CHAPTER 3: LITERATURE REVIEW

3.1 INTRODUCTION

The key role of a transportation system is to assist in the production, consumption and distribution - or the supply chain - of goods and services. This means that goods must be produced and delivered to the market (or customer) in the right quantity, required quality and at competitive price. Multimodal transport could play an important role in facilitating this distribution process.

Multimodal transport as discussed in Chapter 2, can be summarised as: “the transport of goods by several modes of transport from one point or port of origin via one or more interface points to a final point or port where one of the carriers organises the whole transport process”. Multimodal transport is an efficient transport system that provides the physical operation to be carried out within the environment of a simple streamlined documentation, efficient management with effective control, a single liability system and provides a service, which is totally reliable, predictable, and fully meeting the needs of the customer. Efficient operation of transport modes and interface points resulting from reduced barriers and institutions and simplified legal regime is the condition necessary for the effective implementation of multimodal transport operation.

It is viewed that trade is not possible without transport. Support for multimodal transport operation will therefore facilitate regional and international trade by ensuring an uninterrupted and smooth flow of cargo and giving better control over the transport chain.

This chapter will review the literature relating to: (1) transport corridors; (2) international trade competitiveness and multimodal transport; (3) the question of modal selection, and (4) logistics and transport modelling. The purpose of the literature review is to provide a perspective of previous publications and studies that has been conducted as well as to illustrate relevant research areas.

3.2 TRANSPORT CORRIDORS

Trade, transportation, and development are by no means unrelated. Obviously, trade, whether within a country or overseas, is dependent largely upon the various transportation networks and corridors, on the sea, on inland waterways, across the land, or in the air (Rodrigue, 1996).

Transport systems are an expression of spatial structures (Hoyle & Knowles, 1992a). They have a form, offer distribution, and are subject to regulations. Wherever economic activities are distributed in space, transport systems create transactions supported by distribution systems (Black, 1993). This also means that whenever the economy is developing, the transactional demand will grow.

According to Peeters *et al.* (1998), the structure and regulation of the transport system are likely to be influenced by the spatial structure of the territory. Transport is one of the factors that reinforce spatial inequality by linking *a priori* the most productive places. This is because when a set of economically concentrated areas interacts at the regional level, they reinforce the regional spatial inequality of accessibility by corridors of interactions (Rodrigue, 1996).

From an economic perspective, transport corridors provide two fundamental attributes for development: lower distribution costs and land supply for diverse activities (Kessides, 1993; World Bank, 1994, Gillen & Waters, 1996). Since spatial accumulation tends to occur at productive places, when there is adequate land supply and accessibility, corridors are in that context an obvious choice of regional structure (Llanos, 1996).

The emergence of transport corridors, as a process, is the overlay in time and space of diverse modes to a point where the corridors become the structure of the region. Hoyle (1973) suggested that geographical and historical conditions create a basic set

of regional inequalities that the subsequent economic, demographic and transport developments could strengthen. Transport corridors will integrate economic activities over a territory or a region.

3.2.1 Types of transport corridors

A transport corridor is a set of routes between hub centres where maritime, fluvial, land and air transportation systems converge (Fleming, 1999). The nature of convergence in modal corridors is twofold:

First, there exist hub centre-related convergence where transhipment functions are of prime importance and settle the capacity of the distribution system (Flemming & Hayuth, 1994). This is the case of maritime, rail and air transportation and also for some parts of fluvial transportation. In those conditions, hub centres tend to have a radial influence in space.

Second, infrastructure related convergence where shipment infrastructures are the transport system's capacity constraints, like road transportation, and to some extent fluvial transportation (Loo, 1999).

The structure of corridors lies within a set of interacting hub centres where converge modal interactions. Hub centres can be classified in four modal structures: maritime, fluvial, land and air corridors.

3.2.2 Maritime Corridors

International trade and maritime transportation are closely related and enable the establishment of closer trading links between continents. There also exists an important logistic process for the operational exploitation of maritime transportation by a management of transhipment infrastructures and means of shipping. Each of these components converges in places of reduced discontinuity that correspond to littoral zones with a developed regional distribution system providing demand on maritime transportation.

Ports are often the chief facilities linking an economic system with the international market and therefore represent the main hub centres of trade (Takel, 1978). Ports are above all multimodal places and points of convergence of inland transportation (Hayuth, 1987). With the economic growth of their foreland and hinterland, an increasing demand over port system is felt. The capacity of ports to transit goods imposes a limit to economic development.

One of the strategies is therefore to enable the multimodal capacity of the port to fulfil joint demand of the foreland and hinterland with a heavy reliance on the logistics performance of the infrastructures for shipment and transhipment.

The logistics of maritime transportation have experienced important changes during the last 25 years and several ports have specialised in the concentration of transhipment activities (Hayuth, 1982; Wang, 1998). Containers ensure flexibility of shipments and several ports have opted for this multimodal transportation technology to keep and consolidate their status of hub centres. Economic transformations are restructuring the nature and pattern of maritime transportation with new demands on regions.

Hub centres thus require specialised high capacity transhipment infrastructures. However, infrastructures are not the only one dimension in port restructuring, where others like location, maritime services, and strategies pursued by maritime companies, and inland distribution system play a crucial role (Bryan, 1998).

Maritime transportation is very flexible in terms of choice of routes. However, the fixity of ports coupled with economic, political, and physical constraints between them impose the creation of maritime corridors (Pearson & Fossey, 1983). The maritime corridor is a non-discrete path between maritime hub centres, which are places of transhipment functions. The summation of those functions implies a maritime/land interface where maritime corridors are connected with fluvial and land corridors.

Considering that maritime corridors have almost an unlimited capacity, the capacity of maritime transportation is related on the transhipment capacity of ports[1]. Maritime corridors are structured by the integration of maritime services and transhipment functions to maritime distribution functions at hub centres (Frankel, 1999a).

The world has become a system of shipping networks in which individual ports are linked into intricate patterns of dependency in hub/feeder relationships as well as into end to end shipping linkages that reflect the increasing trade dependencies between regional and global economy (Robinson, 1998). The majority of regional economies have long been constrained by regulation in trade, in ports and in national and international shipping operations. They have exposed themselves to a greater or lesser degree to the demand of economic rationalism; so that over the last decade there has been a loosening of the regulatory framework, a reorientation of the interventionist roles of Governments and a more liberal view of the role of the market.

According to Frankel (1999b), the rapid growth of some regional ports provide the necessary cargo threshold conditions for inclusion in new or existing feeder or mainline networks. These ports provide new options for maritime corridor development. But in a competitive regional environment, inclusion in shipping networks has underlined the need for efficiency as well as growth; and these conditions have impacted on, and will continue to impact on management and ownership strategies ports around the world (Flemming, 1999).

Figure 3.1 depicts a schematic representation of Evergreen's round-the-world maritime service, which is a good example of a major liner strategy in providing global shipping capacity. This service thus represents one of Evergreen's main maritime corridors.

Figure 3.1 Evergreen's Round-The-World Maritime Corridor

Source: http://www.evergreen-marine.com.tw

3.2.3 Inland Waterways

An inland waterway, even if slow, offers a high capacity and a continuous flow. Ports perform the role of hub centres by providing fluvial/land and fluvial/maritime interfaces. The fluvial/land interface, often rely less on transhipment infrastructures and is thus more flexible.

Ports may seem less relevant to fluvial transportation but fluvial hub centres are experiencing a growing integration with maritime and land transportation, notably since the emergence of the container. Several industrial regions have emerged or are emerging along a major fluvial axis such as the Rhine River axe in Europe. Although

[1] See Containerisation International Yearbook 2000 for a ranking of the world's biggest ports in terms of transhipment.

