

Session 7b
MODAL CHOICE

Friday 30 August 9.00-10.30am

**INTEGRATED LOGISTICS, INTERMEDIARIES AND
IMPLICATIONS FOR THE FREIGHT TRANSPORT
CHOICE DECISION MAKING PROCESS**

Seu-Keow Cheng

**WAITAKERE ECO-CITY: POTENTIAL FOR LOCAL
SUSTAINABILITY INITIATIVES: INTEGRATING
TRANSPORT & URBAN GROWTH STRATEGIES**

Ann Magee

**RURAL TRANSPORT STRATEGIES -
A NEW APPROACH**

Gillian Akers

ATRF 96

Session Chair: Michael Gross

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Seu Keow Cheng
PhD Student
Institute of Transport Studies

ABSTRACT

With the growing popularity of the integrated logistics management approach adopted by shippers, the operation and provision of freight transport services have changed in ways which increase the role of intermediaries. The trend is for shippers to deal directly with intermediaries rather than with modal operators, focusing importance on relationship such as strategic alliance or partnership. This paper presents a framework for an analysis that links intermediaries and the integrated logistics management approach, and examines the implications for the freight transport choice decision-making process. In contrast to previous freight transport choice studies which have described the process as an arm's-length relationship between shipper and carrier, this paper proposes a model using the hierarchical principal-agent paradigm to explicate the strategic relationship among shippers, intermediaries and carriers in the freight transport choice decision-making process. The paper concludes that the understanding of this change in relationship is essential as the transport industry moves forward to meet the new challenges of a more competitive environment.

Contact Author

Seu Keow Cheng
Bureau of Transport and Communications Economics
Department of Transport and Regional Development
GPO Box 501
Canberra, ACT 2601
Australia

Telephone : (06) 274-6787
Fax : (06) 274-7170
E-mail : SCheng@email dot gov au



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1. INTRODUCTION

It is only since the advancement of the integrated logistics management approach that transportation has been regarded as an independent entity from other logistics functions in the distribution system. Specifically, the approach facilitates the integration of a number of complementary logistics functions into one single system in which all functions are synchronised. Modifications in the logistics management approach have brought about significant changes in the operation and provision of freight transport services, as well as in the relationship among shippers, intermediaries and carriers. Generally shippers deal with intermediaries, such as freight forwarders, customs brokers, shipping agents, third-party logistics providers, etc., rather than with carriers. The underlying reason for the formation of this new relationship is that business dealings are shifting from a transactional focus to a relationship focus, such as alliance or partnership. This relationship has important implications for the conventional interpretation of the freight transport choice decision-making process.

This paper comprises four sections. The second section presents the structure and development of the integrated logistics management approach. Using the theory of transaction costs, the link between intermediaries and integrated logistics management is discussed in section three. With the concept which emerges in the third section, section four develops a framework using the hierarchical principal-agent paradigm to incorporate the interaction among shippers, intermediaries and carriers in the freight transport choice decision-making process. Finally, section five highlights the significance of such a framework in the new competitive environment.

