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CARRIER AND MODE SELECTION FOR SHIPPERS IN THE PEARL RIVER DELTA OF THE PR CHINA – A CASE STUDY OF ZHONGSHAN AND FOSHAN

Peter C Wong#, Colin Bamford*

#Department of Logistics and Maritime Studies, The Hong Kong Polytechnic University

*Department of Logistics and Hospitality Management, University of Huddersfield, UK

Introduction

Since China launched its open door policy three decades ago, the PRD in Guangdong Province has witnessed economic reforms in the late 1970s. These reforms have transformed it into one of the fastest growing areas in the world. In the early 1980s, the Special Economic Zones (SEZs) of Shenzhen and Zhuhai were established with the purposes to learn from Hong Kong and Macao due to their close geographical proximity. China would like to use SEZ as the pilot testing ground for further implementation of its open door policy. Obviously, a successful transformation of these two locations from agricultural industries into manufacturing industry became one of the prime duties of their Mayors. These SEZs had special regulations and taxation to attract foreign investments. Hence, many Hong Kong manufacturers moved into the Shenzhen SEZ nearby as well as other parts of the PRD to take advantage of cheaper land, labour and operating costs. Whilst labour intensive activities shifted to the PRD, higher value-added activities, such as management, finance, logistics, design, R&D and quality assurance remained in Hong Kong. Nowadays, The PRD economic zone is one of China's leading economic regions and a major manufacturing center.

The PRD overview

The PRD consist of nine cities, namely Guangzhou (the provincial capital), Shenzhen, Foshan, Zhuhai, Jiangmen, Zhongshan, Dongguan, four districts and counties of Huizhou and four districts and counties of Zhaoqing. Among all cities, Shenzhen has the highest GDP per capita with its focus on high end manufactured products and logistics services related to overseas consignments (see Table 1). With the increasing land costs and labour costs in the Shenzhen area, factories started moving northwestward along the Pearl River into Dongguan since early 1990s.

Cities	Land area (sq.km)	Population (mn)	GDP (RMB bn)	GDP growth (%)	Per Capita GDP (RMB)	Export (US\$bn)	Actual FDI (US\$bn)
Guangzhou	7,434	10.2	821.6	12.3	81,233	42.9	3.6
Shenzhen	1,953	8.8	780.7	12.1	89,814	179.7	4.0
Zhuhai	1,688	1.5	99.2	9	67,591	21.2	1.1
Foshan	3,848	6.0	433.3	15.2	72,975	29.0	1.8
Huizhou	11,158	3.9	129.0	11.5	33,077	18.0	1.4
Dongguan	2,465	7.0	370.3	14.0	53,285	65.6	2.4
Zhongshan	1,800	2.5	140.9	10.5	56,106	18.7	0.7
Jiangmen	9,541	4.1	128.1	10.8	30,973	9.7	0.9
Zhaoqing	14,856	3.8	71.6	14.2	18,951	2.4	0.9

Table 1: PRD Economic profile (2008)

Source: HKTDC 22-March-2010

The PRD's broad range of industries has developed into various industrial clusters. Along the East Bank of Pearl River these are electronics and IT products manufacturers while the West Bank is best known for household appliance products. Industrial clusters within a close proximity provide convenient bases to source all parts, components and accessories of a product, so that orders can be

assembled quickly. These manufacturers would seem to be benefitting from external economies of scale.

In past years, the Guangdong province government has continuously enhanced transport infrastructure and raised administrative efficiency. The rapid development of various cities in China detained a vast number of labour forces locally which makes Guangdong facing shortages of labour. These prompted Guangdong's initiative to restructure its industries. Nowadays, Guangzhou houses one of the three autos manufacturing bases in China and accounted for nearly 10% of the national total in motor vehicles production. Many world famous auto parts manufacturers are now clustered around nearby areas and have radiated into other PRD cities surrounding Guangzhou. Following the planned economic model pattern from past decades, the Guangdong province government is restructuring the industrial base of each city as follows (Table 2):