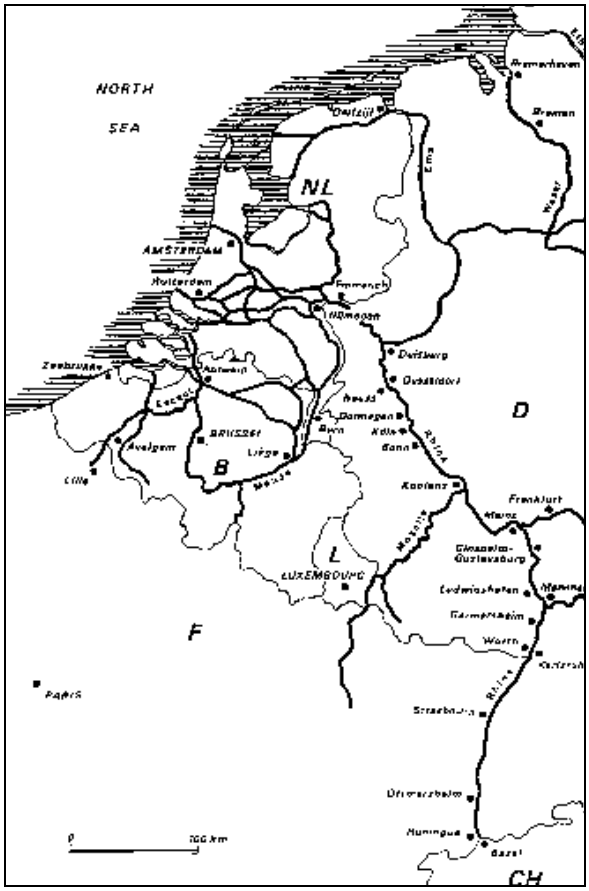
inland waterways are the oldest transportation network to be of significance still, railways and roads have overshadowed their importance.

According to Janelle and Beuthe (1997), the European Union situation relating to inland waterways corridors is instructive. While the Rhine River is open to competition, waterway traffic among the Netherlands, Belgium, and France is strictly regulated by the state or by collusive agreements among concerned parties. Rules regarding the fixing of prices, allotment of cargoes through a queuing process, and the forbidding of traffic on Sundays were intended to protect small boat owners, but they have lessened the competitiveness of European inland waterways and hinder logistics set-ups of multimodal transport corridors.

River-sea navigation is also providing a new dimension to fluvial transportation by establishing a direct interface between fluvial and maritime systems[2]. The places of convergence of fluvial transportation correspond to important waterways having access to port infrastructures and industrial regions. Charlier (1996) suggested that the prosperity of Rotterdam in the Netherlands, and Antwerp in Belgium is partly conditioned by their hinterland relationship with inland navigation, especially into the Rhine system. Presently, the Benelux countries account for some 97% of Europe's movement of maritime containers by barge (2,572,000 TEU[3]), which sector is said to be increasing by annum[4]. Figure 3.2 graphically illustrates European fluvial corridors with the main container river ports in the Rhine system.

[2] "Barges contain big business", in: *Lloyd's List Maritime Asia*, January 1999, pp. 26.
[3] "European intermodal dilemma identified", in: *Containerisation International*, July 1999, pp. 24.
[4] In the Netherlands, barges handled 35.1% of hinterland traffic in 1998 and in Belgium, the percentage was 25.1%.

Figure 3.2 The Rhine System of Inland Waterway Corridors



Source: Charlier & Ridolfi (1994)

3.2.4 Land Corridors

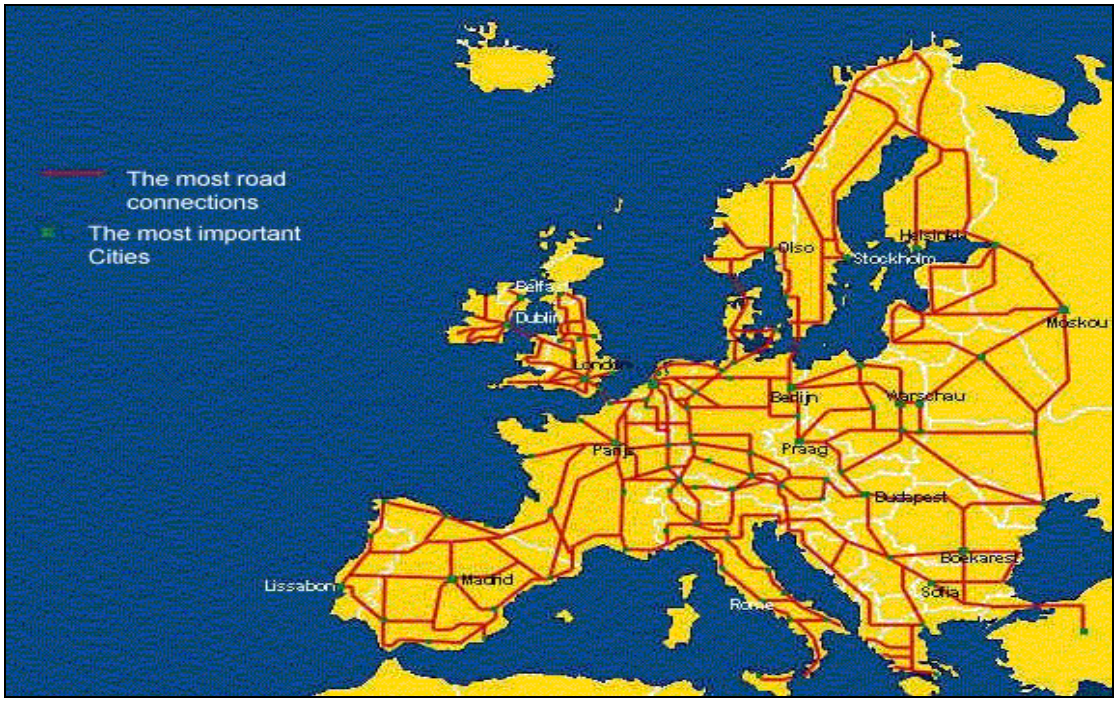
Land transportation corridors can be divided into two modes having separated but often integrated logistics: road and rail.

- ***Road***

Road transportation is by far the most flexible land transportation mode (OECD, 1992). Its importance has increased with the fragmentation of economic systems over vast territories and the growth of the light industrial sector. It handles generally small shipments between several points of origin and destination.

Road transportation, usually, provides only haulage services, except for important road haulage companies managing a fleet and providing transhipment with other modes. The corridor associated with road transportation is not limited to places adjacent to major road axes, but also to points and other facilities located within a peripheral zone. Road hub centres are crossroads where locate warehouses, truck yards and any land transportation structures. However, Black (1993) suggested that integration with other modes favour the convergence of regional road transportation towards hub centres of other modes, notably ports. Figure 3.3 illustrates the main European road corridors.

Figure 3.3 Main European Road Corridors



Source: www.port.rotterdam.nl

A key point here is that these European road corridors:

a) Funnel traffic in particular directions;
b) Concentrate traffic;
c) Stimulate growth and activity along the corridors;
d) And, are catalysts for change, for example, in the standardisation of transport documentation systems and cross border procedures.

- ***Rail***

Rail transportation offers simultaneously speed and capacity, but at the expense of flexibility. It offers an efficient interface between maritime and land transportation systems[5]. This is even truer with the appearance of containers and the impact of multimodal transportation over inland rail distribution systems. Rail logistics are highly complex and imply network management strategies under several constraints of capacity, schedule, nature of shipments, origin and destinations (Henstra & Woxenius, 1999).

Rail and road corridors in Europe are seen as the arteries of the continent and are both the focuses of very powerful policy measures. The aim of these policy measures is to "shrink" European regions, reduce the problem of peripherally and create an integrated European transport network.

The European Union is trying to implement rail corridors under the "Trans-European Rail Freeway" concept in order to boost the efficiency of European multimodal transport corridors[6]. It is a system of rail freight freeways, where services are provided in a competitive environment by all licensed EU-based railway operators, allowing for fast, frequent and predictable freight transport by rail in shuttle trains along the main trading axes (Eberhard, 1999a & 1999b).

