# Reverse Logistics: Antecedents of Successful Implementation and Firm Performance Effects

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Reverse logistics has gained significant attention in operations management research in recent years, but few studies have focused on firm characteristics that lead to the effective implementation of reverse logistics processes. Similarly, the effect of reverse logistics processes on firm performance has not been widely researched. This paper reviews relevant literature, conceptually analyzes the role of reverse logistics, and develops propositions regarding the antecedents of effective reverse logistics processes and the effect of reverse logistics processes on firm performance. Factors considered include successful implementation of forward logistics processes, flexibility in transportation processes, proactive motivation for the adoption of reverse logistics processes, and knowledge management processes. Potential future extensions of this research, including empirical studies to validate or refute the propositions, are identified. Insights from this research can inform the design and implementation of reverse logistics processes by practicing managers.

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## I. INTRODUCTION

Reverse logistics has gained significant attention in operations management research in recent years. Attention to environmentally responsible practices and sustainable operations has been influenced by diverse stakeholders, including government agencies and environmental activists as well as business customers and end-users. Environmentally responsible practices in supply chain management are often referred to as *green operations*. Reverse logistics, which involves the flow of products or materials back upstream through the supply chain, is an important element of green operations. Reverse logistics success stories have been widely reported, but research examining firm characteristics that support effective reverse logistics processes is scarce. Similarly, few published papers in the operations management literature have considered the effect of reverse logistics processes on firm performance. This paper addresses those gaps in the literature by offering relevant propositions concerning the antecedents of successful reverse logistics process implementations, and the effect of reverse logistics on firm performance.

A schematic representation of a closed loop supply chain, consisting of typical forward logistics and reverse logistics processes, is shown in Figure 1.

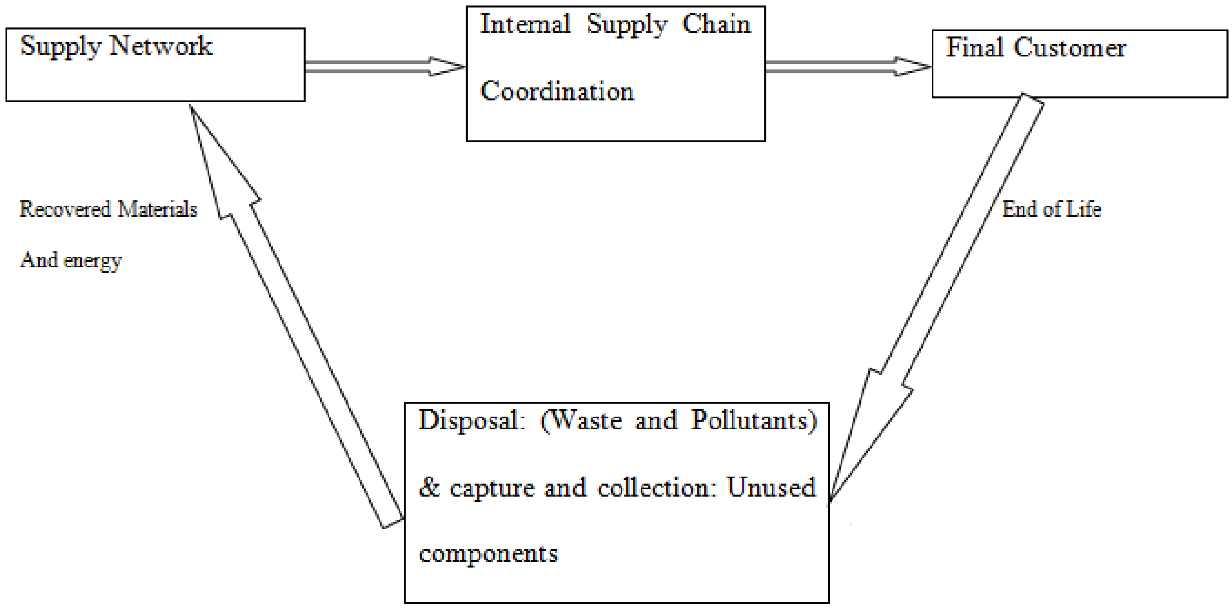


**FIGURE 1. REPRESENTATION OF A TYPICAL CLOSED LOOP SUPPLY CHAIN**

A manufacturing firm has a network of suppliers through which the necessary raw materials, components, and products are brought in. Once they are in, further processing and/or assembly is conducted through internal supply chain coordination. Finished products are then shipped to the firm's external customers. This is the general model of forward logistics processes.