2. THE STRUCTURE AND DEVELOPMENT OF THE LOGISTICS MANAGEMENT APPROACH

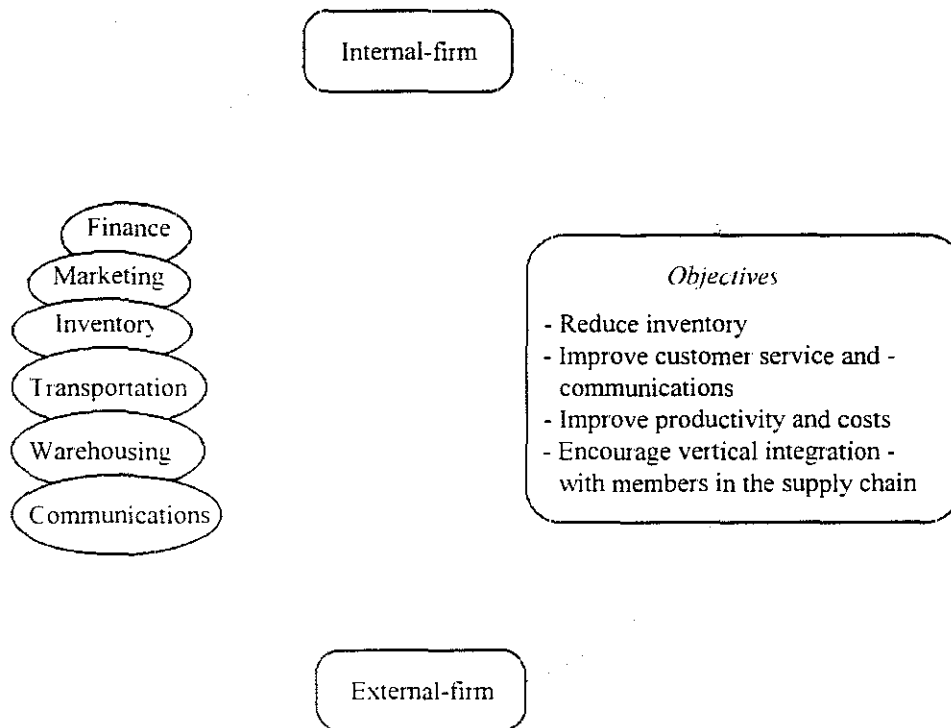
The definition of logistics has been diverse but the core has always been referred to as a process relating to the flow of products from producers to users. Among the many definitions, the Logistics Management Association of Australia defines the concept as 'the process of planning, implementing and controlling the efficient, cost-effective flow and storage of raw materials, in-process inventory, finished goods, and the related information from point of origin to point of consumption for the purpose of conforming to the customer requirements' (Gilmour, (1993), p3). Included within this definition are various functions such as customer service, traffic and transportation, warehousing and storage, plant and warehouse site selection, inventory control, order processing, distribution communications, procurement, material handlings, parts and service support, packaging, return goods handling, and demand forecasting (Stock & Lambert, (1987)).

The conventional treatment of the various functions in the process has been on an individual basis and from an internal firm perspective. It is well established in the literature that the main obstacle to the individual treatment lies in the great diversity and heterogeneity of logistics operations, and hence the involvement of a number of different departments responsible for these operations (ECMT (1987)).

This orientation has changed with the advance of the Just-In-Time (JIT) inventory method. Characteristically, the JIT inventory method requires significant organisational commitment to improve the quality of finished goods, reduce inventories to a near zero level, enhance production efficiencies, and increase responsiveness to customer needs (Lieb & Millen, (1990), p5).

Consequently, JIT has opened the window of opportunity for integration within the firm and integration with external firms (Harrington, (1995); Chow et al (1995)). Many firms have moved towards a system in which individual logistics functions such as finance, marketing, transportation, warehousing, inventory, and distribution communications, while remaining important in their own right, are integrated into a single system. Externally, the firms are connected with other members in the supply chain. As a whole, this implies that, within a logistics chain, all partners are involved in the same logic of accelerated flows of goods and information, which is aimed to minimise inertia within the system (Ernst & Whinney, (1987)), and hence to improve consumer service, productivity and costs (see Figure 1).

Figure 1: Integrated logistics management approach: Elements and objectives



3. THE LINK BETWEEN INTERMEDIARIES AND THE INTEGRATED LOGISTICS MANAGEMENT APPROACH

The preceding discussion suggests that integrated logistics represents an approach to combining transportation and non-transportation (eg, warehousing, communications, marketing, inventory and finance) functions into a single package, in which each function within the package is complementary to one another, so as to provide for more effective freight movement, coordination, and performance. With the shippers' new form of 'consumption technology' (Lancaster (1980)), the operation and provision of freight transport has changed. Specifically, 'the transport sector has dualised itself into two categories of firms, quite different but closely connected' (ECMT, (1987), p22). The first category refers to the modal operator which confines itself to a limited activity, haulage. The second category refers to intermediaries (or third-party transportation services providers) such as freight forwarders, third-party logistics providers, shipping agents, customs brokers, just to name a few.

