Chapter 2

Intermodal Logistics in Urban Areas

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Abstract

International supply chains have experienced remarkable progress on account of changes in the division of labour and the globalising economy. To enjoy the benefits of free trade, intermodal freight transport system is advocated and introduced to provide efficient just-in-time door-to-door long-distance services in a more environmental-friendly manner. This paper aims to build a research framework on intermodal logistics in urban areas and tries to clarify the interactive relationship of intermodal transport and urban logistics through a comparative discussion of the intermodal transport and logistics policies in the European Union (EU), the United States and Japan.

Keywords: Intermodal logistics, urban logistics, transport and logistics policies

1. Introduction

The number of intermodal containers passing through ports worldwide has doubled over the last decade, with similar trends in intermodal air, rail and truck traffic (Horn and Nemoto, 2005). Intermodal transport development has thus become an important policy priority and challenge at the global level. In most EU member countries, intermodalism is an important component of sustainable transport policies often accompanied by modal shift actions diverting freight traffic from road to rail, or to inland and coastal shipping. In the U.S., intermodal transport is driven by the market and the business sector has pushed intermodal use even without major governmental subsidies. Japan, additionally, has started to recognise the need for an overall intermodal transport policy that will serve its domestic and international freight flows, although its focus is on the development and efficient operation of its unimodal transport systems.

Intermodal logistics is theoretically justified by utilising rail or sea mode in the long haul of the international or intercity supply chains. Intermodal transport, however, has two important implications on urban logistics policies (Nemoto, et al., 2006). First, because most of the intermodal terminals are located in urban areas, urban planning considerations are required. Intermodal terminals such as ports, airports and rail terminals were historically developed in urban areas and further growth have taken place due to these facilities. Load units designed for the convenience of intermodal transhipment could also be further modified so that they could be utilised in intracity transport as well. Second, in environmentally-sensitive areas, alternative short-distance intermodal systems to replace trucks are being tested in several countries with governmental support. Hence, there is a need to evaluate the experiments at the moment.

This paper aims to build a research framework on intermodal logistics in urban areas. First, the concept of intermodal transport is clarified and the implications of transport policies on intermodal logistics are elaborated. Second, transport policies that relate to logistics in the EU, U.S. and Japan are reviewed to elucidate the connection of intermodal transport and urban logistics.

2. Intermodal logistics in urban areas

2.1. Definition of intermodal logistics

Intermodal logistics, which is a vital part of integrated advanced logistics and supply chain management, can be defined as the seamless door-to-door freight transport operation using at least two different modes of transport characterised by the minimal handling of goods during transfers. The collection and distribution portions are short and by road, and the main long haulage of containers, swap bodies, trailers or trucks is by rail, waterway, sea or air. In general, intermodal logistics is composed of the following: 1) collection, 2) trunkline, and 3) distribution (Figure 1).

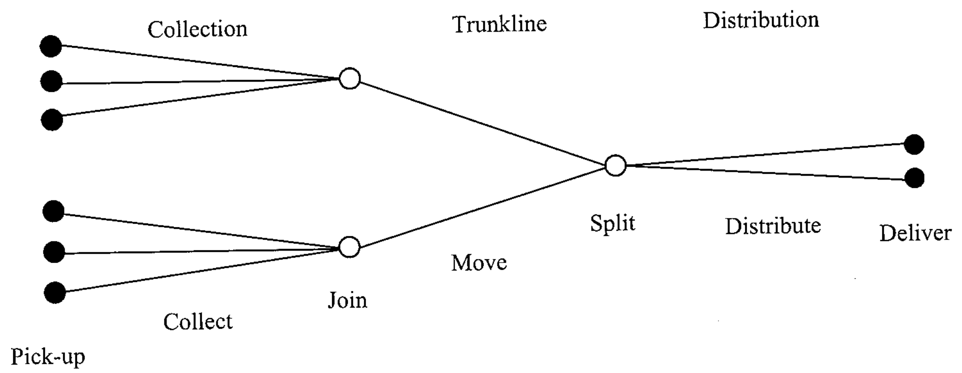

Figure 1. Components of intermodal logistics

These moves transpire by using different networks and by using at least two different transport modes. Rail and waterway are typical transport modes for trunkline, while collection and distribution take place by road. Depending on how intermodalism is defined, a road-road transport chain can also be considered as an intermodal transport chain.