The concept of reverse logistics has gained prominence for a variety of reasons. These include increasing pressure from government entities and other stakeholders to operate in an environmentally responsible way. But it has also become clear that reverse logistics can yield direct business benefits. These benefits can include reduced costs and higher revenue. Reduced costs can result from the recovery and recycling of materials at the end of the life of an individual product unit. Customers may prefer products from environmentally responsible companies; this can increase revenue, raise product brand values, and boost common stock prices.

In response to these developments, the practice of capturing and collecting used products for disposal and/or recycling has become more common. The recovered materials, components, and energy are extracted from the used product, and the waste and pollutants are disposed of in an environmentally responsible and regulation-compliant manner.

In simple terms, reverse logistics is the backward flow of materials and information with an objective to re-use, remanufacture and recycle the useful components, energy content, or the product as a whole. Reverse logistics links the physical movement of all recovered materials from the customers to the suppliers.

Reverse logistics in service settings may require analysis that differs from the perspective applied in manufacturing. Typically, in transportation operations the supply chain focus is distribution, where the starting point is the finished product that must be delivered to the client in a timely manner.

Recovering and putting the recovered products into usable form can be difficult.

Reverse logistics processes are critically important in certain industries. In the pharmaceutical industry, for example, inventory deemed unsuitable must be identified by customers and returned to suppliers in a timely and cost-effective manner. This is particularly important where the health of patients may be put at risk if drugs are not withdrawn from retail environments expeditiously and completely. Given the large number of locations where drugs are kept—including hospital wards, operating theatres, local clinics, and retail pharmacies—this can be complicated and time consuming (Ritchie, Burns, Whittle, and Hey 2000).

Cooper, Lambert and Pagh (1997) list effective procurement, demand management, and order fulfillment as the elements of forward supply chain management. Guide and Van Wassenhove (2002) list reverse logistics, inspection and disposition, reconditioning, and distribution and sales as the elements of reverse supply chain management. In this paper we analyze the relationships in the two directions of material flow, identify relevant linkages, and develop propositions regarding the antecedents of effective reverse logistics processes and the effect of reverse logistics processes on firm performance.

The remainder of this paper is organized as follows. Section two presents a review of the relevant literature. Section three develops the theory and concepts leading to the propositions regarding reverse logistics. Section four discusses the relevance and contribution of this research, considers its limitations, and discusses potential future extensions. Section five presents concluding remarks, and section six lists the references cited in the paper.

## II. LITERATURE REVIEW

Corbett and Klassen (2005) defined reverse logistics as the materials management activities needed to perform product recovery, including the upstream movement of materials and source reduction. Recovery of reusable materials and energy is subject to strict regulations, and affects both internal and external stakeholders of the firm. Strong motivation is often needed to initiate such activities, and to gain economic benefits from this effort. Carter and Ellram (1998) observe that reverse logistics processes must meet two objectives: collecting and reintegrating used products and waste materials into the forward supply chain, and minimizing system-wide resource consumption and environmental impact. These authors explicitly recognize that efficient design and coordination of an integrated two-way supply chain yields higher performance than two separate unidirectional chains. This is consistent with the argument that a broader view, one that includes an environmental perspective, leads to a better understanding of the overall system. It is noted, however, that challenges in managing the incentives and relationships among supply chain partners must be addressed (Carter and Ellram 1998).