[5] "Westport rail connected at last", in: *Containerisation International*, March 1999, pp. 31.
[6] "Kinnock flays European railways as intermodalism inches forward", in: *Freight Management International*, July/August 1998, pp. 28-29.

The freight freeway concept was launched as a concept in the early 1997 and four 'freeways' are currently in operation but with only limited success[7]:

- ***Belifret Freightway***: Connecting Antwerp, Brussels, Luxembourg with Lyon and Marseilles with connections to Turin, Milan and Gioia Tauro in Italy and the Spanish cities of Barcelona and Valencia. The service commenced in January 1998 and is provided by the national railways of each country.
- ***North-South Freightway Freeway***: Connecting Rotterdam, Hamburg, and Bremerhaven to Vienna, Milan, Brindisi and Gioia Tauro. It is also operated by national railways and started in February 1998.
- ***ScanWays***: This has been linked with the above freeway and provides direct service between Oslo, Stockholm and Gothenburg, and Austria, and Italy. It started in November 1998 and will be extended to Helsinki. This service is provided by the national railways of the respective countries.
- ***London-Sopron (Hungary) Freeway***: This links London with central and Eastern Europe. It is the result of initiatives by Rail freight Group and the European freight and Logistics Club. The start up of this service is imminent.

There are still a lot of problems regarding the implementation of rail corridors in the European Union. In the February 1999 issue of Containerisation International[8], it was said that the European rail freight business is currently characterised by:

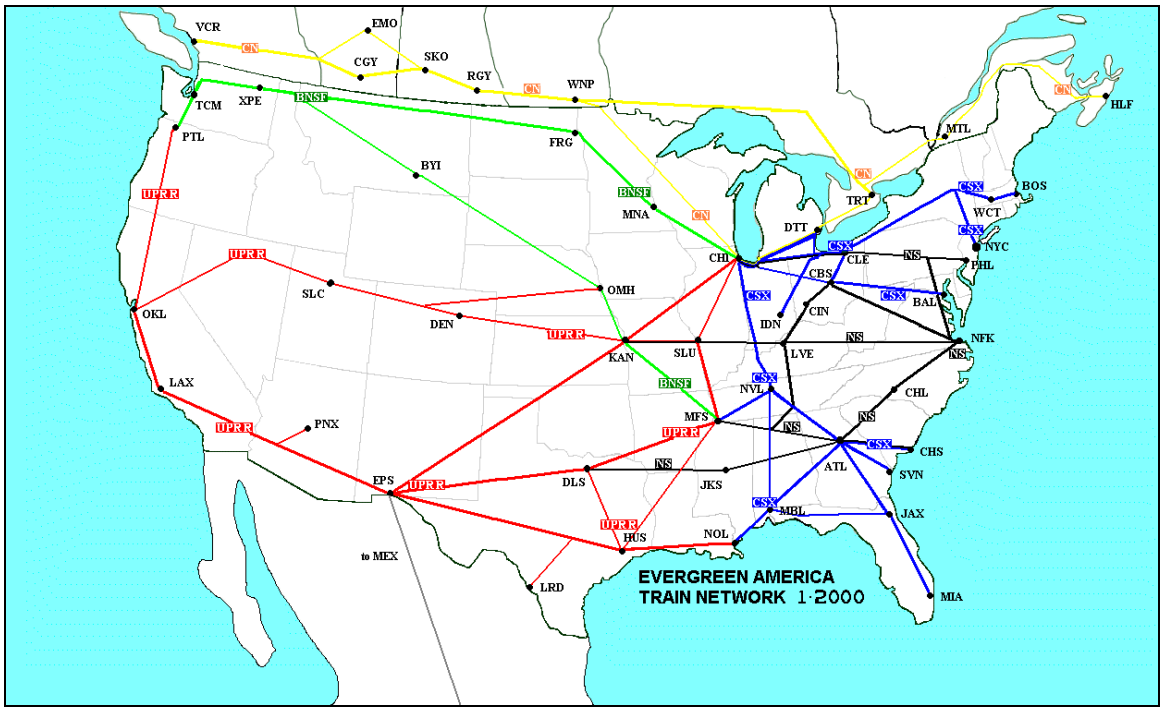
- Access charges which are too high
- Poor international pathing leading to excessive transit times and poor service quality
- Lack of priority in time tabling resulting in poor reliability

According to Baasch (1999), these are some of the main reasons why US rail corridors[9] are vastly more efficient than their European counterparts. Nonetheless, the European Commission is pursuing this 'freight freeway' policy actively.

[7] "Gearing Up", in: *Containerisation International*, February 1999, pp. 62-63.
[8] "European intermodal dilemma", in: *Containerisation International*, February 1999, pp. 35-39.

Figure 3.4 represents a network of rail corridors in the North America that is currently operated by Evergreen line. These rail corridors offer high-speed efficiency and cost-effective quality by lowering customer's landing costs in North America.

Figure 3.4 Evergreen America rail corridors (1999)



Source: www.evergreen-marine.com.tw/sp/sp15.htm

Since land transportation infrastructures are the reflection of the territorial structure, land corridors emerge between major hub centres[10]. They are notably the regional extension of a maritime/land interface where ports have access to their hinterland (Charlier & Ridolfi, 1994).

There exist land transport corridors studies related to other regions of the world but the European and North American examples presented previously are used the illustrate the high level of infrastructure and institutional development needed in order to have efficient transportation systems.

[9] "Alameda rail corridor contract awarded", in: *Containerisation International*, December 1998, pp. 31.

3.2.5 Air Corridors

Air transportation offers a fast and efficient way to link major international centres. The strategy of the majority of international airports is to consolidate regional links, create new national and international services for passenger and freight, to raise their capacity and to make land transportation systems converge towards them (O'Connor, 1995).

If an airport succeeds in positioning itself according to those criteria, it will become a point of convergence and interface at the regional and international level; an air transportation hub centre (Flemming & Hayuth, 1994). The vitality of the air transportation hub is tied to its global accessibility, thus strengthening the role of airports in economic development[11].

Flemming and Hayuth (1994) have argued on how 'centrality' and 'intermediacy' are two significant influences upon the location of a major transport hub. They also suggested that 'proximity' to large facilities in contrast to smaller ones could also be another important factor. They believe that the influence of these concepts' changes over time, and that the patterns of air corridors' changes with them.

Figure 3.5 describes the schematic evolution of air transport corridors in the world. Stage 1 represented the early development of air transport. A linear route was developed with a few major airports and smaller airports were built along the way because aircraft technology at the time only allowed for short flights. This first stage lasted until new aircraft technology overcame the need for intermediate stops.

