REVERSE LOGISTICS PERFORMANCE IN THE THAI AUTOMOTIVE INDUSTRY

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ABSTRACT

This article explores the factors that influence reverse logistics performance, as found in the Thai automotive industry. Supply chain integration is proposed as the key influencing construct of the developed reverse logistics performance model. A structural relationship among key constructs was developed based on the arcs of integration concept proposed by Frohlich and Westbrook (2001) in the context of reverse logistics. A questionnaire survey was conducted among 234 first-tier suppliers of major automotive manufacturing firms in Thailand. Structural equation modelling was used to analyse the empirical data. The results indicated that external and internal integration as well as supply chain orientation significantly influence reverse logistics performance. Information system support and resource commitment also have an indirect influence. Supply chain orientation, information system support, and resource commitment were found to lead a firm to initiate and develop external and internal supply chain integration. However, the scope of reverse logistics in this study focused only on product returns for specific reasons, such as defective product or faulty order processing. Other reasons for returning products were excluded.

INTRODUCTION

Reverse logistics has often been a neglected part of supply chain management even though it can play a critical role in supporting the efficiency and effectiveness of supply chains. A well managed reverse logistics system can result in savings in inventory holding, transportation, and waste disposal costs as well as improving a firm's customer service (Daugherty et al. 2001). High reverse logistics performance would result in customer satisfaction, increased control of inventory, reduced costs, improved corporate image, and would provide higher profitability.

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The reverse logistics field has received more attention in recent years but the number of related studies is still very limited to a small set of constructs, such as industry, firm size, assignment of responsibility (Autry et al. 2001), resource commitment, information system support, relationship commitment (Daugherty et al. 2002), timing and resource, resource commitment, and innovation (Richey et al. 2005). It can be seen that the study of factors influencing the performance of reverse logistics is still at an early stage and with non-conclusive results. There is a need to explore more factors that are related to reverse logistics performance as well as to investigate some of the previously studied factors that still have non-conclusive statistical relationships with reverse logistics performance. Supply chain integration is considered an important construct in the logistics and supply chain area, but, surprisingly, it has been overlooked in the study of reverse logistics performance. Thus, this research attempts to develop a better understanding of the reverse logistics process by investigating the relationship between supply chain integration and reverse logistics performance as well as other related factors.

This paper has three main sections. First, a literature review. Related hypotheses development is subsequently proposed, followed by the methodology section which describes the population, sampling data collection and types of data analysis. Finally, the findings from the survey are presented and discussed.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Reverse logistics

Reverse logistics has been closely associated with recycling and environmental issues (Barry et al., 1993). Defective products were traditionally detected after they have entered the supply chain, resulting in a pull back of products through the system known as product recall. Now, the scope of reverse logistics is broader as there are more actors in the supply chain involved with reverse flows of products on the basis of commercial agreements such as taking back obsolete stocks of short-life products (so called B2B commercial returns); returning of after-use or after- product-life to be remanufactured, recycled or incinerated (so called end-of-use and end-of-life returns).

The handling of returns affects the corporate image and is often an important evaluative criterion used in vendor/supplier selection and subsequent purchase decisions. High quality reverse logistics can promote longer-term relationships since buyers are more likely to repurchase from vendors who do a good job at handling returns. Customer satisfaction can soar with good reverse handling, and corporate profitability can be directly impacted as well. Reverse logistics support also plays a critical role in overall corporate strategy. Some companies have adopted very liberal returns policies and will accept returned merchandise without question (Dawe, 1995). Hence, the reclamation and further handling of assets has become a priority issue for businesses because of the potential for simultaneously enhancing profitability and customer satisfaction (Minahan, 1998).

Lambert and Stock (1981) initially defined reverse logistics as "going the wrong way on a one-way street because the great majority of product shipments flow in one direction" while Murphy and Poist (1989) described reverse logistics as the "movement of goods from a consumer towards a producer in a channel of distribution". Stock (1998) provided a more comprehensive definition, that reverse logistics refers to the role of logistics in product returns, source reduction, recycling, materials substitution, re-use of materials, waste disposal, and refurbishing, repair, and remanufacturing; from an engineering logistics perspective. Tibben-Lembke (2001) modified the definition, based on the definition given by the Council of Supply Chain Management Professionals, as "the process of planning, implementing, and controlling the efficient, cost effective flow of raw materials, in-process inventory, finished goods, and related information from the point of consumption to the point of origin for the purpose of recapturing or creating value or proper disposal". This definition is adopted in this paper. The activities related to reverse logistics include the following:

- Stock balancing return
- End of life / end of season
- Faulty order processing
- Defective / un-wanted products
- Warranty returns
- Recalls
- Environmental disposal issues

In reverse logistics, transportation cost, packaging materials and process, and inventory management, are important issues. Unlike forward logistics, the arrival of a product in the reverse channel tends to be random which makes traditional models of inventory management inapplicable. As such, transportation cost, packing materials and process could also not be controlled. The lack of visibility of a product coming into a returns center makes short-term operational planning so difficult (Tibben-Lembke, 2002).

Reverse logistics performance

Rodrigues et al. (2004) conceptualized logistics performance as the ability of the firm to deliver specified value levels in a timely manner and to do so consistently. Logistics performance focuses on the creation of customer value through cost reduction and/or differential advantage (Stank et al., 2005). Autry et al. (2001) categorized reverse logistics performance into six dimensions: 1) environmental regulatory compliance; 2) improved customer relations; 3) recovery of assets (products); 4) cost containment; 5) improved profitability; and 6) reduced inventory investment. In contrast, Daugherty et al. (2002) proposed only two performance categories of reverse logistics. First is operating and financial performance which covers all the aspects of Autry et al. (2001), while the second is customer satisfaction with returns. Richey et al (2004; 2005) assessed reverse logistics performance based on responsiveness, quality, and economic aspects of the reverse logistics programme. Based on these studies, it can be said that there are three main aspects of reverse logistics performance: costs, customer satisfaction, and responsiveness.

The cost performance aspect of reverse logistics is evaluated based on the overall costs of the reverse logistics process. This includes ordering, transportation, handling, and inventory holding costs as well as other costs incurred when products are returned from customers and delivered back to the customers when needed. The value aspect of performance is evaluated by responsiveness and customer satisfaction. These measurements have been widely used to evaluate reverse logistics and supply chain performance (Autry et al., 2001; Daugherty et al. 2001; 2002).

Supply chain integration and reverse logistics performance

Spekman et al. (1998) proposed a transition concept related to the level of relational intensity among trading partners from open-market negotiations to collaboration. The concept suggested that firms move beyond market negotiation to cooperation and coordination with key suppliers and customer segments. Cooperation is where supply chain management is initiated with low intensity of information exchange between firms and few long-term contracts between suppliers and customers. Firms may move forward to the coordination stage where there is an exchange in workflow and information to make seamless linkages between and among trading partners. In the case of collaboration between firms, partners are engaged in joint planning, future design, product performance, long-term strategic intentions and processes. Through this proposition, the concept of collaboration and supply chain integration are closely related which allows the use of the two terms interchangeably.

Supply chain integration is made of two fundamental components: interaction and collaboration (Kahn and Mentzer, 1996). Interaction represents the communication aspects associated with inter-departmental activities. Collaboration represents the willingness of departments to work together, characterized as the attitudinal aspect of inter-departmental relationships, representing an affective, volitional, mutual/shared process. Bowersox et al. (2003) discussed several elements of integration, including cross-functional unification, structural adaptation, process standardisation, simplification, and compliance. Supply chain integration can be divided into two broad categories: internal and external integration.

Internal integration is a core competence derived from linking internal activities to best support customers' requirements at the lowest total system cost (Stank et al., 2001a). This can be achieved by linking operations into a seamless, coordinated, and synchronised operational flow across internal function areas such as marketing and sales, procurement, manufacturing and assembly, and finished goods distribution, as well as encouraging front-line managers and employees to use their own discretion, within policy guidelines, to make timely decisions (Bowersox et al., 2002; Stank et al., 2001b). External integration with suppliers synchronises the core competencies of selected supply chain members to jointly achieve improved service capabilities at lower total supply chain cost (Bowersox et al., 2002; Stank et al., 2001b). Rodrigues et al. (2004) stated that external integration ensures that all operational interfaces between firms are synchronised by ensuring that all activities are conducted by the supply chain entity that best creates the service and cost configuration to meet customer requirements. In addition to the willingness to work together, Stank et al. (2001b) noted that external integration also requires an investment in the relationship and/or resource sharing. Effective integration involves mutual understanding, a common vision, shared resources, and achievement of collective goal. Another aspect of external integration relates to customer integration which is the extent to which a firm is able to deploy collaborative processing with its valued customers. To achieve customer integration, a firm must seek to build a long-term relationship with its key customers making this an integral part of the entire value network. Stank et al. (2001a) stated that customer integration is the competence firms use to create lasting distinctiveness with customers of choice.