City	Industry development allocation
Guangzhou	Autos and parts, transport equipment, electrical products, electronics, chemicals, garments, textiles, business services, software, toys
Panyu*	Sports goods, textiles, garments, jewellery, toys, electric supply equipment, shipping containers
Shenzhen	Electronics, computer products, telecom products, ICs, toys, plastics, watches, clocks, oil paintings, port services, logistics, finance, printing, artificial trees
Dongguan	Electronics computers, components, peripherals, garments, furniture, shoes, toys, watches, clocks, cutlery, kitchen tools, soldering machinery, angling equipment
Huizhou	Laser diodes, digital electronics, CD-ROMs, telephones, batteries, circuit boards, precision machinery, plastics, chemicals
Zhongshan	Lighting fixtures, lamps, metal products, motorcycles, casual wear, locks, audio equipment
Foshan	Industrial ceramics, ceramic artwork, needlework, textiles, children's garments
Chencun*	Flower farming, ornamental fish, turf farming
Nanhai*	Textiles, aluminium products, motorcycles, underwear
Shunde*	Electrical appliances, woodworking, shipping containers, furniture, machinery, bicycles
Jiangmen	Textiles, garments, paper, batteries

Table 2: industrial base distribution in PRD
Source: HKTDC 22-March-2010

Industrial immigration

In addition to the relocation of industrial territory, started from 1-January 2008, China stipulated section 98 of LAW OF THE PEOPLE'S REPUBLIC OF CHINA ON EMPLOYMENT CONTRACTS 《中华人民共和国劳动合同法》 to ensure the benefits and welfare of the workers are well looked after and protected. Around the same time in 2009 the Shenzhen and Guangzhou governments have enforced the environmental policies for residential and manufacturing areas. Industries that will pollute the water (such as the Textile industry), air (such as metal melting), and noise (such as trucking and warehousing) are under annual scrutiny by the Governments. Industries that emit pollutants are required to move to a designated development location or simply move out from the Guangzhou or Shenzhen areas. Many of these industries have relocated into Zhongshan or Foshan where the local government takes a more relax attitude toward the environmental and labour restrictions.

With its geographical advantage, improving and well established port infrastructure, ports in PRD play a critical role for transporting manufactured goods within the region to abroad even as the manufacturing bases have moved further northwestward. Besides major ports such as Guangzhou Port, Yantian Port, Shekou Port and Chiwan Port of Shenzhen, river ports such as Nasha, Humen and Zhuhai are available to facilitate overseas shipments.

This paper aims to use AHP to study those shippers that have relocated their factories from Guangzhou and Shenzhen into the Zhongshan and Foshan areas and whether there are any different parameters that they will consider for their overseas shipments.

The field survey

Following the results from (Wong, Yan and Bamford 2008), the parameters for carrier selection are summarised in table 3:

Table 3: criteria for carrier selection		
Time in transit	On time performance	Shipment tracing
Meet estimated pickup & delivery	Frequency of damage/ loss	Pickup service
Delivery time	Dependability/ reliability of service	Claim settlement
Assistance in obtaining rate changes	Flexibility	Preference given to shipper
Care in handling	Transit time reliability	Transportation costs
Door-to-door transit time	Long haul performance	Consistency of service
Competitive rates	Satisfies customer	Low freight charges

A questionnaire in Likert Scale format and complied with above parameters was posted to the respondent’s office address and followed up by phone confirmation. Those interviewed were shippers selected on the same basis as the previous study. A total of thirteen questionnaires were received from the respondents after the survey period. These included those questionnaires collected over various meetings and face-to-face interviews. In the actual survey, 45 target companies were selected and the return rate of the survey was 28.8%.

Formation of factors

The formation of factors is obtained by setting the sampling adequacy to above 0.5 after it has been computed from SPSS software. When the data is measured by the Kaiser-Meyer-Olkin (KMO) statistic, sampling adequacy predicts if data are likely to factor well, based on correlation and partial correlation. The rationale behind this method is that there is a KMO statistic for each individual variable, and their sum is the KMO overall statistic. KMO varies from 0 to 1.0 and KMO overall should be 0.5 or higher to proceed with factor analysis.

In this study, seven factors are identified and each questionnaire item within each factor grouping was studied. If one questionnaire item appeared several times under different factors then the sampling adequacy of that questionnaire item was compared with its own score under different factors. The questionnaire item with lowest sampling adequacy was removed from that factor grouping. Hence, all questionnaire items will only appear once within the seven factors. By undergoing this filtering process, questionnaire items left within the factor group have a better correlated nature compared with other items within the factor group.