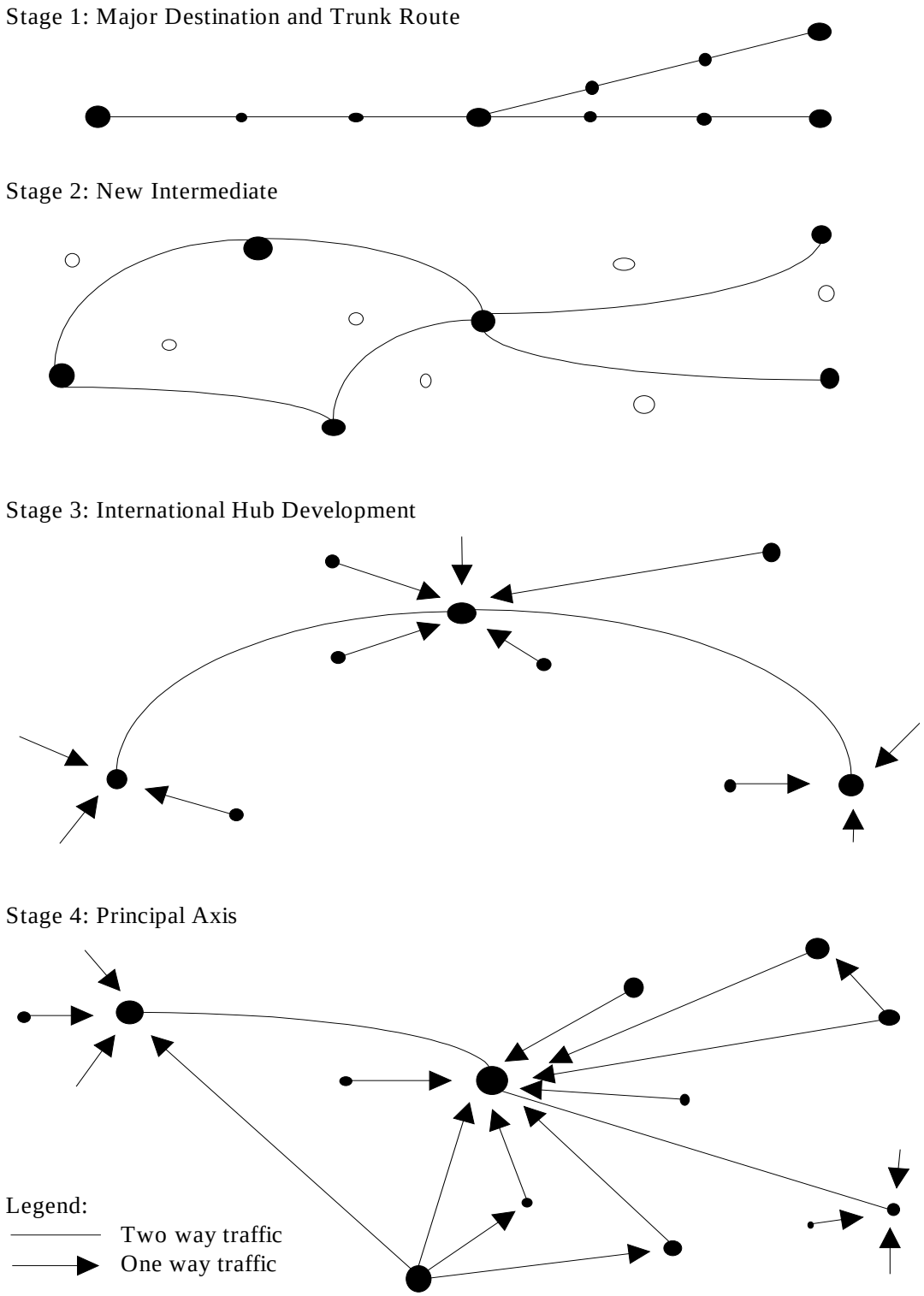
Stage 2 is the result of airports being bypassed in the 1970s. This bypass phenomenon was first felt in Southeast Asia (O'Connor, 1995), where many airlines favoured non-stop services form Europe to Bangkok (Thailand), Singapore and Hong

[10] "Industrial corridors of Seberang Prai", in: *The Star Online*, Internet Edition, 7 December 1998.
[11] "Cargo: chasing the value chain", in: *Airline Business*, November 1998, pp. 52-55.

Kong. Middle Eastern cities and the Indian Sub-continent were over-flown by the main airlines. It may have been possible to bypass Bangkok, but the growth of tourism, and the industrialisation of the Thai economy made Bangkok a destination in its own right, while its role as the last departure point prior to the long leg to Europe gave it a new dimension of intermediacy.

Stage 3 occurs when an airport has developed into a major node in the international network. This airport's significance would be reinforced by feeder services from the smaller airports in the surrounding region. In some cases this feeder traffic reduces the need for direct international services; for example, Burmese, Laotian, Cambodian and Vietnamese traffic to Europe travels first on a feeder service to Bangkok, to connect there with a carrier providing a non-stop service. In the final stage of the diagram the international hub is not only a major destination in its own right but also a central node in a new network that include new North-South axes.

Figure 3.5 The Evolution of Air Corridors



Source: Adapted from O'Connor (1995)

Depending on the economic structure and linkages within the corridor, the needs of integration of road transportation with other modes vary.

3.2.6 Multimodal transport corridors

The importance of multimodal and intermodal transportation is well established. The usage of containers shows the complementary between freight transportation modes by offering a higher fluidity to movements and standardisation of loads (Mahoney, 1985).

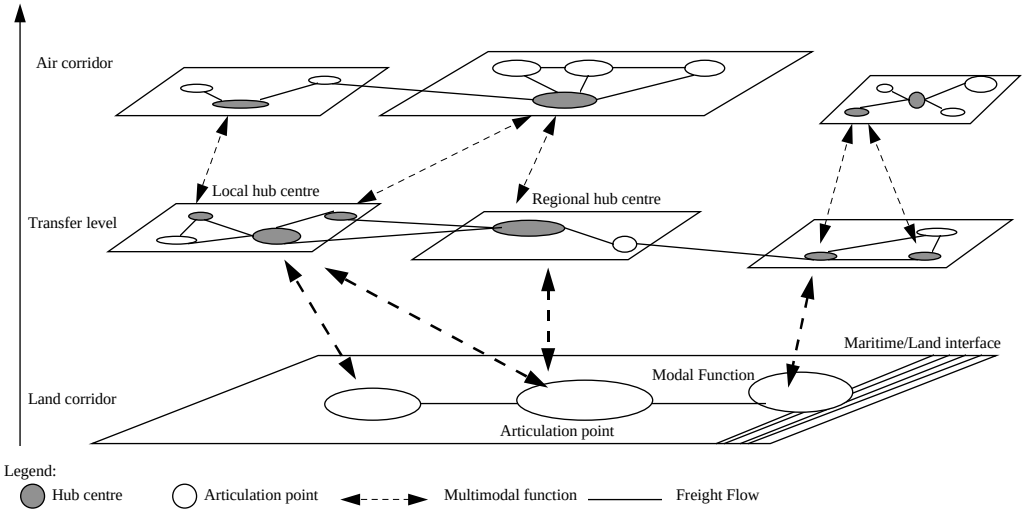
Multimodal transport enables economies of scale within a transportation system where modes are used in the most productive manner (Andersson, 1996; Huerta, 1996). Travel time and costs take a fundamental importance in the globalisation of trade and consequently in transportation.

This is even more reinforced by “just-in-time” production and “door-to-door” service that require a low inventory level and movements between several points of origin and destination. Facing those changes, industrial and transportation firms must re-evaluate their strategies for freight transportation. Those strategies must consider of all modes and all possible transfers between modes[12].

The development of new modal and multimodal infrastructures on a global scale has increased the growing accessibility to international market; several parameters of international transportation have been transformed or at least modified.

Figure 3.6 presents the movements along a corridor within a multimodal transportation system composed of a set of competing hub centres where regional and local transportation networks converge.

Figure 3.6: Generic Multimodal Transport Corridor



Source: Adapted from Rodrigue (1996)

A hub centre can simultaneously have a modal and multimodal convergence functions, particularly if it is the interface between several modal corridors. An international multimodal network converges at hub centres allowing linkages with the transportation system through a maritime /land/air interface. Hoyle (1996) suggested that ports could be the main agents of that function.

An 'articulation' point, is an interface between several modes of transport, it is a gateway. Multimodal transport reinforces the articulation point as a main transport management and value-added centre. The volume and the nature of the traffic it handles measure the importance of the articulation point (Robligio, 1996). In an international articulation point will transit important maritime, land and air traffic. It will also have an area of influence that will encompass several regional hub centres[13]. This notion of articulation point cannot be separated from port infrastructures, where a port acts as an articulation point between a foreland and a hinterland (Hayuth, 1982).

[12] OECD Conference on Intermodal Transport Networks and Logistics, Mexico City, 3-5 June 1997.

The aim of a transport system is to link economic activities, therefore supporting a number of articulation points along multimodal transport corridors (Manouch *et al.*, 1996). Multimodal transport corridors will provide an accessible penetration axis for fragmented production systems over a territory or a region. Articulation points, as gateways, will play a fundamental role in a regional economic system, especially as centres of distribution. The tendency for an articulation point is to develop and reinforce its transhipment functions between foreland and hinterland (Hayuth, 1991).