Supply chain integration, especially external integration among supply chain members, allows synchronization of the core competencies to jointly improve service capabilities with lower total supply chain cost by reducing operational waste and redundancies (Gimenez and Ventura 2005; Rodrigues et al. 2004). Successful integration should therefore result in efficient logistics operations and significant performance improvement (Boyer et al. 2003). Since reverse logistics is a part of the logistics process, it can be expected that such integration also enables efficient reverse logistic operations which would lead to cost reductions, increased production efficiency and higher productivity (Gustin et al., 1995), as well as reductions in inventory, shorter lead times, customer service enhancements, and improved forecasting and scheduling (Muller, 1991). Such improvement partly comes from the effective and efficient reverse logistics operations. Thus, it can be proposed that:

H1: External integration i.e. a) supplier integration and b) customer integration, are positively related to reverse logistics performance.

H2: Internal integration is positively related to reverse logistics performance.

Information system support

The information system is another important factor that supports reverse logistics activity. Firms must be prepared to quickly process and handle returned products on demand. Information system that supports the quick flow of information would facilitate reverse logistics activity. Efficient and effective management of information system helps supply chain members reduce transaction costs, increase confidence levels among firms and decrease uncertainty (Daugherty et al., 2002). Information system support acts as a technological platform that reduces barriers to collaboration, compresses lead-time, eliminates some physical movement and enriches decision-making by providing firms with product visibility (Balakrishnan et al., 1999). Three distinct dimensions of information system support: capability, compatibility, and technologies are the focus of this study. *IS Support Capability* refers to the information system networks that must be sufficiently responsive to anticipate and accommodate operational changes as well as customer demand. Information capability must match business needs. This means that information must be continuously accessible and shared across organizations (Daugherty et al., 1995). *IS Support Compatibility* is defined as the extent to which the firm is able to design and invest in hardware and software that are compatible with those of its trading partners to facilitate the information exchange process. Thus, information system support capability indicates a practical ability, or what the system can do. *Information system support technology* has long been accepted for its potential to serve as a competitive weapon to support overall firm strategic initiatives. Online return capabilities and electronic processing of returns drastically increase the speed with which returns can be handled in order to increase customer satisfaction and reduce return costs.

An information system support allows customers to experience shorter lead time to obtain return authorisation or credit approval, as well as continuously available returns information. This enhances customer satisfaction. Hence, information system support not only influences logistics and reverse logistics performance but also acts as a part of the infrastructure supporting the integration of the extended enterprise. Thus, the relationship between information system support and reverse logistics can be proposed as the following:

H3: *Information system support is positively related to reverse logistics performance.*

H4: *Information system support is positively related to external integration a) supplier integration, and b) customer integration.*

H5: *Information system support is positively related to internal integration.*

Resource commitment

Resource commitment involves the allocation of tangible and intangible entities available to the firm, that enable it to produce efficiently and effectively a market offering that has value for some market segments. Reverse logistics requires a wide range of resources, ranging from information to location-related resources. A reverse logistics program cannot be successful without sufficient resources for its implementation (Tibben-Lembke, 2002). Lack of commitment in resources may result in poor reverse logistics performance (Daugherty et al. 2001; Tibben-Lembke, 2002). A commitment in resources is required in order to overcome the challenges of implementing a successful reverse logistics program (Richey et al., 2004). Firms that lack resource commitment would not be able to implement an information support system nor have any access to it. Therefore, two related hypotheses are proposed.

H6: Resource commitment is positively related to reverse logistics performance.
H7: Resource commitment is positively related to information system support.

Supply chain orientation

Another important construct is supply chain orientation which provides a perspective that favours cooperative efforts that synchronise and converge intra-firm and inter-firm operational and strategic capabilities into a unified whole (Mentzer et al., 2001). Firms with a supply chain orientation would assess customer, product, and competitor inputs to coordinate and organize internal functions and processes with those provided by external supply chain entities to best deliver value to customers as well as to supply chain members (Bowersox et al., 1999). In order to develop supply chain orientation, several related factors are required, which include trust, commitment, cooperative norms, organizational compatibility, and top management support. The details of these are now discussed.