These selected criteria were further grouped under two main categories, namely, internal and external factors. The internal factors are concerned with the elements which are controllable by the shippers/freight forwarders and will eventually affect modal choice. External factors refer to those factors that are beyond the control of the shippers themselves and are mainly controlled by the Customs broker or freight forwarder selected for the shipment. To summarise,

- **Internal factors**
 - Shipper's reputation,
 - Cargo location ,
 - Shipper's own capabilities
- **External factors**
 - Customer service
 - Cargo handling capabilities
 - Relationship with Customs office
 - Comprehensive Global service

In the process of grouping the criteria, it was observed that the majority of practitioners considered themselves (the person in charge of the company) able to settle any problem occurring during the transit of the shipments by their own personal connections with shippers, freight forwarders and even with the Customs office. This is a common phenomenon in China within the business community. However, in this study this phenomenon has not been given as high a weighting as it should have been when building the hierarchy model. Nevertheless, it is an interesting point that further study of this type can be considered.

Analytical Hierarchy Process (AHP)

In this research, an analytical ranking process called the Analytic Hierarchy Process (AHP) was used to evaluate the linkage formats. The AHP developed by Saaty (1983,1987) provides a powerful tool that can be used to make decisions in situations where multiple objectives are present (Saaty 1983). The main theme is the decomposition by hierarchies and synthesis by finding relations through informed judgment. Saaty (1983) emphasized that to be realistic the AHP model must include and measure all variables, both important tangible and intangible, quantitatively measurable and qualitative factors. Researchers such as Song and Yeo (2004), Lirn, Hathanopoulou and Beresford (2004), and Ugboma and Ogwude (2006) have successfully carried out work in port selection studies with the AHP method and have proved that AHP is a suitable method in both subjective and objective selections.

In the general form, the AHP is a nonlinear framework carrying out both deductive and inductive thinking without the use of the syllogism. This is made possible by taking several factors into consideration simultaneously, allowing for dependence and for feedback, and making numerical tradeoffs to arrive at a synthesis or conclusion.

In attempting to include everything in the measurements, normative theories treat intangible criteria as tangibles by postulating a convenient economic scale. In this case, it means it will be difficult to minimize all intangibles in economic terms in order to give the complete acceptance. In short, AHP begins with the traditional concept of ordinal ranking to satisfy a hierarchy and advances further into numerical paired comparisons from which a ranking of the elements in each level is derived. AHP infers behavioural characteristics of judgments (inconsistency and intransitivity) from its basic framework of paired comparisons. It begins by taking situations with a known underlying ratio scale and hence known comparisons ratios, and shows how its method of deriving a scale uniquely through the eigenvector gives back the original scale, then through perturbation, the AHP shows that a derived scale should continue to approximate the original scale providing that there is high consistency. Fundamentally, AHP provides the objective mathematics to process the inescapably subjective and personal preferences of an individual or a group in making decisions (Kinoshita, 1999).

Formation of the hierarchy

The freight costs between overseas destinations and the ports in the West Bank of the Pearl River Delta, Shekou and Yantian, are assumed to be similar hence shippers do not need to consider the ocean freight between the loading ports to final destinations. The selection of transport modes for shippers, therefore, mainly focuses on the distance and cost between the factory and the port of loading at either ports in West PRD, Shekou or Yantian (table 4). Within each loading port, transport modes can be selected accordingly. Three basic modes of transport, namely sea (barge), rail and road (truck) are available at each port except in Shekou where rail is not available. Consequently, there are a total of eight alternatives available for shippers/freight forwarders to transport their cargos overseas.

Table 4 Alternatives of mode choice	
Alternatives	Description
WPR - Truck	Factory to Port in West Pearl River by truck
WPR - Rail	Factory to Port in West Pearl River by rail
WPR - Barge	Factory to Port in West Pearl River by barge
YTN - Truck	Factory to Port in Yantian by truck
YTN - Rail	Factory to Port in Yantian by rail
YTN - Barge	Factory to Port in Yantian by barge
SHK - Truck	Factory to Port in Shekou by truck
SHK - Barge	Factory to Port in Shekou by barge

WPR-Truck refers to the mode of transport from the factory to the loading port by truck to any port at the West bank of Pearl River.