Rodrigue (1996) suggested that as long as an economic system requires the distribution in space of goods, people and information, transport and communication would play a role in the structure and regulation of countries, regions, and their transactional networks. Congestion that may appear along a transport corridor will imply higher distribution costs and even un-reliance of supply. According to Gillis and Damas (1998), this will force the findings of new alternatives and new logistics practises, which can change the regional importance of several articulation points.

3.3 INTERNATIONAL TRADE COMPETITIVENESS AND MULTIMODAL TRANSPORT

3.3.1 Background

World markets are becoming increasingly "globalised" (Krugman, 1995). To a large extent, this reflects the fact that the majority, if not all, countries are adjusting to strong trade liberalisation pressures observable around the world. This pressure stems from international trade agreements, including the World Trade Organisation (WTO), the North American Free Trade Agreement (NAFTA). There is also the development of other trading blocs like the European Union, the Association of South East Asian Nation (ASEAN), the Asia Pacific Economic Co-operation (APEC) and the growth of intra-Asian Trade. These trade policy initiatives have common objective: to open up

[13] According to Carlos Vellez, managing director of APL Mexico, the most important aspect of a good articulation point is efficient intermodal connections ("Great expectations", in: *Containerisation*

new trading opportunities by facilitating international trade. Global economic integration relies upon efficient transport (Hoyle & Knowles, 1993).

Tougher international competition and expansion of geographical markets have forced manufacturers to focus on integrated production and logistic strategies in order to reduce costs, and at the same time, to obtain higher service standard (Ellinger *et al*., 1997). The need to control the transport costs have become as important as the need to keep down other production costs (Lambert & Stock, 1993). The emergence of reliable and competitive door-to-door multimodal transport services can contribute to, and foster, new trading opportunities as well as increased competitiveness (UNCTAD, 1994a).

All integrated transport systems stem from the concept of "Through Transport" and "Through Transport System". In 1966, the Economic Development Committee for the Movement of Exports in the United Kingdom published a report on the recommendations for "Through Transport" system and its operation (HMSO, 1966). This report gave detailed perspective on how through flows of freight traffic between origin and destination could be conducted with minimum transhipment and delay. It also called for the simplification and standardisation of all shipping documents. The suggestion to simplify Customs procedure arose great interest among transport operators and carriers.

Due to the technological innovations and the container "revolution" (UNCTAD, 1993), the "through transport system" quickly changed to a "combined transport system". "Combined Transport", "Intermodal Transport" and "Multimodal Transport" are all the same as far as their operations are concerned. Multimodal transport is the official United Nations terminology relating to this type of operation. Intermodal transport is the term most widely used in North America, as American shippers have been using the term since the end of the 19th century, as well as in Europe. The term Combined transport is still in use even though there seems to be narrowing down the

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International, October 1998, pp. 73-75.)

meaning to encompass only container movements by either road-rail combination or sea-rail combination.

Multimodal transport takes advantage of the recent development in container-based transport logistics to offer better and more cost effective services for shippers. For example the efficient and rapid pace of land-side multimodal development has led to new competitive sea-rail multimodal alternatives to traditional all-water operations (Beresford, 1999a), and the level of efficiency of both conventional and double stack train services has enabled ocean carriers to achieve better utilisation of their fleet (Ashar, 1993).

Transport is no longer a major barrier to trade between developed countries. Indeed, North-North trade routes are served by a large number of continental and intercontinental transport operators, within a competitive commercial environment, based on commercially oriented trade and transport regulations. However, transport remains an impediment for the international trade of many developing countries (Leinbach, 1989). North-South and South-South trade routes are served by relatively fewer transport operators; operational conditions are less favourable; risks are higher, etc. (Robinson, 1989). For these countries, these situation results in failure to develop their international trade potential, in higher price for imports, in lower foreign exchange earnings from exports, in restricted investment and employment and, thus, in limited economic growth. Any improvement made to the present transport conditions is likely to have a very significant effect on the economies of these countries and on the prosperity of their traders (ESCAP, 1994b).

Trading opportunities can be improved by implementing transport logistics operations, by leaving the responsibility for the entire transport operation to only one trading partner, and by an appropriate legal environment, which stimulates the provision of efficient local transport services taking advantage of joint ventures (ESCAP, 1995a). By managing these potential improvements under a multimodal transport approach, synergies can be created resulting in unexpected trading

opportunities for both local traders and transport service providers to the benefit of the national economy.

Such a coherent multimodal transport approach can bring short-term benefits to local traders and transport operators, as well as long-term consistent structural changes in the transport of a country's international trade. A better awareness on the part of all concerned is probably a key element for the development of such an approach. Appropriate technical assistance in creating this awareness and implementing the necessary changes might be another (TIFFA, 1996).

As discussed by Park (1997), there has been a shift in the spatial structure of the global economy, from the West to the Pacific Rim. The global world economy is integrated in a particular international division of labour. The dynamic of uneven development is an area that needs to be taken into account, as developing countries have different level of growth and economic development.

It is therefore necessary to search for a development policy on how to sustain growth and maintain competitiveness. Sustainability and competitiveness can be achieved through the understanding of the dynamics of new spaces of productions, industrial organisation, restructuring and relationships with institutional and social regulatory forms.

In search for a compromise between production costs and trade barriers, transport and distribution related activities, which were originally considered subordinated to production, are now an integrated part of a process that starts with the collection of raw materials and ends with the distribution of the final product to the final consumer. Presently, this is referred to as supply chain management. To keep a tight control of all expenses and to preserve or improve their competitiveness, manufacturing industries searched for economies of scale in production processes and took advantage of the global potential of the division of labour (Krugman & Venables, 1995). This resulted in the spatial concentration of larger but fewer production units supplying the same or even an increased geographical market. Production is now

concentrated into highly specialised but complementary units, sometimes quite far away from each other. Multiple site manufacturing and assembly, working on reduced inventories and spanning countries and continents, is a common practice. As a consequence, shipments are becoming smaller but much more frequent, and require efficient, speedy and flexible logistical systems. Multimodal transport can efficiently service those supply chains by making them more competitive.

3.3.2 Achieving trade competitiveness

The competitiveness of internationally traded products is greatly influenced by various factors, which build up the overall logistics cost.

The main ones are:

1). Cost

The cost associated with the physical transfer of the goods is an essential piece of information in the negotiation of an international trade transaction (Carter & Ferrin, 1995; Bertazi, Sperenza & Ukovich, 1997). To maintain his product's competitiveness, the seller must make sure that his cost is as low as possible. However, on any particular trade route, this cost is made up of a number of costs' elements corresponding to the services provided along each specific link. These elements cannot always be clearly quantified beforehand:

- Some cost elements (direct costs) are directly related to service provided (United Nations, 1988). In general, they are based on published tariffs, which reflect the local market conditions, the quality of the service, and the management capacity of the service provider. These considerations depend on the state of the local infrastructure and equipment, and on the local infrastructure/equipment maintenance policy to provide reasonable transport services. They also depend on the local capacity to plan human resource

development in order to assist managers in making the best use of existing infrastructure and equipment (Leinbach & Chia, 1989).

- Other cost elements (indirect costs) are a consequence of the service provided. They build up as financial costs resulting from poor operations (low speed, unexpected delays, etc.) as additional costs (e.g. increased insurance premiums), or as "consequential costs" (e.g. sales opportunities lost because goods are not readily available) (Mwase, 1986). They reflect the efficiency of the services, the level of risk involved, and the capacity of the service providers to cope with administrative and operational problems.

2). Time

Transit time is an important element as goods in transit cost money (Allen, Mahmoud & McNeil, 1985; Blummenfeld, Burns & Diltz, 1985; Tyworth & Zeng, 1998). Any reduction in transit time would therefore reduce the overall cost of the delivered goods. Transit times can be improved by increasing transport speed while cargo is moving on any particular transport mode, and/or by reducing idle time while cargo is waiting at some interface point for its next movement. The lack of proper multimodal co-ordination of transport operations or the excessive burden of administrative and documentary requirement might neutralise any effort or investment in increasing commercial speed (ESCAP, 1995b; 1996a & United Nations, 1995).