Trust is recognized as an important factor in developing and managing business relationships. It is a substantial dimension in the interaction and network approach (Hakansson and Snehota, 1995), and a basic feature in relationship marketing (Morgan and Hunt, 1994). The importance of trust can be explained by the fact that it is considered as a phenomenon which contributes to the strength of interpersonal relationships, intra-organizational relationships, and inter-organizational relationships (Svensson, 2001). Trust exists when one party has confidence in an exchange partner's reliability and integrity (Morgan and Hunt, 1994). Two aspects of trust, credibility and benevolence are the focus in this study. Credibility is a firm's belief that its partner stands by its word (Anderson and Narus, 1990), fulfils promised role obligations, and is sincere (Dwyer and Oh, 1987; Scheer and Stern, 1992) while benevolence refers to a firm's belief that its partner is interested in the firm's welfare (Larzelere and Huston, 1980; Rempel et al., 1985) and that the partner is willing to accept short-term dislocations (Anderson et al., 1987), and will not take unexpected actions that could have a negative impact on the firm (Anderson and Narus, 1990).

Commitment is defined as an implicit or explicit pledge of relational continuity between exchange partners (Dwyer et al., 1987). Morgan and Hunt (1994) defined commitment as an exchange partner believing that an ongoing relationship with another is so important as to warrant maximum efforts at maintaining it; that is, the committed party believes the relationship endures indefinitely. Moorman et al. (1992) defined commitment to a relationship as an enduring desire to maintain a valued relationship. It is implicit in this definition that firms that are committed to relationships with valued partners in the supply chain will work hard in maintaining the relationship.

Cooperative norm refers to the perception of joint efforts by both supplier and distributor to achieve mutual and individual goals successfully while refraining from opportunistic actions (Siguaw et al., 1998), while *organizational compatibility* is defined as the compatible corporate culture and management techniques of each firm in a supply chain. Organizational compatibility is necessary for successful supply chain management (Cooper et al., 1997; Lambert et al., 1998). Also, *top management support*, which includes leadership and commitment to change, is considered an important antecedent to supply chain management (Lambert et al., 1998), and its absence is a barrier to supply chain management (Loforte, 1993).

Supply chain orientation will lead a firm to practice supply chain management, characterized as the integration of key business processes across the network of organizations from end-user through original suppliers (Lambert, 2004; Min and Mentzer, 2004). The higher the level of supply chain orientation, the greater the level of integration of key business processes across the supply chain (Stank et al., 2005). It is proposed that:

H8: Supply chain orientation is positively related to external integration, a) supplier integration; and b) customer integration.

From the literature it was observed that supply chain orientation, information system support, resource commitment and supply chain integration could play a key role in influencing reverse logistics performance. The relationships among all key constructs is proposed in Figure 1.