The advantage of using different transport modes is in consolidation, particularly in the more longer-distanced trunkline move. Consolidation leads to economies of scale and the possibility to transport goods at higher speeds. As a consequence, extra activities have to be satisfied, such as join and split activities at transfer points. The extra costs and delays that come along with this, and the smaller volumes, make it difficult to initiate intermodal transport services for the delivery of goods in urban areas.

2.2. Implications of transport policies on intermodal logistics

Intermodal transport could decrease negative environmental impact in terms of hazardous gas emissions. However, because intermodal transport inevitably requires mode changes at connecting points, it requires huge investments for constructing and maintaining intermodal terminals and entails added costs during transhipments. The efficiencies of these terminals are crucial for successful intermodal operations.

Figure 2 shows an example of costs for intermodal freight transport by road and rail. The cost for railways per ton-kilometre is generally lower than that for roads, and therefore, the slope of the line representing railways between intermodal terminals is smaller than that for roads-only transport (C_R).

At intermodal terminals, however, since loading and unloading costs (C_T) are incurred, the total cost for intermodal transport (C_I) will be higher than the cost for the road-only transport for trips with shorter distances than critical distance, d_c. For trips longer than critical distance, intermodal freight transport will be more cost efficient. Experiences in Europe indicate that a critical distance of about 400-500 kilometres is necessary to ensure successful operation of intermodal transport.

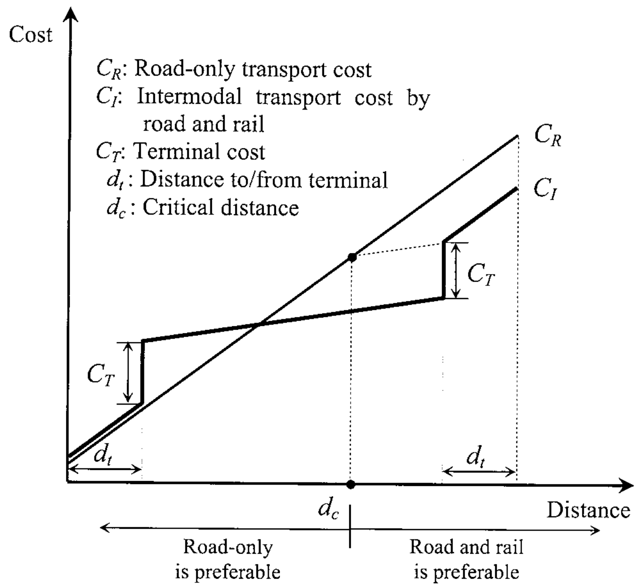

Figure 2. Costs for intermodal freight transport

Hence, the ultimate objective is to reduce the critical distance and enhance the feasibility of intermodal transport over short and medium distances. The main factors that could significantly affect this are: 1) terminal location, 2) use of new transhipment technologies, and 3) inclusion of external costs in the calculation of freight transport costs.

On the issue of terminal location, since majority of transport volumes are transported from and into the urban area, terminals should be located as near as possible to the city centre to reduce the distances for truck collection and distribution ($d_{t'}$). Shorter distances would also ensure higher truck turnaround rates. Figure 3(a) shows the effect of terminal location on intermodal freight transport costs and how the critical distance can be reduced.

If new technologies for the transhipment of goods allow reduction of loading/unloading costs at intermodal freight terminals ($C_{T'}$), the critical distance becomes shorter to ensure acceptability of intermodal transport (Figure 3(b)). Such example is the introduction of standardised load units to reduce costs and delay. Standardisation of load units is a critical success factor for logistics services (Rijssenbrij, 2004). With standardised load units, such as small containers, the move and split activities are simplified consisting of transhipment activities. Transhipment of standardised load units is faster and costs lesser than traditional loading and unloading. In addition, the same containers used for long-distance transport can be used as well in intracity transport to reduce transhipment costs. Small containers can be combined or modularised to form larger container units. Also, the use of standardised and closed load units would make the layout of freight terminals to be much simpler. Without load units, the transfer activities require a freight centre or a distribution centre. Furthermore, new transhipment technologies, such as roll-on roll-off systems, in which no terminals are necessary to transfer goods from one mode to another, would further reduce transhipment costs thereby reducing the critical distance.

