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Knowledge Exchange and Intermodal Logistics Network Integration: Social Network Embeddedness Perspective

Eon-Seong Lee*

Abstract

As intermodal logistics networks play a crucial role in enhancing the entire logistics performance, effectively managing the intermodal logistics network has become a significant strategic consideration in international logistics. The existing literature stresses that inter-organizational knowledge exchange is essential to successfully integrating logistics components and for maximizing logistics performance in the long run. These contentions ensure that knowledge exchange between intermodal logistics network entities-such as shipping lines, port terminal operators, freight forwarders, road and rail freight operators and other related logistics operators-are key factors in facilitating the successful integration of an intermodal logistics network because an intermodal logistics network is an integrated part of the entire international logistics system. This paper aims to investigate the question of how intermodal logistics network entities can successfully exchange knowledge with each other, and whether the knowledge exchange can contribute to the effective integration of the intermodal logistics network. For this, this paper adopts the social network embeddedness perspective in order to identify a useful inter-organizational relationship mechanism within the intermodal logistics networks, allowing the facilitation of knowledge exchange among the network players. A conceptual framework will be developed for the exploration of the aforementioned relationships between the social network mechanisms, i.e. network density, tie strength, knowledge exchange among network entities, and intermodal logistics network integration. Following the parameters of this framework, the theoretical and practical implications will be discussed.

Keywords: *Intermodal logistics network integration, knowledge exchange, social network embeddedness*

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* Corresponding Author, Department of Maritime and Logistics Management, Australian Maritime, College University of Tasmania, Locked Bag 1397, Newnham, Launceston, TAS7248, Australia, Tel: +61-3-6324-9740, Fax: +61-3-6335-4720, E-mail: eslee@amc.edu.au

1. INTRODUCTION

An intermodal logistics network is referred to as “integrated transportation systems consisting of two or more modes” (Haasis, 2008, p. 269). As intermodal logistics networks (i.e. sea and land transport logistics networks in this paper) play a crucial role in enhancing the entire logistics performance, effectively managing the intermodal logistics network has become a significant strategic consideration in international logistics (Marlow and Paixao, 2003). Previous studies highlight that the integration of logistics players consisting of an intermodal logistics network contributes to quicker, more flexible and responsible door-to-door delivery (Jarzemskis and Vasiliauskas, 2007; Paixao and Marlow, 2008; Panayides, 2002;). The current literature places great emphasis on the fact that knowledge exchange among logistics operators is crucial for the successful integration of a logistics chain in the long term, since this allows the entities in a logistics system to avoid wasteful duplication of documentary work, reduces operational time and costs, and improves upper level coordination among entities by enforcing inter-organizational trust and reliability (Paixao and Marlow, 2009; Panayides and Song, 2009). This evidence reveals that intermodal logistics network integration is essential for maximizing logistics performance, and that knowledge exchange is a key factor in facilitating the successful integration of an intermodal logistics network.

Despite the significance of knowledge exchange in the effective management of an intermodal logistics network, existing literature has yet to clearly define a specific way for the entities in the network to effectively exchange knowledge. It has also failed to identify the impact of this knowledge exchange on the integration of the intermodal logistics network. Having acknowledged this research gap, this paper aims to investigate the following: how the logistics players within an intermodal logistics network – such as shipping lines, port terminal operators, freight forwarders, road and rail freight operators and other logistics related operators – can successfully exchange knowledge; and whether successful knowledge exchange will result in greater integration in a intermodal logistics network system. Accordingly, the following research questions (RQs) may arise:

RQ1: How could entities within an intermodal logistics network more effectively exchange knowledge?