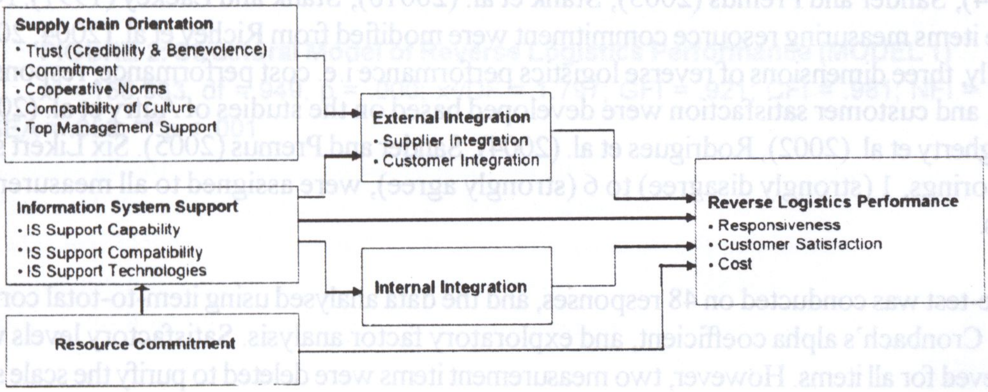

FIGURE 1: Conceptual model of reverse logistics performance

RESEARCH METHODOLOGY

A survey was conducted to obtain empirical data from the Thai automotive industry, which was chosen because a large part of its distribution operations focuses on handling returns (Richey et al. 2005). The day-to-day operations include the reclamation of used parts/products as well as returns of damaged product, overstocks, incorrect shipments, etc. These companies retrieve the items for re-manufacturing and/or refurbishing in preparation for re-sale (Frohlich and Westbrook 2001; Lemke et al. 2002). Therefore, supply chain integration, information sharing and reverse logistics system are expected to exist. The target population was a group of first-tier supplier firms that supply auto-parts, or automotive components, directly to car assemblers. Managers and authorized persons who are responsible for logistics and supply chain tasks were targeted as the key respondents of the survey. The sampling frame was composed by consolidating the name lists from four sources, which resulted in a name list of 508 first-tier supplier firms. This sampling frame was further used for data collection. A questionnaire comprising five major sections was developed and used as a major data collection tool. In the first part, twenty items were modified from Min and Mentzer (2004) to measure six dimensions of supply chain orientation i.e. credibility, benevolence, commitment, cooperative norm, compatibility, and management support. Second, thirteen items were adapted from Daugherty et al. (2002), Closs and Savfitskie (2003), Sander and Premus (2005) to measure three dimensions of information system support i.e. IS support capability, compatibility, and technology. Third, 29 items measuring internal and external integration in both supplier and customer integration were developed from Closs and Savitskie (2003), Rodrigues et al. (2004), Sander and Premus (2005), Stank et al. (2001b), Stank and Lackey (1997). Next, three items measuring resource commitment were modified from Richey et al. (2004; 2005). Finally, three dimensions of reverse logistics performance i.e. cost performance, responsiveness, and customer satisfaction were developed based on the studies of Autry et al. (2001), Daugherty et al. (2002), Rodrigues et al. (2004), Sander and Premus (2005). Six Likert scale anchorings, 1 (strongly disagree) to 6 (strongly agree), were assigned to all measurement items.

A pre-test was conducted on 48 responses, and the data analysed using item-to-total correlation, Cronbach's alpha coefficient, and exploratory factor analysis. Satisfactory levels were achieved for all items. However, two measurement items were deleted to purify the scale since the factor loading of one item was significantly loaded in a wrong component and another item had low item-to-total correlation. Confirmatory factor analysis (CFA) was performed, and the results suggested that construct validity exists for all the proposed constructs.

DATA ANALYSIS AND FINDINGS

An in-person drop-off delivery survey was applied to collect the data, as suggested by Cooper and Emory (1995). A total of 234 completed questionnaires were returned (a response rate of 46.06 per cent). After assessing the non-response bias, two structural equation models (SEM) using AMOS 16 were developed to test all hypotheses. The first structural model was constructed based on the proposed model and main hypotheses. The good fit of the data was illustrated (x^2/DF = 1.797, GFI = .921; CFI = .981; NFI = .958; RMSEA = .058) as shown in Figure 2.

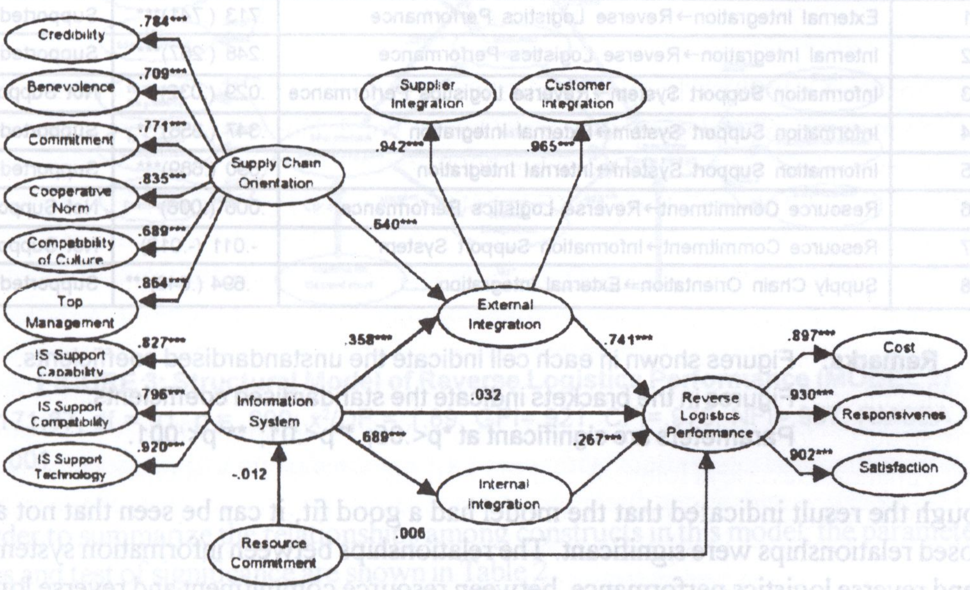

FIGURE 2: Structural Model of Reverse Logistics Performance (MODEL 1)

x^2 = 168.933, df = 949, p = .000; x^2/DF = 1.797; GFI = .921; CFI = .981; NFI = .958, RMSEA = .058; ***p < .001

The parameter estimates showing the structural relationships among constructs in the model are summarised in Table 1.