To reduce the financial cost of their inventories, producers favour arrangements that supply the required input goods "just in time" (JIT), that is, within a short time span before the anticipated use in production or sale (Christopher, 1998). Under these conditions, time reliability is very important. An industry under tight schedule operations (JIT supply chains) cannot afford delays on delivery (Berry & Towill, 1995; Banomyong & Nair, 1998; Banomyong, *et al*. 1999).

3). Safety

Safety of goods is equally important. Any loss or damage, because of theft, mishandling, poor quantity packaging or physical damage caused by accident will result in the non-availability of the goods at the expected time and place, and in expected conditions (Branch, 1994). The financial consequences of such non-availability, in addition to the cost of loss or damage, are similar to the time reliability consequence mentioned above. Strangely enough this has been an area where transportation research is scarce but where legal opinions and proceedings have taken precedence (Verhaar, 1999).

4). Risk

Uncertainties of schedules, breakages, loss, pilferage, rules and regulations, etc., are some of the issues faced by traders and might disadvantage exporters and importers (ESCAP, 1995c & 1997).

The above mentioned considerations indicate that trading opportunities can benefit from better organised transport logistics services such as multimodal transport. To take advantage of multimodal transport in increasing their competitiveness, sellers and buyers must adapt their commercial practices, and governments must provide the transport/logistics service providers with an institutional, regulatory, and operational environment which can stimulate the application of multimodal transport systems (UNCTAD, 1990 & 1994b).

The introduction of multimodal transport (ESCAP, 1995a) in a country provides the opportunity to realise synergy from the potential improvements, which can be obtained from public and private interests: public administrations, state owned and private transport companies, importers and exporters. Multimodal transport should be seen as a system approach to trade efficiency and competitiveness, not as a turnkey system, which can be bought and installed from one day to the next.

Such a system approach calls for an integrated view of all-relevant trade and transport related issues in a country (United Nations, 1995). Governments can take a leading role in supporting this approach by designing the proper legal framework and streamlining administrative bottlenecks (Customs, banking, insurance, foreign exchange controls, etc.).

Such a multimodal transport system approach must encompass not only the economic, commercial and operational aspects of the international movement of goods, but also all issues related to the facilitation of trade and the responsibility for the goods while in transit. To take into account all interests involved in the development of multimodal transport, the relationships between transport users, services providers and governments must be clearly identified and proper co-ordination in the implementation of improvements must also be established (ESCAP, 1994; 1995a & 1996a; Jung, 1996; Wong, 1997).

Multimodal transport can provide a greater awareness of the specific modal and interface improvements by identifying physical and institutional bottlenecks along the supply chain. The development of multimodal transport will also promote the need for properly regulated transport operators. This can result in an increased level of trade competitiveness for all three key players.

Transport Users can expect the economic and financial benefits from the use of multimodal transport in the forms of the following factors:

- Reduced transit-time; increased time reliability; and increased security of cargo, particularly at interface points (Hayuth, 1987; Branch, 1994).
- Reduced transport costs (e.g. from negotiated rates on quantity cargo) and other costs (resulting from the use of modern transport related technologies: containers, EDI, etc.) (ESCAP, 1983; 1991; 1995d & 1996b; ESCAP/UNDP, 1993).
- Pre-agreed price for door-to-door transport operation (TIFFA 1998 & 1999).
- Closer commercial relationships with services providers (Ozsomer *et al.*, 1993).
- Greater awareness and understanding of transport related issues regarding their trade (trading terms, packing, insurance, banking, etc.).
- New trading opportunities from non-traditional exports, under the stimulus of improved transport services.

Service providers (UNCTAD, 1994b) can expect the following benefits:

- The boosting of their profession as international transport/logistics operators. This is particularly true for freight forwarders becoming multimodal transport operators and logistics service providers (ESCAP, 1995a; TIFFA, 1993; 1996; 1998; 1999).
- The increase of their local market shares and the opening of new market overseas, thereby increasing their profits.
- The increase in their financial liquidity through the collection of prepaid freight on containerised door to door transport contracts, providing them with key financial leverage and with the possibility of sub-contracting shipping, railway and truck space at competitive rates while controlling sub contractors' payment schedules.
- Commercial incentives to adopt new technologies such as the Internet and EDI (Vanroye & Blonk, 1998; Murphy & Daley, 1998).
- The need to reconsiders their marketing strategies, for example, for transport/logistics service providers to concentrate their activities in “niche” operations to serve specific commodities on specific trade routes (Mentzer, 1997).

Governments will also benefit from multimodal transport since it offers the opportunity to streamline and update trade and transport related administrative procedures and regulations. It also stimulates countries' trade and promotes new activities for countries' transport sector. Multimodal transport will save on (and probably earn) hard currency (ESCAP, 1995a).

3.4 MODAL CHOICE

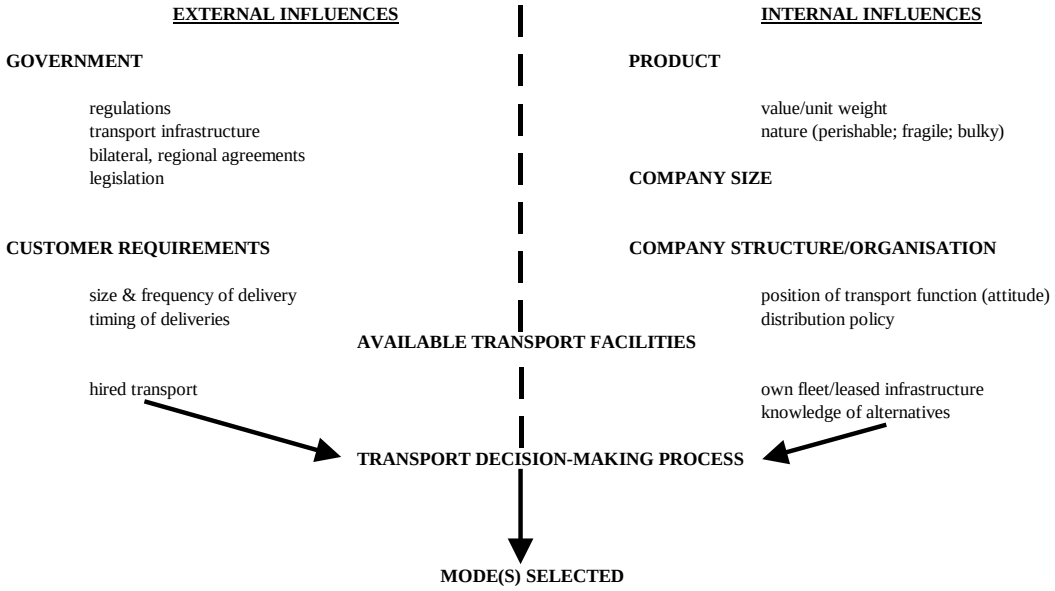
Hayuth (1992) has shown that the underlying approach to most transportation studies has been the separate treatment of individual modes and nodes of transport, such as sea transport (Drewry, 1996), sea ports (Hoyle, 1996), dry ports (Beresford & Dubey, 1990), railroads (Mwase, 1986; Jung & Beresford, 1995), inland waterways (ESCAP, 1995e), road transport (OECD, 1992 & 1996) or air transportation (O'Connor, 1995). Certain studies have been conducted on intermodal or multimodal transport (Ashar, 1993; Adjadjihoue, 1995; Jung, 1996; Wong, 1997; Woxenius, 1998) but they are still a minority in the main body of transportation and logistics research.

According to McKinnon (1989), the allocation of freight among transport modes, often called modal split, has been one of the most controversial topics in the field of transport logistics. This is because many modal choice decisions are not always based upon a full and rational appraisal of options available. Nor does a commercial approach take into account the full cost of each mode or modal services, especially in respect of external factors such as safety and environmental impact.