In order to answer RQ1, it is necessary to address what theoretical foundation would be chosen in the undertaking of this research. This paper applies a social network embeddedness perspective, which is one of the most utilized theories in

strategic management. This perspective examines how organizations can coordinate inter-organizational relationships within a social network in order to exchange knowledge, and determines whether the shared knowledge may help to improve a firm's competitive advantages. The social network embeddedness perspective highlights that a focal firm's structural and relational position within a network, such as its network density, centrality, structural hole and tie strength within a network, create a knowledge exchange advantage (Nahapiet and Ghosal, 1998; Yli-Renko et al., 2001). This approach could offer significant insights into the inter-organizational mechanisms which are required for effective knowledge exchange among intermodal logistics network entities to take place. For example, a port terminal operator embedded in an intermodal logistics network consisting of the inter-connection between shipping lines, freight forwarders, and rail and road freight transport operators may effectively share knowledge throughout their structural and relational position within the network. When recognizing this issue, the following subsidiary research question (SRQ) may arise; as such, this study would investigate this issue.

SRQ: Through what structural and relational network embeddedness mechanism can intermodal logistics network entities most effectively exchange knowledge?

The next issue is about the effectiveness of knowledge exchange in terms of facilitating intermodal logistics network integration. Existing literature in global logistics and supply chain management notes that knowledge exchange is one of the key determinants for the successful integration of global logistics and supply chains (Paixao and Marlow, 2003; Panayides and Song, 2008). Previous studies in transport and logistics also stress the significance of knowledge resource in promoting more effective logistics services and integration (Haasis, 2007; Hult et al., 2007). These contentions would ensure that knowledge exchange would help to further integrate intermodal logistics networks. With this recognition, we will raise the second research question as follows:

RQ2: Does knowledge exchange within an intermodal logistics network facilitate increased integration of the intermodal logistics network?

With the recognition of the aforementioned research goals and research questions, this paper will discuss the following points. Firstly, the significance of intermodal logistics network integration in global logistics and supply chain management. The effect of knowledge exchange between intermodal logistics network players on its successful integration will also be discussed. As a successful way to create knowledge

exchange among intermodal logistics network entities, our literature review introduces the concept of relational and structural network mechanisms from a social network embeddedness perspective and examines how its key mechanisms can help the network players to effectively exchange knowledge. Based on a critical review of the existing literature, a conceptual model shows the positive relationship between the inter-organizational network mechanism, knowledge exchange and intermodal logistics network integration which will be developed. After this is explained relevant propositions will then be suggested. This will be followed, finally, by the discussion and conclusion.

2. INTERMODAL LOGISTICS NETWORK INTEGRATION

Integration is referred to as how individual components work together as a single unit in a co-operative manner in order to achieve their common goals (O'Leary-Kelly and Flores, 2002). Logistics integration can be reflected by the extent to which the divided activities of logistics (e.g. parties located both upstream and downstream in a logistics system) coordinate and work together as a single function. The ultimate goal of logistics integration is to satisfy customers by offering an efficient and effective flow of goods and services (Novack et al., 1995). Well connected and integrated logistics functions make it easier for the members to eliminate operations that do not add value to the customer, to respond quicker to requirements of other functions, to improve efficiency and productivity in order to reduce costs, and to reduce inventory and response times (Waters, 1999).

There is additional evidence supporting the benefits of logistics integration: for example, (i) cost reduction and (ii) customer service/satisfaction improvement in global logistics. Bowersox (1978) suggests that an integrated system of logistics contributes to the creation of a cost-based advantage rather than to a system which operates with separately optimized functional subsystems. Vickery et al. (2003) discovered the positive effects of an integrated logistics system on customer service and financial performance. Narasimhan and Jayaram (1998) support the notion that logistics integration has a positive impact on customer satisfaction.

Chin et al. (2004) also discuss the benefits of integration in terms of cost and customer satisfaction-based advantages. Global firms who succeed in logistics integration can deliver products to customers at the required time, to the appropriate location and at a reasonable price. Consequently, logistics integration contributes significantly to cost reduction and leads to increased customer satisfaction. Table 1 summarizes the concept, goal and benefits of logistics integration.