TABLE 1: Parameter Estimates and Test of Significance (MODEL 1)

Hypothesis	Structural Relationships between	Coefficients	Results
H1	External Integration→Reverse Logistics Performance	.713 (.741)***	Supported
H2	Internal Integration→Reverse Logistics Performance	.248 (.267)***	Supported
H3	Information Support System→Reverse Logistics Performance	.029 (.032)	Not Supported
H4	Information Support System→External Integration	.347 (.358)***	Supported
H5	Information Support System→Internal Integration	.690 (.689)***	Supported
H6	Resource Commitment→Reverse Logistics Performance	.006 (.006)	Not Supported
H7	Resource Commitment→Information Support System	-.011 (-.012)	Not Supported
H8	Supply Chain Orientation→External Integration	.694 (.640)***	Supported

Remarks: Figures shown in each cell indicate the unstandardised coefficients.
Figures in the brackets indicate the standardised coefficients.
Parameters are significant at *p<.05; **p<.01; ***p<.001.

Although the result indicated that the model had a good fit, it can be seen that not all the proposed relationships were significant. The relationships between information system support and reverse logistics performance, between resource commitment and reverse logistics performance, and between resource commitment and information system support were found to be not statistically significant. Thus, while H1, H2, H4, H5, and H8 were supported, H3, H6, and H7 were not.

While the first structural model can test all the main hypotheses, sub-hypotheses could not be tested. Thus, a second structural equation model was developed and analyzed. The results of the model fit indicated that the model 2 fitted relatively well (x^2/DF = 1.89; GFI = .921; CFI = .979; NFI = .957; RMSEA = .062) even when the external integration construct was replaced by its two dimensions, i.e. supplier integration and customer integration. The details of model 2 are presented in Figure 3.

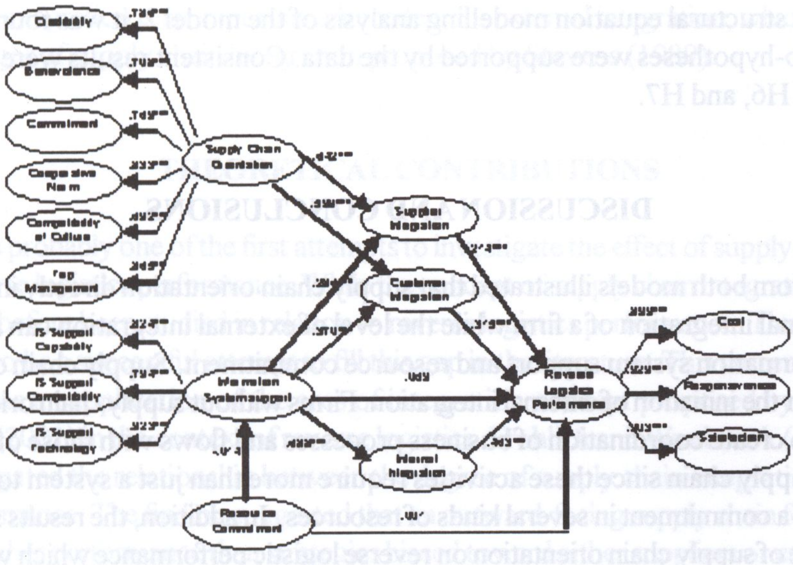

FIGURE 3: Structural Model of Reverse Logistics Performance (MODEL 2)

x^2 = 171.87, df = 91, p = .000; x^2/DF = 1.89; GFI=.921; CFI=.979; NFI=.957; RMSEA = .062; ***p<.001

In order to summarize the relationships among constructs in this model, the parameter estimates and test of significance are shown in Table 2.