Corbett and Klassen (2006) assert that the benefits to OM theory and practice of adopting an environmental perspective are subject to the "law of the expected unexpected side benefits." This means that adopting an environmental perspective is beneficial, but that these benefits usually materialize in unexpected forms—and are often greater after the fact than can accurately be predicted in advance. Implementing reverse logistics incurs costs for transportation, recycling, reuse and/or remanufacturing. The resulting economic benefits may not be immediately recognized and quantified, but these benefits may emerge over the time and in multiple forms—eventually surpassing the initial investment and the operating costs incurred. In a different domain, the claim of Crosby (1979) that "quality is free" (i.e., the view underlying programs such as "zero defects" and "zero waste"), has been applied to environmentally responsible operations by King and Lenox (2002). This argument posits that the reduction of waste yields benefits that can fully offset the related costs. Chandrasekhar, Dougless and Avery (1999) applied a similar argument, noting that environmental responsibility is free based on an analysis of cost reductions. In a more recent study, Reed and Chiang (2012) developed and detailed strategies for gaining competitive advantage through sustainable business practices.

Dowlatshahi (2010) defined reverse logistics, unlike traditional forward logistics, as involving a manufacturing entity that retrieves previously shipped parts and products from the point of-consumption to the manufacturing entity for possible recycling, remanufacturing, or disposal. The use of these recovered components reduces the cost of manufacturing and production and at the same time is environmentally responsible. Thierry, Salomon, van Nunen, and Van Wassenhove (1995) identified three disposition alternatives for companies involved with reverse logistics: direct reuse, which refers to reselling the product; product recovery by repairing, refurbishing, remanufacturing, cannibalization and recycling; and waste management.

Melbin (1995) determined that firms practicing reverse logistics secured other benefits beyond the psychological satisfaction of supporting social causes by reducing the environmental impact of their activities and eliminating waste. These firms can also benefit from stronger customer loyalty due to being perceived as an environmentally aware organization—which can ultimately increase firm revenue and income.

Some studies indicate that firms may adopt environmentally responsible operating practices without specifically focusing on reverse logistics processes. One example of this is provided by Wu, Dunn, and Forman (2012), where a review of green operating practices in large global firms does not specifically highlight reverse logistics processes. This reinforces the view that attention to the effect of reverse logistics processes on firm performance, as considered in this research, is warranted.

Recent literature on closed-loop supply chains focuses on business economics, and treats reverse logistics processes as an element of closed-loop supply chain management. Atasu, Guide, and Van Wassenhove (2008) provide a review of published research on product reuse in closed-loop supply chain research, and treat reverse logistics as an element of remanufacturing processes. Guide and Van Wassenhove (2009) consider reverse logistics in the broader context of developments in research on closed-loop supply chains, and advocate a business economics focus for closed-loop supply chain research. Souza (2013) offers a review and classification framework for closed-loop supply chain research, and recognizes reverse logistics costs as an element of optimization models for network design. The call for research in this general area to address business economics is consistent with our recognition of the firm performance effects of reverse logistics processes.

Researchers investigating the effect of environmentally responsible management practices on firm performance have used different measures of firm performance. Some published papers use market-based measures related to changes in the share price of publicly-traded companies, others use measures drawn from published financial statements, and some papers consider other evaluation criteria. Stock price changes in response to public announcement of environmental management initiatives, awards, and certifications were used as the measure of firm performance by Jacobs, Singhal, and Subramanian (2010). Stock market price performance, as measured by Tobin's $q$, is used as the measure of firm performance for multinational enterprises that invest in emerging nations by Dowell, Hart, and

Yeung (2000). King and Lenox (2002) examine the relationship between environmental initiatives and firm performance; these authors use financial statement-based return on investment (ROI) as well as Tobin's *q* to evaluate firm performance. Menon and Menon (1997) explore the effect of a marketing strategy that emphasizes environmental responsibility, and call for a measure of firm performance that recognizes some combination of (a) increasing sales and profit, and (b) environmental and social performance.