Table 1.
Concept, Goal and Benefits of Logistics Integration

	Logistics Integration	References
Concept	The extent to which divided activities within logistics worked together as a single function	O'Leary-Kelly and Flores (2002).
Goal	To satisfy customers by offering an efficient and effective flow of goods and services	Waters (1999).
Benefits	To reduce business costs To reduce lead time in the logistics process To enhance service effectiveness To improve customer satisfaction	Bowersox (1978); Narasimhan and Jayaram (1998); Vickery et al. (2003); and Chin et al. (2004).

Source: Compiled from various sources.

Intermodal transportation is an essential part of logistics integration (Mason and Lalwani, 2004). Intermodal transport is defined as “the transport of unitized loads by the coordinated use of more than one transport mode” (Panayides, 2002, p. 401). As an entity within a global logistics system, the players within an intermodal transport system are encouraged to operate as one single integrated unity (Panayides, 2002). This integrating demand has brought about an intermodal logistics network concept. An intermodal logistics network is referred to as “integrated transportation systems consisting of two or more modes” (Haasis, 2008, p. 269). As intermodal logistics networks (i.e. sea and land transport logistics networks in this research) may affect the enhancement of all logistical performance, effectively managing the intermodal logistics network has become a significant strategic consideration in international logistics (Marlow and Paixao, 2003). Previous studies highlight that the integration between logistics players involved in an intermodal logistics network contributes to quicker, more flexible and responsible door-to-door delivery (Jarzemskis and Vasiliauskas, 2007; Paixao and Marlow, 2008; Panayides, 2002).

The integral role of an intermodal logistics network can be easily understood by looking at a pipeline where goods are flowing, like the one depicted in Figure 1. In the upper portion of Figure 1, the key functions of logistics from vendors to customers (e.g. sourcing, inbound and outbound storage, transportation, operations and distribution) are inter-linked as one unit of a pipe through which goods move. If one function in the pipe has a problem, the whole flow of goods would fail to be smoothly processed. The bottom portion of the figure shows the flow of goods from raw materials to delivery to the final consumer. This portion of the figure is linked with several pipes and integrated as one large system by extending the channel of one pipe. The intermodal logistics network, as a part of the transportation within the pipe, is an

intermediate channel in each pipe, and connects several components within or between the pipes by moving cargo. If the intermodal logistics system is not well coordinated and integrated into the whole system—for example, in the case of increased costs, delays and the occurrence of accidents—the flows of the pipe(s) may be affected by these problems. Therefore, an intermodal logistics network is no longer a separate/independent entity pursuing its own benefits (Mason and Lalwani, 2004); rather, it should keep pace with other logistics elements by handling cargoes in a co-operative manner so as to realize mutual benefits for everyone in the logistics chain (O’Leary-Kelly and Flores, 2002). In this sense, the successful integration of an intermodal logistics network is indispensable.

Figure 1.
Transportation in Global Logistics Integration

Source: Kanflo (1997, p. 171).

The integrated demand for an intermodal logistics network may require the entities to work together in a co-operative manner in order to handle cargoes in a more flexible and efficient way and to realize the mutual benefits among firms in the integration system (O’Leary-Kelly and Flores, 2002). The integration of an intermodal logistics network may be observed in terms of the following four factors: the integration of flows (physical, information, financial); the integration of processes and activities; the integration of technologies and systems; and the integration of actors (structures and organization) (Fabbe-Costes and Jahre, 2007).

Having acknowledged the significance of intermodal logistics network integration, the next section will explore how intermodal logistics network integration can be realized. This issue will be discussed based on the knowledge management perspective.

