availability, 'connectivity' and 'product suitability' which, if categorized, are related to infrastructure. It might be an odd result compared to the others in the literature. However, it must be appreciated that local conditions particularly infrastructure can affect their decision factors.

The study on satisfaction level received from the current road and rail transport system also provide certain inferences into the situations of the current road and rail transport system. All the attributes in rail, mode characteristics, service characteristics, and infrastructure are below average satisfactory level. It may indicate that railways in Myanmar need to fix up on almost all dimensions to be competitive with the roadways.

However, since most of the study in Chapter Five is typically descriptive in nature rather than analytical, only general observations can be made from this analysis. This therefore leads to a more detailed analysis to gather an in-depth understanding of attributes in mode choice that influences the freight users' behaviour.

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7.2.4. Stated Preference Modelling and Analysis Results

In Chapter Six, estimates of attributes and their elasticities were analysed using simple discrete choice modeling based on the Stated Preference Survey. The findings reported here are for the most straightforward model. However, the values obtained reflect the perceived utilities of the shippers, transport/logistics service providers and forwarders today. These results are presented irrespective of whether they will subsequently be confirmed or qualified by follow up investigations.

The result also has noteworthy implications in terms of the potential freight of rail transportation could attract and the implementation strategy to be developed. The significance of all attributes in the aggregate model implies there are rooms for improvement in rail transport to attract market share. Meanwhile the cost is still paramount for the mode choice for all the commodities categories. A significant value of reliability and frequency for logistics/transport service providers and for forwarders dictates modal shift policies promoting rail transportation competitively with road transportation should focus on the quality aspects of the rail mode. For instance, policies should aim at removing the bad image of rail mode and adapt the policies to meet the needs of freight services.

To relate the findings of this section to the previous section, the findings can be said to be consistent. In Chapter 5, it was found out that the freight agents: shippers, logistics/transport operators and freight forwarders rated price, transit time, reliability, frequency and loss and damage as the top most important attributes in mode choice. The analysis from stated preference for all the samples also shows that these variables have an impact on mode choice between road and rail. Some levels of heterogeneity are disclosed within the respondent segments. The transport cost importance for shippers is revealed in logit model results as well as in the elasticity analysis that shippers of rail mode respond more positively to changes in transport cost. This has implications that the mode attraction strategy for rail still can focus on shipment size. On the contrary, the policy makers should be recognized that there is a change in the requirements of logistics/transport service providers and forwarders that other attributes like frequency, transit time, and reliability have become crucial for freight transportation. The implication to focus on quality aspects for mode choice from the previous logit analysis is asserted more by this finding.

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Policy analysis also reveals that rail needs to improve its freight environment such as infrastructure, regulatory and institutional aspects so that improvement in mode attributes can be seen to help attract its market share from road transport.

Overall, this study made a major contribution to the freight transport mode choice empirically in a developing country governed by the limited concern on the importance of logistics and supply chain management. Currently, regardless of increasing infrastructure investment projects, certain policy analysis and transport project evaluation like cost benefit analysis or freight demand analysis is still lacking in Myanmar. For example, in road transportation, establishing toll fees and setting weight limit rules will not be influenced by any of policy analysis. ADB (Oct 2012b) also pointed out "the government's national integration policy of extending the road and rail networks to remote areas of the country has deepened the transport challenges". Since the policy to extend those areas with little reasoning on economic incurred the high cost and economic returns and revenue potential were low. Thus this study provides a first basis for bringing policy maker's awareness towards freight transport policy and provides policy makers with the necessary tools to identify the critical areas that should be addressed by future policy action.

7.2.5. Directions for Further Studies

The objectives and results of this research suggest a number of directions for further research. Socioeconomic variables would have better explained the existence of systematic variations in the mode choice behaviour of individuals. For example, inclusion of consignment size and value, the cargo travelled distance will better explain the mode choice.

This study has limitation in fewer attributes in stated preference design and is limited to only two alternatives: road and rail. Further study should examine many more transport mode choice which includes ranges of inland water transport and multi-modal transport. More market segments also should be included with special attention to cross-modal measurements and a broader range of transport service attributes.