Characteristically intermediaries are organisers who create bundling strategies that increase variety and complementarity effects to exploit the demand shift associated with complementarity (Matutes & Rigibeu, (1992)). In general, intermediaries possess expertise and systems which shippers lack. These are designed to replace and augment shippers' in-house capabilities (Sheffi (1990)), and to encourage 'opportunistic behaviour' (Williamson (1979)). By establishing strategic relationships with intermediaries, shippers acquire the ability to exploit not only their own internal resources, but also the collective resources of the entire supply chain (Harrington (1995))

The expertise and systems of the intermediaries help to reduce shippers' transaction costs in general, and to improve productivity and consumer service in particular. The contribution of intermediaries in reducing shippers' transaction costs can be reflected through several important dimensions in a transaction. These dimensions are transaction specificity, transaction uncertainty, transaction frequency (Williamson (1979)) and volume (Windsperger (1994))

Transaction specificity

The JIT inventory method requires shippers to meet extensive communications needs (Lieb & Millen, (1990); Walton (1994)). The process of 'staying in-touch' with customers and suppliers requires several distinctive types of information processing services such as freight bill auditing and payment, tracking, electronic data interchange, transaction processing, etc. These services require an extensive investment in sophisticated software, communications, procedures for product-flow control, carrier-performance monitoring, plant compliance, route design, and so on (Sheffi (1990))

As these services are function-specific, it is not beneficial for shippers to manage them in-house. The ability of intermediaries to provide these services allows shippers to concentrate on their core business, and consequently minimise their opportunity

costs. The same reasoning applies to other logistics functions that are function-specific, namely fleet operations (eg, container control, and intermodal trailer operations) and warehousing.

Transaction uncertainty

The two types of uncertainty involved in a transaction are environmental uncertainty and behavioural uncertainty (Windsperger (1994)). Intermediaries' knowledge of physical distribution and/or international shipping requirements provides shippers with immediate access to general or specialised traffic management expertise (TSD, (1985), p1). They arrange services to move any shipment anywhere, or operate as specialists with unique knowledge to serve certain parts of a country or world regions, handle different types of commodities, or move goods efficiently by different modes of transportation. Their worldwide operating networks of offices and/or agents are an essential part of their services. They provide communication, distribution, and commercial intelligence services that are not normally available to shippers acting on their own (TSD (1985)). In general, the expertise of intermediaries can be treated as a 'source of confidence' for shippers and hence can reduce their perceived transaction uncertainties. The benefits of reducing uncertainties can be translated into stability in price and service offerings by shippers, which in turn improves their comparative advantage.

Transaction frequency and volume

Intermediaries do not necessarily own their transport assets. Most of them contract out the majority or all of the "haulage" obligations imposed on them by shippers to modal operators. Basically, they assist shippers in carrier selections, routing, and rate negotiation. By acting on behalf of several shippers, they can achieve lower transportation costs through their abilities to consolidate freight from different shippers with different frequencies and volumes. "The objective here is not only to get economic leverage, but mainly to balance transportation lanes, to even out seasonality, and to reduce random fluctuations, thus reducing the logistics costs for all participating shippers" (Sheffi, (1990), p34).

In general, shippers with lower transaction frequency and transaction volume can be disadvantaged by high transaction costs. The related costs are search costs and information costs. "Search costs" refers to time and money that are involved in the process of searching for transportation and non-transportation services providers. "Information costs" relates to costs incurred by incomplete knowledge of the attributes of alternative providers (Hocherman et al., (1987)). The intermediaries' abilities to allocate transport capacity hence create the necessary bargaining power for the shippers to realise potential savings. Again, lower transaction costs can be translated into more stable prices and service offerings by shippers.