3. KNOWLEDGE EXCHANGE AND INTERMODAL LOGISTICS NETWORK INTEGRATION

Knowledge encompasses useful information or know-how in effective business management (Lee and Song 2010). Previous studies have highlighted that knowledge exchange is one of the key determinants facilitating logistics integration (Paixao and Marlow 2003; Panayides and Song, 2008; Zhao et al., 2002; Vickery et al., 2003). For instance, Panayides and Song (2008) examined key parameters consisting of seaport integration within the context of the global supply chain, and addressed that the amount of information and the communication system which is used by supply chain players are crucial factors in promoting supply chain integration of seaport container terminals. Jarrel (1998) also highlighted that information exchange would facilitate the higher levels of supply chain integration, because it allows supply chain entities to enhance reliability, dependability and speed. Paixao and Marlow (2003) stressed that the level of information exchange between players within the transport chain would help to accomplish logistics integration by enabling organizations to avoid duplication of documentation and by allowing them to maximize data processing procedures.

The above studies ensure that knowledge exchange with other players in a supply chain or in global logistics will facilitate the integration of the logistics/supply chain. This contention could be applied to the discussion on the intermodal logistics network integration of this paper. In other words, knowledge exchange may promote a higher level of intermodal logistics network integration. For example, if intermodal logistic network entities such as shipping companies, port terminal operators, land/road transport operators, and other related logistics service providers exchange additional knowledge which is crucial to their logistics services, they will become highly coordinated with each other, allowing them to communicate seamlessly and to establish an inter-organizational device or data processing routines which will help them achieve their common logistics goals. Knowledge exchange would also enable the network entities to discuss common problems while continuing to experience a smooth logistics flow within the intermodal transport system, and to jointly develop possible solutions such as the development of crucial technologies or certain useful systems. In addition, as intermodal logistic entities share more knowledge with others, they can increasingly understand other entities' various business situations and practices, and adjust their operations in a more collaborative and flexible manner in order to avoid unneeded conflicts, to reduce wasteful activities, and to compromise their own interests for the greater cause, i.e. maximization of the performance of the entire logistics system wherein they belong. As a result, knowledge exchange between intermodal logistics network entities is crucial to enable them to effectively work together as an integrated

unit and thus realize a higher level of intermodal logistics network integration in terms of the flow of goods and information, processes, technology/systems and structure/organizations (Fabbe-Costes and Jahre, 2007). Because of this information the following proposition is being suggested.

Proposition 1: Knowledge exchange between intermodal logistics network entities may be positively associated with a higher level of intermodal logistics network integration.

4. SOCIAL NETWORK EMBEDDEDNESS AND KNOWLEDGE EXCHANGE

A social network is defined as “a set of nodes among people or organizations which is linked by a set of social relationships of a specified type” (Laumann, Galaskewicz, and Marsden, 1978, p. 458). Other studies commonly regard a social network as a pattern or way of social relationships among various forms of organizations (e.g. firms or institutions) (Gulati, 1998; Nahapiet and Ghoshal, 1998; Kogut, 2000). A number of studies identify that a social network is a crucial resource upon which firms can draw on the sharing and transferring of knowledge and the improvement of strategic performance (Gulati, 1999; McEvily and Zaheer, 1999). The major research findings from social networks and their knowledge-based advantages can be summarized by the following two points:

- * A social network facilitates knowledge exchange among firms, which then contributes to a firm’s capability to create a sustainable competitive advantage (Burt, 1992; Gulati, 1998; Holm et al., 1999; Kogut, 2000, Kogut and Zander, 1995; Nahapiet and Ghoshal, 1998).
- * Knowledge-based advantages may be affected by a firm’s structural and relational position in a social network (Burt, 1992; Gulati, 1998; Human and Kraatz, 1998; Madhavan et al., 1998; McEvily and Zaheer, 1999; Provan, 1997; Powell et al., 1996; Rowley et al., 2000).

Near common consensus agrees that firms can exchange knowledge effectively within a social network wherein they are embedded, since the network provides timely chances to get valuable knowledge and resources (Gulati, 1999; McEvily and Zaheer, 1999; Rowley et al., 2000). Different positions within a network bring varying opportunities and change the chances of achieving informational priorities and maintaining competitive advantages (Chen and Miller, 1994), a view which is expressed in the network embeddedness perspective.