Significantly larger samples will be required to obtain more precise values for freight mode choice behaviour across commodities and across freight users. However, the results of this study are not only encouraging but also provide a first step for freight transport

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evaluation which has never studied before.

For more flexible and accurate model performance, the modeling should be extended to accommodating interaction effects and including more factors. Moreover, as this study is based only on logit (binary) model, a comparison with other models such as probit would be recommendable.

Stated preference method is agreed to be an appropriate method for analyzing hypothetical market situations. However, if the study is extended to forecasting demand for modal shift, revealed preference approach is preferable. Recently, studies have embraced a pooled RP and SP approached which compensate each disadvantage for freight mode choice and demand analysis. Thus in the future, this study should be extended to applying a pooled approach.

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APPENDIX 1

Questionnaire for Transport User's Survey

Section 1: General Information

Name of Establishment: ----------

Address:----------

---

1. Nature of establishment:
   1. Dependent
   2. Independent
2. Choose the best answer that best fits your job level.
   1. CEO levels
   2. Executive level
   3. Director
   4. Manager
   5. Staff
   6. Other (please specify)

   ----
3. The main business(commodities) the establishment deals with, please state:
   ----
4. Number of employee ----------
5. Please indicate the amount this establishment spends on transport per year?
   1. < USD 5000
   2. USD 5,001 and USD 10,000
   3. USD 10,001 and USD 50,000
   4. USD 50,001 and USD 80,000
   5. USD 80,001 and USD 100,000
   6. >USD 100,000

6. Please state the number of people in this firm who are concerned with transport and or distribution.
   ----
7. Please state transport decision maker in this firm?

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8. Do any transport decisions require the approval of the Board of Managing Director?
   1. Yes
   2. No

   If 'Yes' please specify

   ---

9. Is transport considered an important activity within the firm?
   1. Yes ( )
   2. No ( )
10. As a firm, do you have and revise your transport and/or logistic strategy?
   1. Continually ( )
   2. Monthly ( )
   3. Quarterly ( )
   4. Half quarterly ( )
   5. Annually ( )
   6. Irregularly ( )
   7. Never ( )

Section 2: Transport Usage

1. Please state the modes with which your consignment is usually shipped.
   1. Private Car ( )
   2. Road Truck ( )
   3. Railway Service ( )
   4. Inland waterway ( )
   5. Others ( )
2. Why do you choose this particular mode above? Please state.

   ……

   ……
3. State the average consignment size per shipment.

   ……..kg (or)/lb/(or)ton
4. State the value of consignment per shipment.

   …….USD/Kyats
5. State the weight of consignment per shipment.

   ……m3 (or)cubic feet
6. Do you always employ the same mode?
   1. Yes ( )
   2. No ( )
   3. If 'No" what is the reason for this?

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7. Do you have “Choices” for your shipment?
    1. Yes ( )
    2. No ( )

8. Who bears the cost of transport normally?
    1. Manufacturers ( )
    2. Agency ( )
    3. Wholesaler ( )
    4. Consignee ( )
    5.

9. Do you use “container” for your shipment?
    1. Always ( )
    2. Sometimes ( )
    3. Not at all ( )

10. In terms of “weight”, how do you normally ship your cargo?
    1. Full loaded (FCL) ( )
    2. Consolidated (LCL) ( )

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Section 3: Attitudes

(1) When considering the transport of your consignment, how important are the following features? Please indicate one.

	Not Important	Somewhat Important	Important	Very Important	Most Important
Reliability	1	2	3	4	5
Availability	1	2	3	4	5
Price	1	2	3	4	5
Transit Time	1	2	3	4	5
Connectivity	1	2	3	4	5
Product Suitability	1	2	3	4	5
Loss and Damage	1	2	3	4	5
Customer Information	1	2	3	4	5
Adaptability	1	2	3	4	5
Customer Friendly Attitude	1	2	3	4	5
Negotiability	1	2	3	4	5
Access to Decision Makers	1	2	3	4	5
Ease of Payment	1	2	3	4	5
Claim Processing Time	1	2	3	4	5
Frequency	1	2	3	4	5

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(2). Regarding the following respects, please rate on a scale of 1-10 with 10 being completely satisfied. (Mark the one selected)