The inclusion of external costs, such as environmental costs, in transport cost calculation would also have a large effect on the determination of the critical distance. The current transport system does not consider the widespread external costs that road transport generates. However, if we incorporate the amount of externalities for each mode in transport cost calculation, regardless of the actual introduction of taxes or penalties based on them, then the slope of the line for road transport would be steeper, as shown by $C_{R'}$ in Figure 3(c). The critical distance would then become shorter because of this change.

Combining the three factors would theoretically result in a much larger reduction of the critical distance, as shown in Figure 3(d). Therefore, it can be said that terminal location, use of new technologies, and inclusion of external costs are important concerns in the successful operation of intermodal transport in urban areas. An implication of this result is that it might be possible that a sustainable intermodal freight transport system could exist within the confines of the city.

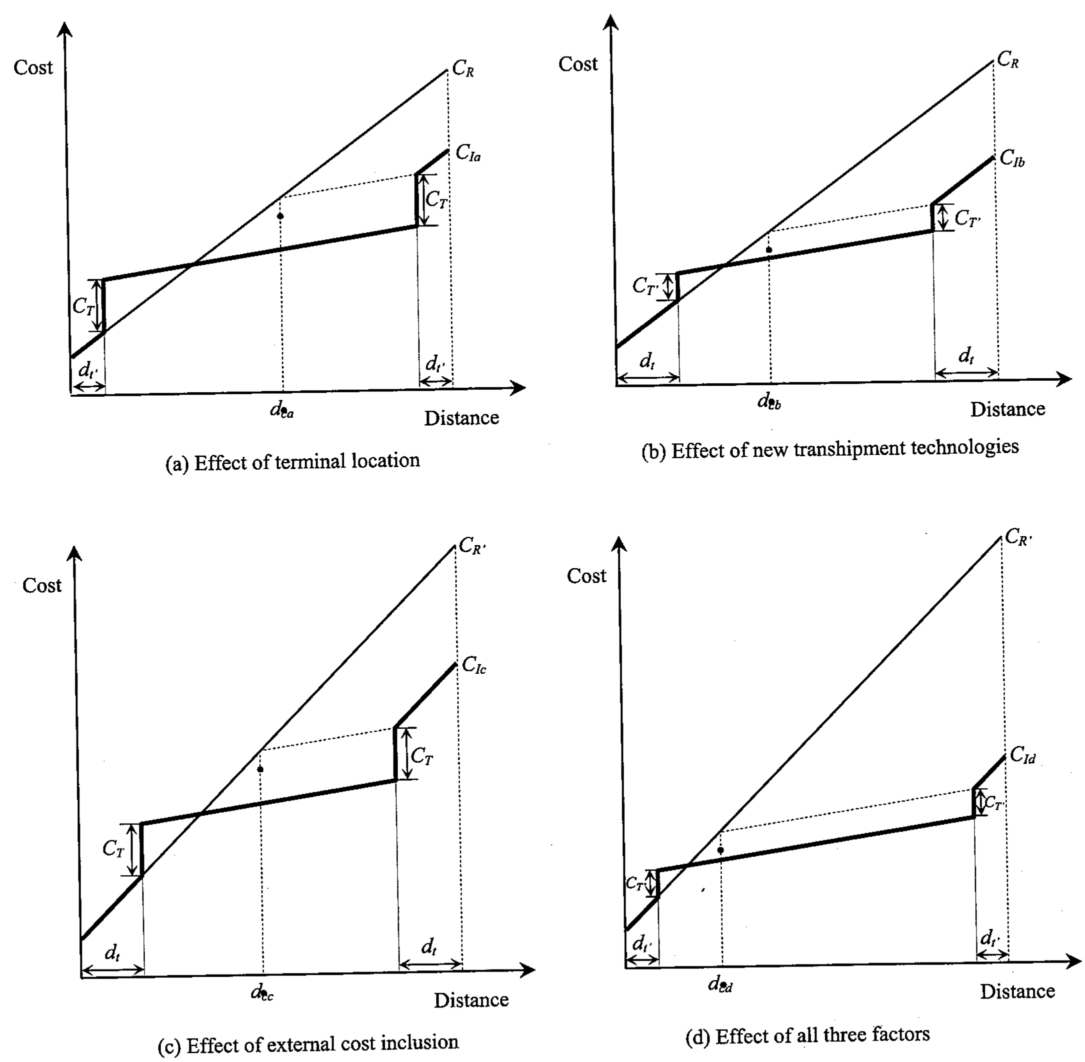

Figure 3(a)-(d). Effects of various factors on the critical distance

Intermodal transport is expected to have significant environmental impacts in terms of reduced pollution as shown by numerous studies done by the European Union (EU). In regions where the environment takes primary priority, intermodal transport is being practiced such as in the transport of waste materials by rail and inland waterway even for short trips within the city. The EU studies revealed the social cost savings that may accrue from the use of intermodal freight transport.

3. Review of intermodal transport and logistics policies

3.1. European intermodal and logistics policy

Many European governments emphasise the need for an intermodal transport and logistics policy to combat highway congestion and environmental problems, and to increase overall traffic efficiency and profit from the benefits of coordinating modes. Table 1 summarises the key elements of the EU's basic intermodal policy as put forward in the European Commission's 1997 Communication.

In Europe, intermodal transport has a large share in hinterland transport to and from seaports, rail transport, in particular in Belgium and Germany, and water transport in the Netherlands. The rise of the sea container in maritime transport has played an important role while the shuttle rail concept and the introduction of container barges made it possible to transport containers in large quantities by rail and waterborne systems. In order to promote these systems, intermodal terminals have been built in urban areas. Another focus is on testing and implementing innovations in logistics concepts and systems, harmonising and standardising intermodal loading units (i.e., pallets, containers and swap bodies) and creating the right technical conditions for stimulating the development of "freight integrators" specialising in the integrated, seamless transport of full loads at the European and global level.

Table 1. Major elements of intermodal policy in the EU

Infrastructure	Technology	Rules and Standard