The strategic behavior and resource-based advantages of firms within a network may vary according to a firm's position in the network. The various levels of network embeddedness cause an asymmetry in accessing resource acquisition across the firms, and alter the network-based knowledge advantages, which can lead to different outcome levels for the firms (Burt, 1992; Grantovetter, 1985; Uzzi, 1997). The different informational advantages which can be found in a network are explored systemically by using the network embeddedness perspective (Grantovetter, 1985). The network embeddedness perspective indicates two types of mechanisms in order to describe the differential knowledge-based benefits: structural and relational embeddedness (Grantovetter, 1992; Gulati, 1998).

4.1 Structural Embeddedness

According to Gulati (1998), structural embeddedness is defined as follows:

“Structural embeddedness or the positional perspective of a network focuses on the informational roles that an organization occupies within the overall structure of the network. This means that information not only travels through proximate ties within a network, but also through the structure of the network itself” (p. 296).

The structural embeddedness perspective acknowledges that the structure of a social network's ties can create a number of opportunities to acquire external resources, and a superior structural position in a network enables firms to rapidly share knowledge (Burt 1992). There are some key variables of the structural embeddedness such as network density, centrality and the structural hole. The most popular variable for structural embeddedness is network ‘density’. Network density is referred to as the extent to which ties among actors are inter-connected within a network. It can be calculated as “the ratio of the number of ties actually observed to the number theoretically possible. Therefore, the greater the interconnectedness, the higher the density will be. This indicates that “a network in which ‘everyone knows everyone else’ will be a very dense network” (Grantovetter, 1976, p. 1288).

A dense network can have a positive impact on actors' behaviors and outcomes. Firstly, it facilitates faster and more efficient flows of knowledge and enables actors to share and distribute resources with each other through increased interconnections within the network (Coleman, 1990; Valente, 1995). Secondly, the behavior and business practices of actors within a highly dense network can be easily monitored, since everyone is well acquainted with each other. This reputation effect may serve as an effective tool to monitor or sanction other firms' business actions (Chen and Miller,

1994; Granovetter, 1985). Finally, because actors in a dense network interact with each other frequently and closely, they can more easily build trust, norms, and shared behavioral routines (Colman, 1990). Consequently, an actor in the highly dense network is exposed to a rich flow of knowledge resources and has more opportunities to develop an inter-firm governance mechanism, which leads to enormous informational advantages for the actor.

Figure 2.
Intermodal Logistics Network

We can also apply the network density concept to intermodal logistics network practices. An intermodal logistics network consists of multiply linked firms involved in the areas of sea and land transportation. This can encompass shipping lines, port terminal operators, rail and/or road operators, related logistics service providers such as warehouses, distribution centers, etc. They can also be linked through vertical (buyer - supplier) or horizontal (technology, information, or other forms of resource-sharing) relationships. These multiple network relationships within intermodal logistics systems are depicted in Figure 2. Firms which are embedded in a high density network are differentially exposed to knowledge and ideas because they have superior access to that knowledge (McEvily and Zaheer, 2001). Therefore, higher network density give firms in an intermodal logistics network more opportunities to easily exchange knowledge (Gulati, 1999). Based on this argument, the following suggestion has been proposed.

Proposition 2: The greater the density within an intermodal logistics network, the greater the exchange of knowledge between firms.

4.2 Relational Embeddedness

Gulati (1998) illustrates the relational embeddedness concept as follows:

“Relational embeddedness or cohesion perspectives on networks stress the role of direct cohesive ties as a mechanism for acquiring fine-grained information. “Actors who share direct connections with each other are more likely to possess common information and knowledge.” (p. 296).

Literature on network embeddedness highlights tie strength as the most important indicator of relational network embeddedness (Granovetter 1973; Uzzi, 1997; Rowley et al. 2000). Granovetter (1973) defines tie strength as “a combination of the amount of time, the emotional intensity, the intimacy (mutual confiding), and the reciprocal services which characterize the tie” (p. 1361). Rowley et al. (2000) refer to tie strength as “the frequency of interaction between partners and their level of resource commitment to the relationship” (p. 371).