1. Road (Truck)Transport (Myanmar)

	Not at all satisfied									**Completely satisfied**
1. Reliability	1	2	3	4	5	6	7	8	9	10
2.Availability	1	2	3	4	5	6	7	8	9	10
3.Price	1	2	3	4	5	6	7	8	9	10
4.Transit Time	1	2	3	4	5	6	7	8	9	10
5. Connectivity	1	2	3	4	5	6	7	8	9	10
6.Product Suitability	1	2	3	4	5	6	7	8	9	10
7.Loss and Damage	1	2	3	4	5	6	7	8	9	10
8.Customer Information	1	2	3	4	5	6	7	8	9	10
9.Adaptability	1	2	3	4	5	6	7	8	9	10
10.Customer Friendly Attitude	1	2	3	4	5	6	7	8	9	10
11.Negotiability	1	2	3	4	5	6	7	8	9	10
12.Access to Decision Makers	1	2	3	4	5	6	7	8	9	10
13.Ease of Payment	1	2	3	4	5	6	7	8	9	10
14.Claim Procession Time	1	2	3	4	5	6	7	8	9	10
15.Frequency	1	2	3	4	5	6	7	8	9	10

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2.Rail Transport (Myanmar)

	Not at all satisfied									Completely satisfied
1. Reliability	1	2	3	4	5	6	7	8	9	10
2.Availability	1	2	3	4	5	6	7	8	9	10
3.Price	1	2	3	4	5	6	7	8	9	10
4.Transit Time	1	2	3	4	5	6	7	8	9	10
5. Connectivity	1	2	3	4	5	6	7	8	9	10
6.Product Suitability	1	2	3	4	5	6	7	8	9	10
7.Loss and Damage	1	2	3	4	5	6	7	8	9	10
8.Customer Information	1	2	3	4	5	6	7	8	9	10
9.Adaptability	1	2	3	4	5	6	7	8	9	10
10.Customer Friendly Attitude	1	2	3	4	5	6	7	8	9	10
11.Negotiability	1	2	3	4	5	6	7	8	9	10
12.Access to Decision Makers	1	2	3	4	5	6	7	8	9	10
13.Ease of Payment	1	2	3	4	5	6	7	8	9	10
14.Claim Procession Time	1	2	3	4	5	6	7	8	9	10
15.Frequency	1	2	3	4	5	6	7	8	9	10

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Collection

BIBLIOGRAPHY

Abdelwahab, W. M. (1998). Elasticities of Mode Choice Probabilities and Market Elasticities of Demand: Evidence from Simultaneous Mode Choice/Shipment Size Freight Transport Model. *Transport Research -E , 34* (4), 257-266.

Abshire, R. D., & Premeaux, S. R. (1991). Motor carrier selection criteria: Perceptual differences between shippers and carriers. *Transportation Journal , 31* (1), 31-35.

ADB. (Oct 2012a). *Interim Country Partner Strategy:Myanmar.*

ADB. (August 2012). *Myanmar in Transition: Opportuniities and Challenges.*

ADB. (Oct 2012b). *Myanmar Transport Sector Initial Assessment.*

ADB. (2014). *Myanmar: Economy*. Retrieved February 16, 2015, from Asian Development Bank: http://www.adb.org/countries/myanmar/economy

AJTP. (2013, December). *ASEAN-Japan Transport Statistics December 2013*. Retrieved December 10, 2014, from ASEAN-Japan Transport Partnership Website: http://www.ajtpweb.org/statistics/compareasean/road_transport_2012

Arunotayanun, K. (2009). *Modelling Freight Supplier Behaviour and Response.* Doctoral Thesis submitted at the University of London.

Asian Development Bank. (2014). *Key Indicatior for the Asia and the Pacific 2014*. Retrieved January 15, 2015, from Asian Development Web site: http://www.adb.org/sites/default/files/publication/43030/ki2014_0.pdf

Asian Development Bank. (2012). *Myanmar:Transport Sector Initial Assessment.* Mandaluyong: Asian Development Bank.

Banomyong, R. (2000). Multimodal Transport Corridors in South East Asia: A Case Study Approach. *Unpublished PhD Thesis at the University of Wales* .

Ben-Akiva, M., & Lerman, S. R. (1985). *Discrete Choice Analysis: Theory and Application to Travel Demand.* Cambridge: MIT Press.