A country's or a region's freight modal split is influenced by a range of factors, such as size, topography, the spatial distribution of its population and industry, the density of its transportation networks, the structure of its economy and governments' policies on transport regulation, investment and taxation.

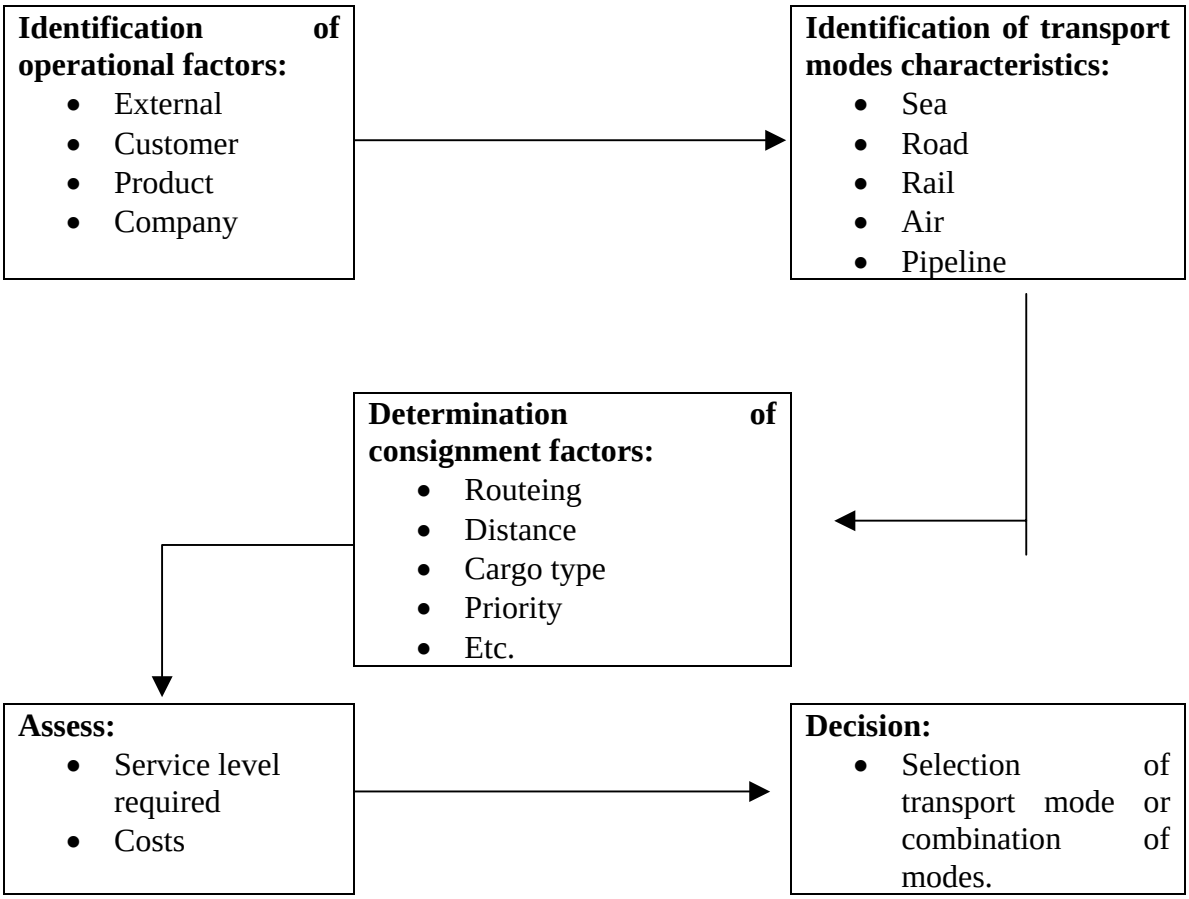
Cullinane and Toy (2000) considered that freight route and mode choice research requires the identification of major attributes, which influences these modal decisions. Figure 3.7 describes parameters that determine freight modal split. There are both external and internal influences that will impact on the transport decision-making process subject to the available transport facilities. The external influences are the regulatory framework and customers' requirements, while internal influences are based on the product and the company size and structure. Figure 3.8 presents a conceptual model of modal selection method as suggested by Rushton & Oxley (1989). Identification of various levels of influential factors must first be performed before determining the level of trade-off that is acceptable for modal choice.

Figure 3.7: Parameters determining freight modal split



Source: Adapted from Jeffs (1985)

Figure 3.8 Method of Modal Selection



Source: Modified from Rushton & Oxley (1989)

In 1982, Cunningham suggested that models of freight modal choice can be categorised into one of four areas: (1) the traditional approach, which is based upon the cost characteristics of competing modes; (2) the revealed preference approach, which utilises the observed division of traffic among modes; (3) the behavioural model, which examines the effect of the decision maker's perceptions concerning modal performance upon his choice of transport mode; and (4) the inventory-theoretic model, which attempts to predict modal choice on the basis of the total cost of shipping the product. It is interesting to note that McGinnis (1989) evaluation of freight transportation choice models did not include behavioural models, nonetheless, he asserted that the transport decision is typically affected by at least six factors: (1)

freight rates; (2) reliability; (3) transit times; (4) pilfered and damaged goods; (5) shipper market considerations, and (6) carrier considerations.

The choice of transport mode has a direct impact on the efficiency of a logistic channel. Each transport mode possesses different characteristics, different strengths and weaknesses. Depending on the mode chosen (Liberatore & Miller, 1995), the overall performance of the logistic channel will be affected. The transport decision-maker chooses the transport mode within a logistic system. Depending on his requirements, unimodal, combined, multimodal or integrated transport logistics will be utilised. The main contribution of behavioural model is the recognition of the impact of the decision-maker's perception on the modal selection decision. This is why it is important to develop behavioural models.

Gray (1982) identified three main types of behavioural models:

(1) Economic Positivism

The first one assumes that modal choice is dictated by economic cost variables. This approach is based on the neo-classical theory of the firm and hence assumes that a firm maximises its profits with full information and complete certainty and that there are no problems of organisational nature. The essence of the economic positivist approach is that the decision-making unit-assumed to be the firm-attempts to maximise short-term revenue and/or minimise short-term costs in trading situation where transport is a central element.

(2) Technological Positivism

The second type of model assumed that modal choice is based on relationships between physical aspect of the transport system (e.g. speed, frequency) and physical aspects of the product (e.g. perishability, value-weight ratio). This is known as the technological positivist approach, where in this approach freight rates and other costs

have no special place and are simply seen as one of many variables, which may explain transport choices.

(3) Perceptual Approach

The perceptual approach is similar to the technological approach but is different by assuming that the independent variables influencing choice are determined by the transport user's subjective perception of the situation rather than by objective measurements. This approach treats transport as a product purchased like any other product. Gilmour (1976); Hayuth (1985); Mwase (1986); Jeffs & Hills (1990); D'Este (1992); Evers *et al.* (1996), and Banomyong & Beresford (2000) are good examples of the perceptual approach.

Gilmour (1976) analysed the modal choice of distribution and transport managers for freight movement between Melbourne and Sydney. He examined the attitudes of shippers towards modal choices based upon their perception of particular modes of transport offered. He discovered that cost factor was the highest. But in 1985, Hayuth, in a separate study, found that the delivery time factor was the most important. Mwase (1986) argues that although the least cost mode may seems to be the preferred factor, the most realistic mode choice is the one that takes into account other types of services that may be offered by a particular mode of transport.

Jeffs and Hills (1990) studied behavioural model for freight transport modal choices and discovered that many variables appeared to exert an influence on the modal choice decision making processes, namely: customer requirements; product characteristics; company structure and organisation; government interventions; available transport facilities; and decision makers' own perception.

In 1992, D'Este developed a behavioural framework to represent the various stages in the decision-making process and the interaction of factors that influenced shipping managers when selecting carriers in the Ro/Ro ferry trade between Melbourne and Tasmania in Australia. The study also discovered that most respondents has

developed intuitive selection techniques and found it very difficult to analyse and explain how their choices were made.