4. IMPLICATIONS FOR THE FREIGHT TRANSPORT CHOICE DECISION-MAKING PROCESS

The preceding discussion suggests that the integrated logistics approach has influenced the operating structure of the freight transport industry, and resulted in the formation of new relationships between intermediaries and shippers and carriers. Intermediaries are, on the one hand, 'a medium for the spread of logistical innovations' (ECMT, (1987), p22), and on the other hand, are retailers for transport services. They can be regarded as the 'gravity' that pull together shippers and carriers in the supply chain.

Despite the seeming importance of these relationships shift (Murphy & Hall, (1995)), the literature is deficient in a theoretical framework to explicate the content of this relationship. Because of the intellectual commitment to neoclassical economic models (Williamson (1981)), earlier studies in freight transport choice decision-making have failed to treat the interaction among the various players in a credible way; they have either ignored it or treat the relationship in the form of an arm's-length relationship between shipper and carrier (eg, McGinnis, (1990); Abshire & Premeaux, (1991); Foster & Strasser, (1990); Lambert et al (1993)). This weakness is crucial given the non-trivial level of risk and resources potentially involved in setting up purchasing arrangements (Heide & John, (1990)). The key properties of the new form of relationship that the arm's-length approach fails to capture are:

- the delegated transport choice decision-making behaviour between shippers and intermediaries; and
- the economic significance of the contribution of intermediaries in carriers' product differentiation, and their impacts on shippers' buying behaviours or arrangements.

The proposed modelling approach

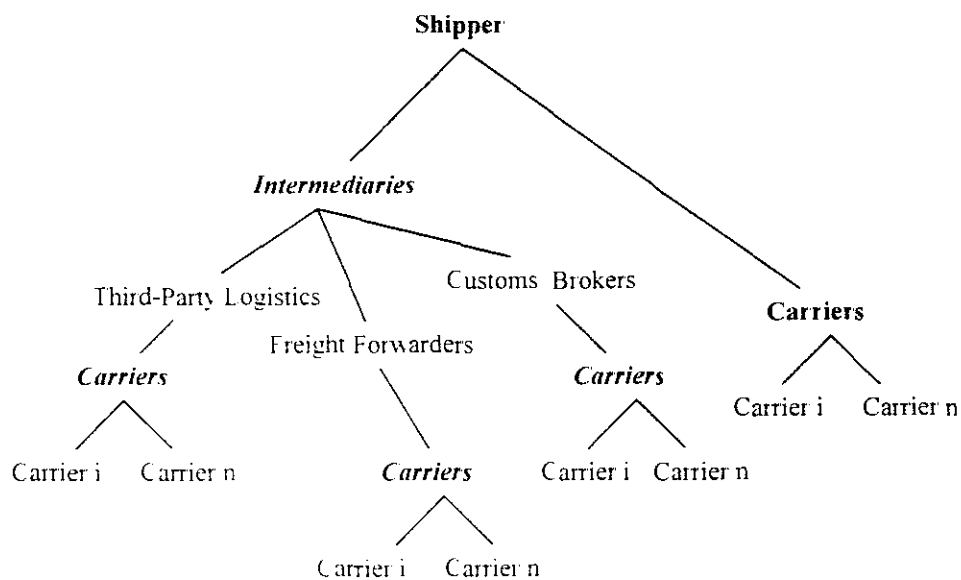
Given the integrated logistics management environment, the paper conceptualises that the interaction between shippers and intermediaries embraces not only a procedure of strategic partnership choice decision-making, but also a procedure of freight transport choice decision-making. It follows that the two choices are intimately related and it is impossible to consider one in isolation from the other. This setting applies regardless of whether the transaction is made domestically or internationally. Consequently, the modelling approach adopted begins with specifying the structure of relationship among the various players, followed by verifying the content of their relationships and the procedures involved in freight transport choice decision-making.