WPR-Rail is possible for shippers/freight forwarders. There are scheduled departures in the region daily for shippers whose cargos are heavy and hazardous in nature.

WPR-Barge is offered by terminal operators of West bank ports. They provide daily barge services which are convenient to those shippers/freight forwarders who are faced with congested roads and who are located near to one of the West Bank ports in the PRD region.

YTN-Truck provides a direct delivery route from factories to the Yantian port. Recently, the infrastructure around the port has been upgraded from just one road and one tunnel to four roads, four tunnels and one interchange. The major highways that are connected to the Yantian port are: the Yanpai Highway; Yanba Highway; Huiyan Highway; Wutongshan Tunnel; Luosha Road—Wutongshan Tunnel and Mingzhu Interchange. With this sophisticated transport network, road transport at Yantian actually integrates the port with highways to the port and the economic hinterland of the Pearl River Delta.

YTN-Rail offers shippers/freight forwarders a service directly connected to the State-owned Rail Pingyan Railway from the port. Rail services are welcomed by shippers who have a large amount of cargo. They are highly cost-effective whilst employing highly sophisticated security systems. Furthermore, both import and export procedures involving Customs declarations and booking container space on vessels can now be handled at inland offices. Besides the Pingyan Railway, there are also the Dalang, Guangzhou – Yantian Container Rail Service and Changping, Dongguan – Yantian Container Rail Services.

YTN-Barge is a feasible option for the shippers/freight forwarders who are located close to one of the ports along the Pearl River. There is a scheduled barge operation from local barge companies that sail daily direct to Yantian port.

SHK-Truck offers a direct link between shippers' factory/warehouses to the port. Due to the topography of adjacent land close to the port area, the infrastructure connected to the port can be described as hilly and winding. With an increase in the number calling from international liner companies, trucking is a mode for shippers located nearby.

SHK-Barge offers access for shippers/freight forwarders to use their port. Dedicated South China Shuttle Barge Services has covered most of the major PRD and South China coastal ports.

The building of a hierarchy

The ultimate goal of mode selection is to achieve "Satisfaction" for the shippers/freight forwarders requirements in exporting their overseas shipments. Hence, the hierarchy of this study is indicated in the chart in Figure 1.