Decision-makers' own perception can determine whether or not a particular mode will be used. This overall perception was found, by Evers *et al.* (1996), to be driven largely by six perception factors: timeliness, availability, firm contact, suitability, restitution [compensation], and cost. Hence, as a decision-maker's perception of these six individual factors associated with a particular mode improves, the decision-maker's overall perception of the mode should improve, and the likelihood of that mode being used should also increase.

The majority of modal choice models adhere strictly to one of these doctrines but this does not mean that hybrid models are not possible. Hybrid models may be needed for the application of different approach to different aspects of the modal choice process. The essential difference between the three approaches lies in the central unit of analysis: the economic positivist approach concentrates on the firm; the technological positivist approach concentrates on the consignment and the perceptual approach is primarily concerned with the individual decision-maker.

The performance of a particular mode of transport influences the effectiveness of the logistics system. The process of selecting the appropriate mode is dependent upon a variety of service attributes (Kent & Parker, 1998). Pedersen and Gray (1998) examined transport selection criteria in the case of Norway. Norway has some very distinctive features such as a very strong export dependency with a small home market, a peripheral location, and an extreme topography. It was also found that the use of transport modes is clearly affected by the type of product transported and the availability of modes.

3.5 LOGISTICS AND TRANSPORT MODELLING

In a speech delivered at *Intermodal 98*, Klaus Gieson, head of central corporate development with Thyssen Hassen, said that transport today is all about logistics. Service providers need to think more in terms of producing total transport solutions, rather than the provision of one or two links in the chain.

Multimodal transport has forced a reconsideration of the traditional unimodal approach to transportation and logistics (Raguraman & Chan, 1994). Policy may implement multimodal transport but it is the transport decision-maker that will make the choice of transport mode in a logistics system. Depending on his requirements, unimodal or multimodal transport will be utilised.

This is particularly true for exporters who retain control of the transport function, as they will be faced with a wide range of modal options. Many international movements involve the use of more than one transport mode. McKinnon (1989) listed the factors influencing the choice of international physical distribution for exporters (see Table 3.1). These factors vary between foreign markets so it is common for firms to employ different logistics systems in different countries. Several logistics systems may also be used to serve a single foreign market.

Table 3.1: Factors influencing international physical distribution

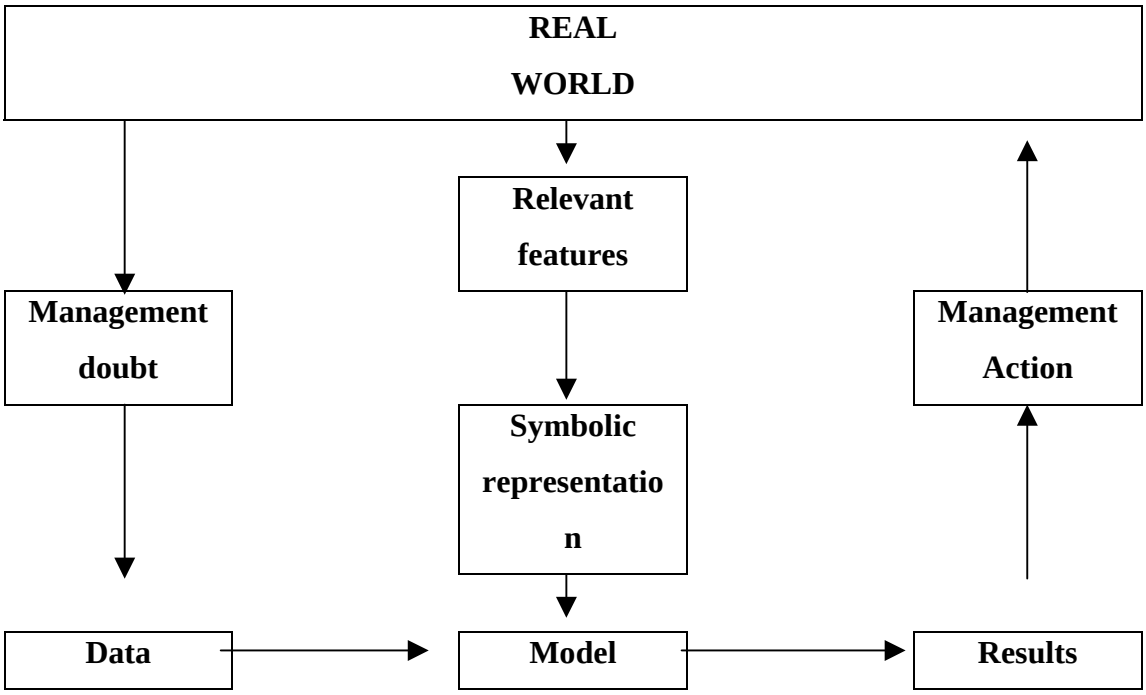
Product-related	*Exporter-related*
value density	location of plants
perishability	firm size
length of product life cycle	investment priorities
product range	export marketing strategy
turnover rate	corporate structure
Market-related	*Environment-related*
no. of distributors/customers	standard of infrastructure
size of distributors/customers	political/economic stability
level of customer service	government regulations
volume of sales	customs constraints
quality of distributors	availability, cost & quality of distribution contractors
growth prospects	

Source: McKinnon (1989)

This multimodal transport choice is of vital importance to the success of international trade. This is why various models have been created (Min, 1991; Levander, 1992; Barnhart & Ratliff, 1993; Yan, *et al.* 1995; D'Este, 1996; Christopher, 1998; Beresford, 1999a) to aid logistics decision makers in choosing the most effective transport modes or combination of modes that not only minimises cost and risk, but also to satisfy various on-time service requirements.

Sussams (1992) suggested that the need for modelling is derived from management's perception and attempts to influence the 'real' world. Management is often faced with doubt and uncertainty about the types of action that needs to be taken in order to obtain positive results. The preferred approach is to collect or synthesise relevant data; input data to the appropriate model; run the model; interpret the results and take appropriate action. However, before such a sequence of events can take place, a suitable model has to be developed. Figure 3.9 illustrates the need for model development.

Figure 3.9 Conceptual modelling



Source: Sussams (1992)

Logistics and transport modelling techniques will be examined in more details in Chapter 5, which relates to research methods and techniques.

3.6 SUMMARY

This chapter has tried to summarise the relevant literature relating to transport corridors, international trade competitiveness and multimodal transport, the question relating to the selection of choice of mode, and logistics and transport modelling.

Transport corridors, and multimodal transport corridors in particular, are very important for the economic development of a country or a region. These multimodal transport corridors facilitate access to international markets through the use of hub

centres and articulation points. Articulation points are places where there is an important transit of maritime, land and air traffic.

As markets are becoming “globalised”, trading opportunities can be improved by implementing multimodal transport. Multimodal transport can help build and sustain the competitiveness of internationally traded products by reducing transit-time, reducing transport costs, increasing reliability and increasing cargo security.

The selection of transport mode is directly related to the competitiveness of multimodal transport. Depending on the mode chosen, the efficiency of the multimodal transport corridor will be affected. This is why a behavioural approach in understanding modal choice selection is important, as the selection of transport mode or combination of modes is often based on transport users’ subjective perception.

In order to select the optimum multimodal transport configuration, a number of models have been created and published in the literature. These models are designed to help transport users in their decision making process for minimum cost, risk and reliability when trading internationally.

The literature has suggested that multimodal transport can be a tool for creating competitive advantage when trading internationally. However, there are still many gaps in the literature. Research and publications relating to freight transport modal choices are numerous but only a handful of them concern developing and/or land-locked countries. There also exist a limited number of studies on modelling multimodal transport corridors in Europe or North America but none of them are related to the geographical area involved in this research (i.e. South East Asia). This literature review is not exhaustive, and other references that were not included in this chapter will be used in the succeeding chapters as appropriate.