The structure of the relationship is presented using the three-tier hierarchical principal-agent paradigm (Tirole (1986)). The paradigm defines the relationship among the various players in the form of shippers/intermediaries/carriers (or principal/agent/carrier). It follows that there are two stages involved in the process of their interaction. The first is the interaction between shippers and intermediaries, and the second is the interaction between intermediaries and carriers. The content of the

relationship of the various players can be expressed in the form of a hierarchical contract (Cremer & Riordan, (1987)), in which intermediaries are defined as agents (or partners) to shippers, and in turn, are regarded as customers or agents of carriers

Consequently, the principal-agent paradigm will be translated into a hierarchical discrete choice process. The process embraces two levels of choice decision-making. The first is the choice of intermediaries by shipper, and the second is the choice of carriers by intermediary. To encompass the interdependencies of joint-needs among the various players and the impacts on choice-set formation, the overall model structure representing this choice hierarchy can be expressed as block-conditional. That is, 'a block of lower-level choices is made conditionally on higher-level choices, but the choices within each block may be determined jointly' (Ben-Akiva & Lerman, (1976), p35) An overview of a sample hierarchical choice decision-making process is presented in Figure 2.

Figure 2: An overview of a sample hierarchical choice decision-making process of various players



Data and model output

The hierarchical discrete choice model will be estimated using revealed preference and stated-choice data (Hensher et al., (1988)). The former refers to observed choice behaviour of a shipper based on the actual characteristics of alternatives in the choice-set (eg, freight forwarders, third-party logistics providers, etc.), and the latter refers to the likely choice response of a shipper based on the formulation of hypothetical characteristics of alternatives in the choice-set. The principal aim of using stated-choice data is to predict intermediaries and carrier choices, and to derive the values of transport and non-transport logistics services in general, and the value-of-time in particular.

The key outputs that can be derived from the model include a set of attributes of intermediaries. These attributes are a proxy for some of the attributes which the shipper may desire in a carrier and which are partially embedded in the structure of the intermediaries' distribution system (Porter (1974)). Most importantly, the model provides the relative importance and trade-offs of transport and non-transport logistics services. This information is essential for the evaluation of not only the integrated logistics management approach (as compared with the independent approach), but also the implications for the freight transport choice decision-making.

5. CONCLUSION

The paper has demonstrated that the change in the freight transport industry structure in terms of the operation and provision of services has a significant influence on the buying arrangements of shippers, and the relationships among the various players, due to the growing significance of intermediaries in the provision of transport and non-transport logistics services. The three-tier hierarchical principal-agent paradigm allows the incorporation of the hierarchical contractual relationship among the players, the product differentiation contribution of intermediaries in carriers' services, and the resulting delegated transport choice decision-making. As the industry moves forward to meet the challenges of the more competitive environment, this knowledge will be useful in assisting the industry in making the appropriate adjustments to improve its operating efficiency.

Acknowledgement

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References

Abbreviations

ECMT European Conference of Ministers of Transport
TSD Transport Services Division

Abshire, R. D. and Premeaux, S.R. (1991). "Motor Carrier Selection Criteria: Perceptual Differences Between Shippers and Carriers." *Transportation Journal*, 31(1), pp 31-35

Ben-Akiva, M. and Lerman, S.R. (1976). "Disaggregate Behavioral Model of Automobile Ownership" *Transportation Research Record* 569, pp 34-51.

Chow, G., Heaver, I.D and Henriksson, L.E. (1995). "Strategy, Structure and Performance: A Framework for Logistics Research." *The Logistics and Transportation Review*, 31(4), pp 285-307.

Cremer, J. and Riordan, M.H. (1987) "On Governing Multilateral Transactions with Bilateral Contracts." *Rand Journal of Economics*, 18(3), pp 436-451.

ECMT, (1987). "The Role of Shippers and Transport Operators in the Logistics Chain." *Report of the Seventy-Six Round Table on Transport Economics*, Economic Research Centre, ECMT, Paris April 29030, 1987.