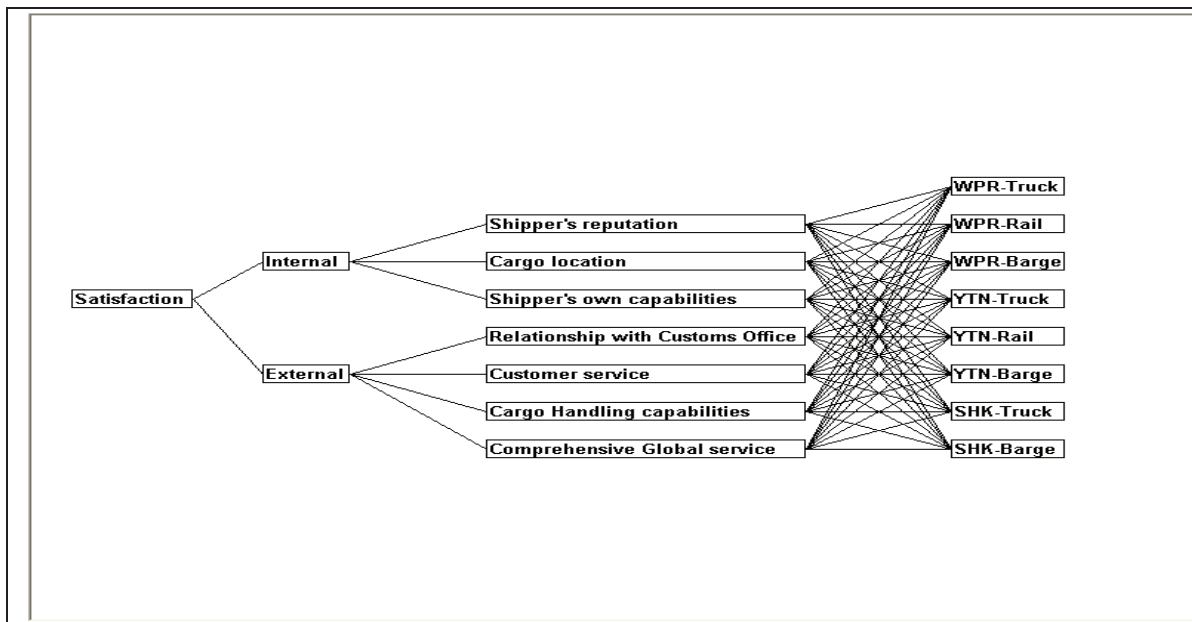


Figure 1 Basic Hierarchy structure for this study

Under this hierarchical structure, the various types of cargos will go through the selection process differently. Consequently, shippers/freight forwarders with different transit times and weekly volumes are divided into four major groups as listed in Table 5.

Table 5- Shippers with different cargo nature	
Group 1	Shippers with large weekly volume – over 6 Teus per week
Group 2	Shippers with low weekly volume – less than 2 Teus per week
Group 3	Shippers with consignment of time sensitive – such as fashion
Group 4	Shippers with consignment of no time sensitive attached – such as textile

Group 1 is assigned to Shippers with large weekly volumes. The cut-off point is set at 6 Teus per week so shipper/freight forwarders need to consider their mode choice every day.

Group 2 is assigned to shippers/freight forwarders who only have less than 2 Teus consignments per week. It is difficult for these shippers/freight forwarders to select transport modes as they must send the consignment to another freight forwarder for consolidation. The choice of transport mode will therefore be determined mainly by the freight forwarder or third parties.

Group 3 shippers are assigned to a consignment that is time sensitive and requires an urgent delivery. Usually, ports with better flexibility in terms of cargo handling will be the first choice for those shippers. Finally, Group 4 is reserved for consignments that are not time sensitive at all. Several meetings were conducted and industrial practitioners were divided and invited to provide interview information according to the above groupings.

The attendees in each group were required to do a pair wise comparison between the seven factors with respect to their own consignment's nature against weekly volume, cargo value and time sensitivity. The average time taken to complete the pairwise comparison was around 45-60 minutes. If consignments possessed two or more cargo characteristics, then shippers were required to do an extra comparison for the other cargo type. Decision Plus developed by Criterium Decision of InfoHarvest Inc. USA, was used in this survey and results were obtained direct from the software. By using the AHP software CDPlus 3.0, those attending meetings were required to go through the factor comparisons individually.

Results

The software gives the following results.

Group 1 Shippers

Shippers, who have a high weekly volume, prefer to use trucks for all loading ports in the PRD (Figure 2). WPR-Truck, SHK-Truck and YTN-Truck are the preferred choice of delivery. The alternatives then go to WPR-Barge, SHK-Barge and YTN-Barge. The WPR-Barge receives a higher ranking than the SHK-Barge due to high cargo volume that can fill up the barge easily. Rail connections receive the lowest ranking from this group of shippers.