Examples of firm performance measures can also be found in papers that address operations management topics other than environmental management. Hendricks and Singhal (1997 and 2001a) examine the effect of successful total quality management (TQM) implementation on firm performance, and use changes in operating income (Hendricks and Singhal 1997) and changes in operating income before depreciation, sales growth, and the relationship of total sales to total expenses (Hendricks and Singhal 2001a) to measure firm performance. These same authors have also used stock price performance as the measure of firm performance with respect to successful TQM implementation (Hendricks and Singhal 2001b). Jiang, Frazier, and Prater (2006) examine the relationship of outsourcing to firm performance; these authors use operationally-oriented ratios drawn from published financial statements to evaluate firm performance. These ratios include measures of efficiency (sales to total expenses), productivity (total sales to asset classes and total sales per employee), and profitability (return on assets and net profit margin).

## III. THEORY AND PROPOSITIONS

### 3.1. Successful Implementation of Forward Logistics Processes

The level of interdependence among parties in a supply chain is high. This interdependence can present the risk of trading partners displaying opportunistic behavior to the detriment of other supply chain participants. Yet—despite the risks involved—timely order fulfillment, coupled with proper demand management and cost-efficient procurement methods, can positively influence participants' perceptions of the inter-organizational relationship. This can create higher brand value, and positive perceptions among trading partners foster loyalty and dependability within the supply chain. This facilitates the sourcing of materials, components, and products as well as the design and implementation of forward logistics processes.

The major hurdles in reverse logistics involve completing the return of products and components in a timely way, and selling remanufactured or refurbished products while creating the perception that refurbished items can function as well as the original product. An effective forward supply chain process helps to create loyalty among the trading partners and customers, and thus increases the likelihood that these obstacles can be overcome in reverse logistics processes. Timely return of products and components becomes more likely as trading partners and customers develop a sense of accountability with respect to the process. Higher sales may ultimately result as channels are managed properly and customers' perceptions of the firm are elevated. At the same time, it becomes necessary to manage the launch and branding of the refurbished products so that the market position of the newly-manufactured items is not compromised.

Managers should plan and manage their investment in forward and reverse supply chains jointly in order to design sustainable supply chains with reverse logistics processes. This tends to promote balance among environmental responsibility, social responsibility, and profitability - thus honoring the three pillars included in the *triple bottom* *line* model, as coined by Elkington (1994). This includes minimizing waste in the forward supply chain, and effectively managing the reverse supply chain to include product returns for repair, remanufacturing, and material recovery. This paradigm can be extended to include product design for disassembly. Kocabasoglu, Prahinski, and Klassen (2007) pointed out that established supply chain relationships help managers optimize their reverse logistics investment for two reasons. First, information from both suppliers and customers helps managers identify reverse logistics investment opportunities. Second, collaboration in the forward supply chain enhances management of the reverse logistics processes. For example, downstream supply chain partners can collect, sort, and ship used products. Therefore, positive relationships within the supply chain should support better process design and better decision making in reverse logistics.

Accurately estimating transportation cost is an important element of cost management in logistics operations. If the firm has an effective system for outbound transportation management and the parties who perform these transportation activities are reliable, it is likely that the same system and service providers can be used for reverse logistics. Additionally, if it is agreed that the firm or its trading partners will bear the expenses of outbound transportation, this clarity in the forward supply chain supports effective working relationships in reverse logistics processes. On the contrary, discord among trading partners will tend to increase reverse logistics costs. Given that transportation costs generally account for a large percentage of the costs associated with reverse logistics, it is important to have efficient and reliable transportation processes in place. Often the same transportation system and service providers can be used for inbound and outbound traffic; this will tend to reduce the costs associated with planning and executing reverse logistics processes.

The typical forward logistics process involves the transportation of finished goods (following the conversion of raw materials) to support usage, resale, or consumption by the firm's customers. Cooper et al. (1997) pointed out that improving performance in procurement, demand management and order fulfillment requires significant amounts of information for analysis by management. Reverse logistics includes completing the return of materials and acquiring the related information. It is logical to assume that higher efficiency in the forward flow of materials and information in the forward supply chain facilitates the retrieval of products and related information in reverse logistics processes. It is likely that well-developed systems and capabilities applied in forward supply chain operations will yield success in reverse logistics processes.