Ernst and Whinney (1987) *Corporate Profitability and Logistics --- Innovative Guidelines for Executives*. (Council of Logistics Management and National Association of Accountants: United States of America)

Foster, J.R and Strasser, S. (1990). "Carrier/Modal Selection Factors: The Shipper/Carrier Paradox." *Journal of the Transport Research Forum*, 31(1), pp 206-212

Gilmour, P. (1993) *Logistics Management--- An Australian Framework*. (The Longman Cheshire: Melbourne)

Harrington, I. (1995) "Taking Integration To the Next Level." *Transportation and Distribution*, August 1995, pp 26-28

Heide, J.B. and John, G. (1990) "The Determinants of Joint Action in Buyer-Supplier Relationships" *Journal of Marketing Research*, 27, pp 24-36

Hensher, D., Bernard, P.O and Truong, T.T. (1988). "The Role of SP Methods in Studies of Travel Choice" *Journal of Transportation Economics and Policy*, 22(1), pp 45-58.

- Hocherman, I., Prashker, J.N. and Ben-Akiva, M. (1987). "The Transaction Cost Approach to Modelling the Demand for Automobiles." *Journal of Advanced Transportation*, 21(2), pp 173-93.
- Lambert, D.M., Lewis, M.C. and Stock, J.R. (1993) "How Shipper Select and Evaluate General Commodities LTL Carriers." *Journal of Business Logistics*, 14(1), pp 131-144.
- Lancaster, K. (1980). "Consumption and Product Variety." *Journal of Business*, 53(3), Part 2, pp s79-s102.
- Lieb, R.C. and Millen, R.A. (1990). "The Responses of General Commodity Motor Carriers to Just-In-Time Manufacturing Programs." *Transportation Journal*, 30(1), pp 5-11.
- Matutes, C. and Regibeau, P. (1992). "Compatibility and Bundling of Complementary Goods in a Duopoly." *The Journal of Industrial Economics*, 11(1), pp 37-54.
- McGinnis, M.A. (1990) "The Relative Importance of Cost and Service in Freight Transportation Choice: Before and After Deregulation." *Transportation Journal*, 30(1), pp 12-19.
- Murphy, P R and Hall, P K. (1995). "The Relative Importance of Cost and Service in Freight Transportation Choice Before and After Deregulation: An Update." *Transportation Journal*, 35(1), pp 130-38
- Porter, M (1974). "Consumer Behaviour, Retailer Power and Market Performance in Consumer Goods Industries." *The Review of Economics and Statistics*, 61(4), pp 419-436.
- Sheffi, Y (1990). "Third-Party Logistics: Present and Future Prospects." *Journal of Business Logistics*, 11(2), pp 27-39
- Stock, J.R and Lambert, D M (1987) *Strategic Logistics Management* (Irwin Homewood: Illinios)
- Tirole, J (1986). "Hierarchies and Bureaucracies: On the Role of Collusion in Organisations." *Journal of Law Economics and Organisation*, 2(2), pp 181-212
- TSD. (1985). *Sector Profile of the Canadian Freight Forwarding Industry* (Department of Regional Industrial Expansion: Canada).
- Walton, L W (1994) "Electronic Data Interchange (EDI): A Study of Its Usage and Adoption Within Marketing and Logistics Channels." *Transportation Journal*, 34(2), pp 37-45.

Williamson, O. (1979). "Transaction Cost Economics: The Governance of Contractual Relationships." *The Journal of Law and Economics*, 22(2), pp 233-261.

Williamson, O. (1981). "The Modern Corporation, Origins, Evolution, Attributes." *Journal of Economic Literature*, 19, pp 1537-1568.

Windsperger, J. (1994). "The Evolution of the Vertical Integrated Firm: A Transaction Cost Analysis." In K. Aiginger and J. Finsinger (Eds), *Applied Industrial Organisation*, pp 111-130 (Luwere Academic Publishers: Netherlands).