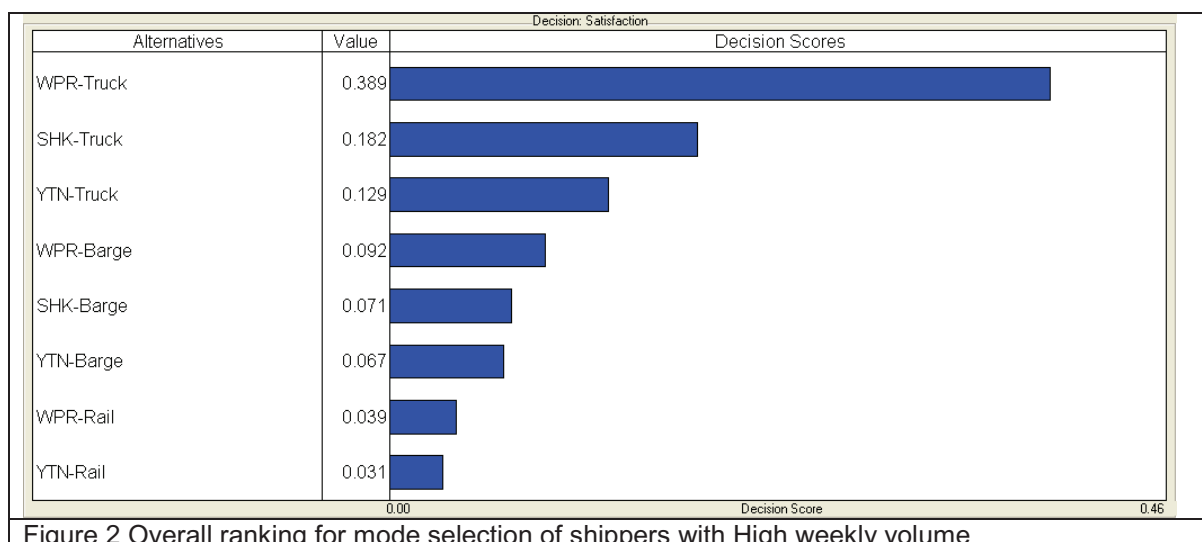


Figure 2 Overall ranking for mode selection of shippers with High weekly volume

Group 2 Shippers

Shippers who have small weekly volumes to export and require freight forwarders to provide consolidation rank WPR-Truck as their first priority. This type of cargo which is less-than-container load (LCL) will be treated as high value cargo because it is charged by Cubic Meters (CBM) instead of on a per container rate. Freight forwarders have to bring this LCL to a depot for consolidation (Figure 3).



Figure 3 Hierarchy graph for shippers with Low weekly volume

Group 3 Shippers

Figure 4 shows the results for time sensitive shipments. Trucking and barge services connected to WPR were preferred and followed by SHK-Truck and YTN-Truck. The selection of WPR-Truck and WPR-Barge is mainly due to the flexibility available for shipments that have more choice to load their cargoes at various loading ports.

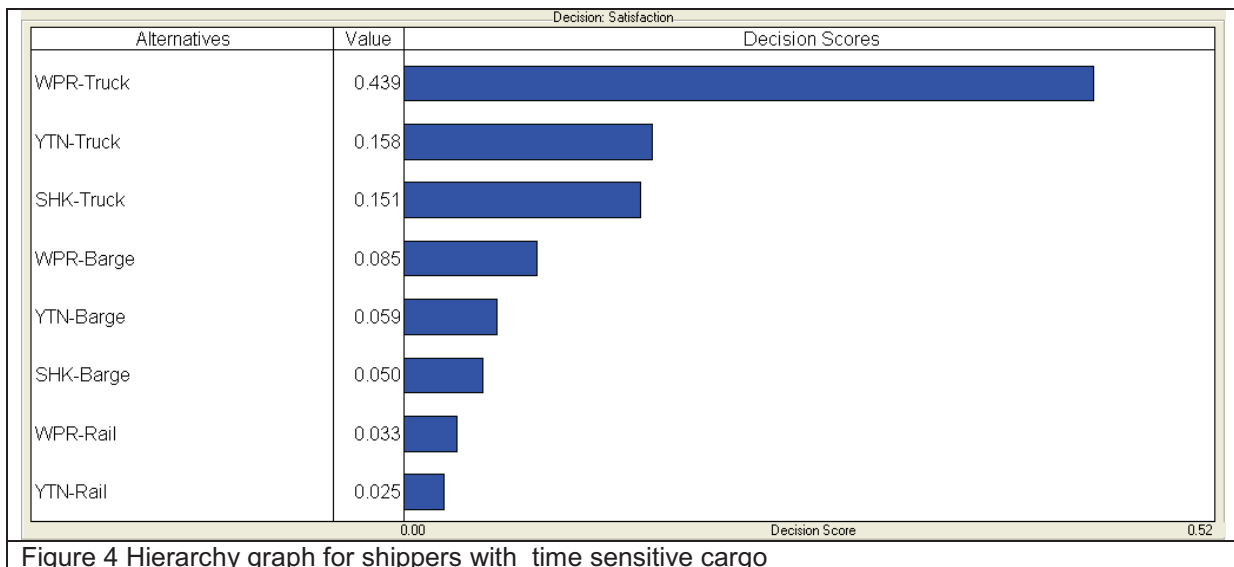


Figure 4 Hierarchy graph for shippers with time sensitive cargo

Group 4 Shippers

The overall score for non-time sensitive shipments, (see figure 5), trucking services connected to WPR, SHK and YTN scored the highest. YTN-Truck obtained a higher rank than SHK-Truck because the road connection to the YTN port was better accessed that shippers prefer using YTN even if their cargo was not time sensitive. Rail connections to all ports continue to have the lowest score in the ranking list.