Beuthe, M., Bouffioux, C., Maeyer, J. D., Santamaria, G., Vandresse, M., & Vandaele, E. (2003). A multi-criteria analysis of stated preferences among freight transport alternatives. *ERSA 2003 Congress.* University of JYVÄSKYLÄ.

Bierlaire, M. (1998). Discrete Choice Models. *Operations Research and Decision Aid Methodologies in Traffic and Transportation Management , 166*, 569.

Blauwens, G., Vandaele, N., Voorde, E. V., Vernimmen, B., & Witlox, F. (2005). Towards a modal Shift in Freight Transport? A Business Logistics Analysis of Some Policy Measure.

Collection

Transport Reviews: A Transnational Transdisciplinary Journal , 26 (2), 239-251.

Bolis, S., & Maggi, R. (1999). Logistics strategy and transport service choices: An adaptive stated preference experiment. *34* (4), 490-504.

Boomer, G. (n.d.). Introduction to Experimental Design for Discrete-Choice Models. Retrieved from www.statwizards.com/.../Introduction%20to%20Experimental%20Design

Brooks, M. (1990). Ocean Carrier Selection Criteria in a New Environment. *Logistics and Transportation Review , 26* (4), 339-355.

Brooks, M. R., Puckett, S. M., Hensher, D. A., & Sammons, A. (2011). Understanding Mode Choice Decisions: A Study of Australian Freight Shippers. Santiago De Chile: IAME 2011 Conference.

Christian Ksoll & John Quarmby Consultants. (n.d). *Private Sector Views on Road Transport along the Yangon-Mandaly-Muse/Ruili-Kunmimg Corridor*. Retrieved January 25, 2013, from Captain Aung Web site: www.captaung.com

Consultants, O. (2014). *Myanmar Transport Masterplan.* Yangon.

Cook, P. D., Das, S., Aeppli, A., & Martland, C. (1999). Key Factors in Road-Rail Mode Choice in India: Applying the Logistics Cost Approach. *Proceedings of the 1999 Winter Simulation Conference. 2*, pp. 1280-1286. Phoenix, AZ: IEEE.

CSO. (2011). *Statistical Year Book.* Yangon: Central Statistical Organization.

Cullinane, K., & Toy, N. (2000). Identifying influential attributes in freight route/mode choice decisions: A content analysis. *Transportatio Research Part E , 36*, 41-53.

Cunningham, M. T., & Kettlewood, K. (1975). The influence of the image of suppliers on buyer behaviour in the freight transport market. *International Journal of Physical distribution and logistics management , 5*, 238-251.

CUTR. (2004). *Analysis of freight movement mode choice factors.* Florida Department of Transportation Rail Planning and Safety.

Daugherty, A. F. (1979). Freight Transport Demand Revised: A Microeconomic View of Multimodal Multicharacteristic Service Uncertainty and the Demand for Freight Transport. *Transport Research , 13B* (21), 81-288.

de Jong, G., Gunn, H., & Walker, W. (2004). National and International Freight Transport Models: an Overview and Ideas for Further Development. *Transport Reviews , 24* (1), 103-124.

DICA. (n.d.). *Data and Investment*. Retrieved May 10, 2015, from DICA:

Collection

http://dica.gov.mm.x-aas.net/

Domencich, T., & McFadden, D. (1975). *Urban Travel Demand: a Behavioural Approach.* Amsterdam:North-Holland.

Evers, P. T., Harper, D. V., & Needham, P. M. (1996). The determinants of shipper perceptions of Modes. *Transportation Journal , 36* (2), 13-25.

Feo, M., Espino, R., & Garcı´a, L. (2010). An Stated Preference Analysis of Spanish Freight Forwarders Modal Choice on the South-West Europe Motorway of the Sea. *Transport Policy , 18*, 60-67.

Ferrarini, B. (2013, January). Myanmar Trade and its Potential. *ADB Working Paper Series, No,325* .

Fowkes, A. S., & D.Tweddle. (1988). A Computer Guided Stated Preference Experiment for Freight Mode Choice. *paper present at the PTRC, 16th Summer Annual Meeting.*

Fries, N., & Patterson, Z. (2008). Carrier or Mode? - The Dilemma of Shippers' Choice in Freight Modelling. *Swiss Transport Research Conference.* monte Verita.