TABLE 2: Parameter Estimates and Test of Significance (MODEL 2)

Hypothesis	Structural Relationships between	Coefficients	Results
H1a	Supplier Integration→Reverse Logistics Performance	195 (.214)***	Supported
H1b	Customer Integration→Reverse Logistics Performance	293 (.315)***	Supported
H2	Internal Integration→Reverse Logistics Performance	431 (.463)***	Supported
H3	Information System Support→Reverse Logistics Performance	.065 (.069)	Not Supported
H4a	Information Support System→Supplier Integration	294 (.286)***	Supported
H4b	Information System Support→Customer Integration	373 (.370)***	Supported
H5	Information System Support→Internal Integration	692 (.688)***	Supported
H6	Resource Commitment→Reverse Logistics Performance	001 (.001)	Not Supported
H7	Resource Commitment→Information System Support	-.013 (-.014)	Not Supported
H8a	Supply Chain Orientation→Supplier Integration	735 (.642)***	Supported
H8b	Supply Chain Orientation→Customer Integration	671 (.599)***	Supported

Remarks: Figures shown in each cell indicate the unstandardised coefficients; Figures in the brackets indicate the standardised coefficients. ***Parameters are significant at p<.001.

Based on the structural equation modelling analysis of the model 2, it was found that all the proposed sub-hypotheses were supported by the data. Consistent results were obtained for H3, H3, H5, H6, and H7.

DISCUSSION AND CONCLUSIONS

The results from both models illustrated that supply chain orientation directly influenced the level of external integration of a firm while the level of external integration can also be influenced by information system support and resource commitment. Supply chain orientation is mandatory for the initiation of external integration. Firms without supply chain orientation may not be able to create coordination of business processes and flows with those of other members of the supply chain since these activities require more than just a system to support the operations or a commitment in several kinds of resources. In addition, the results suggested an indirect effect of supply chain orientation on reverse logistic performance which was mediated by external integration. Supply chain orientation leads a firm to initiate external integration with its suppliers and customers which, in turn, enhances reverse logistics performance. The finding also suggested that information system support can significantly influence the level of external integration and internal integration. With more information sharing and cooperation among supply chain partners and among departments inside a firm, the performance of reverse logistics can then be improved. However, in order to generate such performance improvement, the investment in information system support capability, compatibility, and technologies must be made in a way that can enhance the extent of external integration and internal integration of a firm. Although the result suggested that there was no direct relationship between resource commitment and reverse logistics performance, it was found that resources committed to logistics operation would lead to a higher level of external and internal integration. With such integrations, the performance of reverse logistics can be enhanced. Thus, resource commitment is also considered important and necessary for a successful implementation of a reverse logistics program.

Consistent with the literature, the findings suggested that there was a significant positive relationship between external integration and reverse logistics performance and between internal integration and reverse logistics performance. Effective cooperation and coordination among supply chain partners and internal departments would ensure a responsive reverse logistics system. Without proper integration, it would be more difficult to effectively manage product returns. Both external integration and internal integration must be performed simultaneously in order to smooth out the reverse logistics process. A lack of either internal integration or external integration in a supply chain would create a bottleneck which affects the performance of the reverse logistics process. For external integration, this study revealed that it is necessary for a firm to pay attention to both supplier integration and customer integration, since both are important for superior reverse logistics performance. The result of this study also suggested that internal integration is an important antecedent for external integration, which is consistent with the stages of supply chain integration proposed by Stevens (1989).

THEORETICAL CONTRIBUTIONS

This study is probably one of the first attempts to investigate the effect of supply chain integration on reverse logistics performance. While the concept of supply chain integration is not new, it had never before been studied in relation to reverse logistics performance. Thus, this study is considered to be a successful attempt to fill this gap in the literature. This current study can be considered as an application of the arcs of integration concept proposed by Frohlich and Westbrook (2001) in the context of reverse logistics. Frohlich and Westbrook (2001) empirically investigated the relationship between the degree of supply chain integration and operational performance. The finding suggested that an outward-facing supply chain focus is associated with higher performance than strategies biased toward either suppliers or customers. The current study also considered external integration as supplier integration and customer integration independently, but in the specific context of reverse logistics performance rather than operational performance of a firm. The result was in the same direction to that previously suggested. Both supplier integration and customer integration were found to directly influence reverse logistics performance. It can be interpreted that both supplier integration and customer integration are required to enhance the performance of the reverse logistics process, while having only supplier integration or customer integration would lead to an inferior reverse logistics system.

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