• Intermodal design of Trans-European Networks (TEN) • Missing links (intermodal priority projects) • *Design of intermodal transfer points*	• IT system, ITS • Satellite based communication system • EDI • Value-added logistics services (esp. E-logistics)	• Intermodal competition rules • Intermodal liability, work regulations • Common charging and pricing • *Interoperable systems & equipment (esp. load units)*

3.2. American intermodal and logistics policy

Efficient logistics system in North America is indispensable for the North America Free Trade Agreement (NAFTA) involving the U.S., Canada and Mexico. Because of the size of its economy and its central geographical location, the U.S. has taken initiatives in enhancing intermodal logistics and transport in the region. The original milestone of American intermodalism was the Intermodal Surface Transport Efficiency Act of 1991 (ISTEA 91) which provided the legislative framework to develop "a National Intermodal System that shall consist of all forms of transportation in a unified, inter-connected manner".

Table 2 summarises the essential elements of the U.S intermodal policy. Its basic philosophies are: 1) intermodal is industry and market driven, and 2) government acts as a convener and catalyst (i.e. few public sector interventions and few governmental initiatives).

U.S. executive and legislative bodies are discussing the renewal of the next long-term transport legislation, called SAFETEA, i.e. the Safe, Accountable, Flexible and Efficient Transport Equity Act. Several different drafts of the forthcoming legislation have been put forward and, as usual, discussions about funding and taxation are at the forefront. Broadly speaking, freight mobility, global connectivity, security and border infrastructure are among the priority goals.

Restraint measures against freight vehicles in urban areas are not common in the U.S. except in large cities (e.g. New York). It is because there are few conflicts between urban activities or urban land uses (e.g. commercial and residential uses), owing to spacious area and strict land use controls.

Table 2. Major elements of intermodal policy in the U.S.

Infrastructure	Technology	Rules and Standard
• National corridor development	• ITS intermodal freight program	• Freight facilitation strategy
• *NHS intermodal freight connectors*	• Intermodal border clearance	• Freight partnerships
• Intermodal cargo hubs	• R&D	• Freight analysis decision framework
• Coordinated border infrastructure program		• Education & training
		• *Standards, dimension & weight of containers*

3.3. Japanese intermodal and logistics policy

According to the OECD report prepared by the Asian Task Force (2003), several countries including Singapore, Korea and Japan have developed well-defined comprehensive logistics policies. Most of the countries, however, have mode-specific freight transport policies, while Malaysia and the Philippines explicitly refer to the importance of intermodality. Clearly, it will take some time to have a region-wide intermodal logistics policy in Asia. The focus of this paper is on the review of Japanese logistics policies as an Asian case study.