Gray, R. (1982). Behavioural Approaches to Freight Transport Modal Choice. *Transport Reviews , 2* (2), 161-184.

Grosso, M. (2011). Variables influencing transport mode choice: a generalized costs approach. *Working Papers SIET 2011* .

Gust Blauwens, Peter De Baere, Eddy Van de Voorde. (2002). *Transport Economics.* Antwerpen: Uitgeverij De Boeck.

Hayuth, Y. (1985). Freight Modal-Split Analysis for Air and Sea Transportation. *Logistics and Transportation Review , 21* (4), 389-402.

Hensher, D. A., Rose, J. M., & Greene, W. H. (2005). *Applied Choice Analysis.* Cambridge: Cambridge University Press.

Jeffs, V., & Hills, P. (1990). Determinants of modal choice in freight transport: a case study. *Transportation , 17*, 29-47.

JICA. (2014, July 24). *Myanmar National Transport Master Plan*. Retrieved January 3, 2015, from JICA Web site: http://www.jica.go.jp/information/seminar/2014/ku57pq00001nep1r-att/kf20140813_01_01.pdf

JIFFA. (2012, March). *ASEAN Logistics Survey Volume 5: Myanmar*. Retrieved February 20, 2014, from JIFFA Web Site: http://www.jiffa.or.jp

KMPG. (2013, May 30). *Infrastructure in Myanmar*. Retrieved October 15, 2014, from

Collection

KMPG Wed site: www.kpmg.com/MM/en/.../Documents/Infrastructure-in-Myanmar.pdf

Landcaster, K. (1966). A new approach to consumer theory. *Journal of Political Economy , 14*, 132-157.

Louviere. (1988). Conjoint analysis modelling of stated preferences: a review of theory, methods, recent developments and external validity. *Journal of Transport Economics and Policy XXII* , 93-119.

Louviere, J. (1988b). *Analysing Decision Making: Metric Conjoint Analysis.* Newbury Park: Sage Publications.

Louviere, J. J., Hensher, D. A., & Swait, J. D. (2000). *Stated Choice Mehods: Analysis and Application.* Cambridge: Cambridge University Press.

Matear, S., & Gray, R. (1993). Factors Influencing Freight Service Choice for Shippers and Freight Suppliers. *International Journal of Physical Distribution and Logistics Management , 23* (2), 25-35.

McGinnis, M. A. (1979). Shipper attitudes toward freight transportation choice: A factor analytic study. *International Journal of Physical Distribution & Materials Management , 10*, 25-34.

Ministry of Commerce. (2015). *Trade Data*. Retrieved March 9, 2015, from Ministry of Commerce Web Site: http://www.commerce.gov.mm/my/content

Murphy, P. R., Daley, J. M., & Dalenberg, D. R. (1991). Selecting links and nodes in international transportation: An intermediary's perspective. *Transportation Journal , 31* (2), 33-40.

Mwase. (1986). Models of Rail/Road Modal Split: A Tanzania Case Study. *Transportation Planning and Technology , 11* (2), 105-116.

Myint, T. A. (2013). Development of Rail Network in Myanamr. *Myanmar Transport and Logistics Summit*, (pp. Slide 45-46). Yangon.

Nam, K. C. (1997). A study on the estimate and aggregation of disaggregate models of mode choice for freight transport. *Transportation Research Part E , 33* (3), 223-231.

Nam, K. (1992). Mode Choice Analysis for Commodity Transport in Korea. *Thesis submitted for the PhD Degree in the University of Wales*, (p. 147).

Norojono, O., & Young, W. (2003). A Stated Preference Freight Mode Choice model. *Transportation Planning and Technology* , 1-1.

Pederson, E. L., & Gray, R. (1998). The transport selection criteria of Norwegian exporters.

Collection

International Journal of Physical Distribution & Logistics Management , 28, 108-120.

Picard, G., & Gaudry, M. (1998). Exploration of a box coxlogit model of intercity freight mode choice. *Transportation Research Part E: Logistics and Transportation Review , 34* (1), 1-12.

Public Works, Ministry of Construction. (2012).