Strong ties have the following notable benefits on knowledge exchange within a network. Firstly, trust between organizations can be developed through a strong network relationship, and this also facilitates the exchange of valuable resources and information which are otherwise difficult to transfer in the market (Uzzi, 1997). Secondly, strong and close ties can promote in-depth and two-way communication. This allows actors to share knowledge that is more proprietary and more tacit (Krackhardt, 1992; Uzzi, 1996). In addition, as firms with strong network ties communicate with each other in a deeper and more open manner, they can acquire more prompt and proper feedback from each other, which helps to effectively and efficiently coordinate the different functions of the various actors. Such routines also make it easier for firms to correct and solve mutual problems (Uzzi, 1997).

Given the assumption that high network density facilitates greater knowledge exchange among intermodal logistics network entities, these strong ties may affect the extent of knowledge exchange within a network. For example, although firms within an intermodal logistics network can exchange knowledge by being exposed to the knowledge flows via an extremely dense network, if their relationship with their network partners is weak or they don't trust each other, the willingness to transfer knowledge will not exist and the quality of the shared knowledge will be decreased. Consequently, the actual knowledge exchange between those partners may inevitably be

limited. On the other hand, if the network partners regard their relationship as quite trustworthy and feel goodwill toward each other, they would be more proactive in exchanging knowledge with each other and there will be an increase in the knowledge related synergy effect. Therefore, knowledge sharing may vary depending upon the quality of the relationship between network partners. In other words, the high tie strength may further facilitate the effect of high network density on knowledge exchange within an intermodal logistics network. In this sense, the following proposition can be suggested.

Proposition 3: The positive association between network density and knowledge exchange will intensify with a higher level of tie strength.

The above discussion regarding intermodal logistics network embeddedness, knowledge exchange and intermodal logistics network integration is depicted in Figure 3.

5. CONCLUSION

This study discusses the effects of knowledge exchange on intermodal logistics network integration and examines the determinants of knowledge exchanges between firms in the network from a social network embeddedness perspective. The key factors of social network embeddedness considered in this paper are network density and strong ties within an intermodal logistics network. This research demonstrates that firms within an intermodal logistics network may exchange additional knowledge if they are embedded in a highly dense network. The knowledge exchange throughout the dense network can be more easily facilitated when the tie strengths with other entities are high. These contentions verify the significance of structural and relational embeddedness of social networks in exchanging knowledge amongst firms, which has itself been significantly addressed in existing studies in business management. Yet the argument of this paper is noteworthy, given that the existing literature has focused mostly on the independent impact of strong ties on knowledge-based advantages, without investigating the moderating role of strong ties on the knowledge exchange itself, i.e. the impact of strong ties on the positive association between network density and knowledge sharing. This paper also clarifies that knowledge exchange can lead to increased integration within intermodal logistics networks.

Figure 3.
Conceptual Framework

The above arguments have been made on the basis of the existing literature which is published on strategic management and logistics and supply chain management studies. These attempts would be indispensable to the current intermodal logistics research, given the fact that an intermodal logistics network is a key integrated system within global logistics and supply chain management and its management should be more systematically designed from a strategic management point of view in order for the intermodal system to add additional value to the rest of the logistics chain. This paper should also provide meaningful strategic insight to managers of logistics companies who are involved in the maritime and land transport industry, in terms of how they strategically manage the inter-organizational relationships within an intermodal logistics network in order to share more knowledge in order to create a more integrated system. This paper also encourages managers to think more broadly about their managerial direction, and shift their thinking towards a more holistic approach, i.e. the integration of an intermodal logistics network, rather than focusing solely on their own independent operations. Nevertheless, the arguments contained in this paper are solely theoretical in scope. Future research will require empirical analysis in order to test whether the proposed relationships are supported by practical data.

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