About the same time as the EU's intermodality communication, the Japanese Government decided on the "Comprehensive Program of Logistics Policies." The goal is to strengthen competitiveness by promoting integrated logistics. As such, Japan does not have an "intermodal" policy, but clearly there are many elements and features that address the intermodal challenge. Table 3 summarises the key elements of this policy agreed at a Cabinet meeting in April 1997.

Table 3. Major elements of intermodal policy in Japan

Infrastructure	Technology	Rules and Standard
• Co-operation between modes • Elimination of bottlenecks • Development of international hubs • *Development of intermodal terminals*	• IT applications, computerisation • ITS, GPS • EDI • SCM, E-commerce • New transport technologies	• Less government interventions • Simplifying regulations • Abolishment of demand/supply regulation • Facilitation of logistics market • Pricing mechanism • *Standards, codes, pallets, containers*

Three levels of logistics systems were established, each involving a number of intermodal elements:

- logistics - rationalising door-to-door deliveries, use of railway and inland waterway, waste logistics, improved terminal transport

- regional logistics - modal role-sharing, promotion of coastal shipping and related equipment, promotion of rail cargo, access roads to other modes

- international logistics – container terminals and cargo handling, import/export procedures; domestic land transport of marine containers and larger semi-trailers, expansion of domestic coastal shipping; promotion of competitive international sea and air cargo transport

Seaports have played a vital role as intermodal terminals for handling imports and exports. While these terminals are basically located in large cities, such as in Tokyo, Yokohama, Nagoya, Osaka and Kobe, large trucks and trailers used for dispatching and receiving operations have become the major cause of congestion in the city. Among the measures being considered to prevent the entry of large trucks in cities is to develop the logistics network, particularly the expressways. Improving access routes to railway stations and sea ports is essential for promoting intermodal freight transport. If door-to-door travel times can be reduced by improving access routes to intermodal terminals, it is possible to get more cargoes shifting from trucks to intermodal systems.

3.4. Policy implications

Most freight nodes, distribution centres and intermodal transfer points are located in cities, which generate important freight flows with significant impacts in terms of congestion, liveability and pollution. One of the crucial tasks in freight transport policy making, which has not been extensively understood, is the issue on how to effectively plan and coordinate intermodal and logistics policies.

In reviewing European, American and Japanese policy statements, a high degree of commonality can be found. The policy intentions pursue the same broad directions - intermodal policies are expected to make the logistics system efficient and environmentally friendly with systematic applications of advanced technologies and innovation in intermodal facilities and operation. In particular, some references point out the strong association of existing logistics policies on intermodal policies related to infrastructure and standards, such as in the development and utilisation of 'intermodal terminals' and 'load units', shown in italics in Tables 1 to 3.

4. Conclusions

The paper examined the relationship of intermodal transport and urban logistics and revealed that both have basically similar objectives of improving efficiency to attain environmental-friendly logistics. However, they had been handled as separate policy concerns and their interactions were mainly not considered in policy planning. Since intermodal transport performance mainly depends on logistics policies, and vice versa, it is desired that they must be planned in coordination with each other to attain better results. If the needs or requirements of each could be considered and incorporated in planning, a more efficient and environmental-friendly logistics system can be established.

The paper also identified several factors that could significantly affect the successful operation of intermodal transport over short and medium distances. Terminal location, use of new transhipment technologies and inclusion of external costs are among the main concerns that could reduce the critical distance needed to ensure feasibility of intermodal transport in urban areas. By combining the reduction effects of the factors, it might be possible to design a sustainable intermodal freight transport system within the urban area.

The comparative policy review has shown that we can indeed learn from differing intermodal policy emphases and directions in other regions. As a decision support tool, and to benefit from more detailed international analyses of intermodal projects and experience, it would be worthwhile to select and assemble data on a few global logistics indicators for monitoring and benchmarking, focusing on key features of intermodal logistics. In particular, the impacts and effectiveness of short-distance intermodal systems have not been completely recognised, and thus, it is important to ascertain assessment criteria using these indicators. This could be effectively done through the network of international organisations active in global trade and transport, and now security as well, for which an enormous amount of data are now being collected and exchanged.

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