Regan, A. C., & Garrido, R. A. (2002, February). Modeling Freight Demand and Shipper Behaviour: State of the Art, Future Directions. University of Califonia, Irvine, U.S.A.

Road Transport Administration Department, Ministry of Rail. (2014, March 3). *Vehicle Information*. Retrieved March 3, 2014, from Road Transport Administration Department Website: http://www.myanmarrtad.com/?q=en/article/68

Rodigue, D.-P., & Notteboom, D. (2013). *The Geography of Transport Systems*. New York: Routledge.

Rose, J. M., & Bliemer, M. C. (2004). The design of stated choice experiments: the state of practice. *Working Paper, Institute of Transport Studies.* the University of Sydney.

Shen, G., & Wang, J. (2012). A Freight Mode Choice Analysis Using a Binary Logit Model and GIS: The Case of Cereal Grains Transportation in the United States. *Journal of Transportation Technologies* , 175-188.

Shen, S., Fowkes, T., Whiteing, T., & Johnson, D. (2009). Econometric Modelling and Forecasting of Freight Transport Demand in Great Britain. *European Transport Conference.* London: Association for European Transport.

Shinghal, N., & Fowkes, T. (2002). Freight Mode Choice and Adaptive Stated Preferences. *Transportation Research Part E: Logistics and Transportation Review , 38* (5), 367-378.

Stock, J., & La Londe, B. (1977). The transportaiton mode choice decision revised. *Transportaion Journal* , 51-59.

Swait, J., Louviere, J. J., & Williams, M. (1994). A Sequential Approach to Exploiting the Combined Strengths of SP and RP data: Application to Freight Shipper Choice. *Transportation , 21*, 135-152.

Swe, N. N. (2013). Development of Rail Transportation and Implementation of Dry Ports in Myanmar. *Policy Dialogue and Workshop on Logistics between Myanmar and Japan.* Yangon.

Train, K. (2002). *Discrete Choice Methods with Simulation.* Cambridge University Press.

Train, K. (2002). *Discrete Choice Methods with Simulation.* Cambridge University Press.

UN Comtrade. (2013). 2013 International Statistics Year Book . New York.

Collection

Van Es, J. V. (1982). Transport de Marchandises _ Une Evaluation. *Table Ronde 58, CEMT.* Paris.

Vieira, L. F. (1992). The Value of Service in Freight Transportation. *Unpublished PhD Thesis at the Massachusetts Institute of Technology* .

Wang, Y., Ding, C., Liu, C., & Xie, B. (2013). An analysis of Interstate freight mode choice between truck and rail: A case study of Maryland, United States. *13th COTA International Conference of Transportation Professionals. 96*, pp. 1239-1249. Procedia-Social and Behavioural Sciences.

Whyte, J. L. (1993). The Freight Transport Market: Buyer-Seller Relationships and Selection Criteria. *International Journal of Physical Distribution & Logistics Management , 23* (3), 29-37.

Wigan, M., Rockliffe, N., Thoresen, T., & Tsolakis, D. (2000). Valuing long-haul and metropolitan freight: Travel time and reliability. *Journal of Transportation and Statistics , 3* (3), 83-89.

Wildert, S., & M.Bradley. (1992). Preference of Freight Services in Sweden. *paper presented at the Sicth World Conference in Transport Research.* Lyon, France.

Winston, C. (1983). The Demand for Freight Transportation: Models and Applications. *Transportation Research Part A , Vol 17A* (6), 419-427.

Witlox, F., & Vandaele, E. (2005). Determining the monetary value of quality attributes in freight transportation using a Stated Preference approach. *Transportation Planning and Technology , 28* (2), 77-92.

Wong, P. C. (2007). An Evaluation of the Factors that Determine Carrier Selection. *Unpublished PhD Thesis at the University of Huddersfield* .

Zhao, X., Yang, Z., Yang, Z., & Feng, Y. (2005). Study on the choice of transportation mode for regional logistics. *Proceedings of the Eastern Asia Society for Transportation Studies*, *5*, pp. 16-31.

Zlatoper, T., & Austrian, Z. (1989). Freight transportaiton demand: a survey of recent econometric studies. *Transportation , 16*, 27-46.

Collection