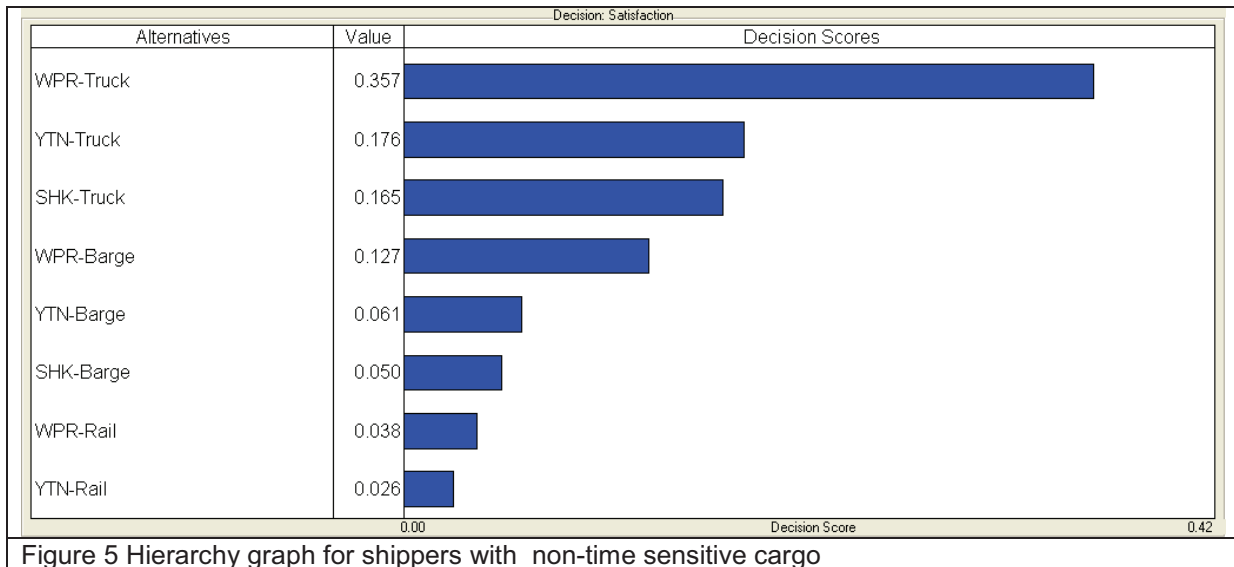


Figure 5 Hierarchy graph for shippers with non-time sensitive cargo

Summary of the findings

The results from the alternatives clearly reflect the mode choice preference of most shippers/freight forwarders after relocation of their manufacture bases in the PRD region.

Trucking is the top mode choice for any loading port in the PRD. The results obtained differ from the previous study due to better road infrastructure constructed over recent years and the better accessibility of the ports in the West Bank of the Pearl River.

Barge operations are also welcomed by shippers whose factory or depot is situated near to the river bank of the PRD or their cargo is heavy or dangerous in nature. If the cargo volume is big, then the sailing schedule becomes quite flexible as the shippers can easily fill up the barge and start sailing. Barge operation is one of the popular mode choices for shippers mainly due to terminal operators deploying dedicated barge services along the PRD ports in order to extend the catchment areas and consolidate cargoes sourced from upper stream of PRD.

Rail is not favoured by any shippers/freight forwarders mainly due to the location of the railway terminal and the fixed departure schedule of the service. Rail services are controlled by the Minister of Railways in China so shippers have to match their shipment with the published schedule.

Industries that produce heavy pollutants in the process of production moved away from the Guangdong and Shenzhen areas under the street labour and environment laws. The opening of various ports in the West Bank of the Pearl River helps them to contain their transport costs for overseas shipments. Consequently, relocation does not have many negative impacts on them. However, if they happen to relocate again in the future then they have to move inland and it will increase their operational costs for overseas shipments.

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