All of this highlights the significance of forward supply chain design. A better-designed forward supply chain can enhance the probability of successful implementation of reverse logistics processes—providing an efficient way to recover the value and/or dispose of returned products. This can yield significant value-added opportunities. On the other hand, poorly designed and executed supply chain processes will tend to add cost and impede responsiveness.

This leads to the following proposition:

> Proposition 1: *Successful implementation of forward logistics processes positively influences the implementation of reverse logistics processes.*

### 3.2. Flexibility in Transportation Processes

The effective implementation of reverse logistics processes offers many potential benefits. These include compliance with government regulations pertaining to environmental management, satisfactory response to pressure from stakeholders to adopt environmentally responsible business practices, and increased revenue. The probability of realizing these benefits will be maximized if reverse logistics processes are designed and implemented systematically. This includes the design and implementation of effective processes for inbound and outbound transportation. Dowlatshahi (2010) noted that transportation costs play an important role in determining the economic viability of reverse logistics processes. If transportation costs are prohibitively high, the economic viability of the reverse logistics processes will be severely limited. This becomes especially important where, as is often the case, profit margins on remanufactured items are small.

Jayaraman and Luo (2007) noted that delay in transporting returned printers tends to reduce the value remaining in the product. Tracey (2004) identified transportation as a source of competitive advantage. For most companies engaged in reverse logistics, determining the average transportation cost per returned item can be difficult. With that in mind, most practicing managers involved in reverse logistics closely monitor and control transportation expenses. Cost management measures may include optimization modeling for route selection, outsourcing transportation to third-party service providers, and using mixed modes of transportation.

As the preceding paragraphs indicate, efficient transportation processes are critical to the effective implementation of reverse logistics. Transportation is a significant element of reverse logistics cost. Flexibility in transportation routes, mechanisms and forms can yield cost reductions in both inbound and outbound logistics. Transportation service characteristics as identified by Ballou (2003) include speed, dependability, capability, availability and adequacy of equipment, availability of service, frequency of service, security, claims handling, shipment tracing and problem solving assistance. Some of these characteristics play a critical role in cost containment and reduction. Depending on specifics of the situation and required frequency of service and/or reliability, transportation flexibility may be compromised to meet specific needs. For example, it may be possible to consolidate routes so that the same routes and transportation equipment can be used for both new and remanufactured products. In other cases, reverse logistics requirements may make it necessary to establish new routes because the pre-existing routes cannot be utilized efficiently for the reverse product flow.

Several dimensions of transportation flexibility can impact the cost of transportation. Reverse logistics processes can employ single transportation modes or multiple modes in conjunction, including aircraft, ships, rail cars, and road vehicles (Ballou 2003). Transporting goods by multiple modes without unpacking is termed as intermodal transportation.

Each transportation mode has inherent advantages and disadvantages in terms of cost, distance, and flexibility. Air transportation is fast and may be preferable for moving high-value products over long distances, but is expensive in terms of cost per ton-mile. Transportation by ship or barge is inexpensive in terms of cost per ton-mile, but is slow and not available for inland locations. Rail transportation is inexpensive in terms of cost per ton-mile but unreliable from a scheduling perspective. Trucking is more expensive per ton-mile than other land-based modes, but trucks are the most flexible mode and can be used for long hauls over the highway network or for last-mile transportation to locations not served by other modes. Pipeline transportation offers low variable cost, but is only available for bulk products in liquid, gaseous, or slurry forms (Ballou 2003).

Thus, there are many tradeoffs to be considered in designing transportation processes. Intermodal transportation can offer lower overall transportation costs in many forward and reverse logistics applications. As noted by Dowlatshahi (2010), "Intermodal transportation increases the reach of an entity to reclaim parts and products from a larger geographic area; therefore, increasing the viability and profitability of reverse logistics endeavors. Intermodal service must also be timely scheduled to avoid any scheduled production delays or poor machine and labor utilization."

Dowlatshahi (2010) also observed that shipping in bulk maximizes cube utilization while minimizing per mile charges. If shipping in bulk can be combined with freight consolidation for inbound and outbound routes, transportation costs can be reduced significantly. There are, however, situations where firms cannot wait for the entire truckload to fill before shipping because of demand and due date considerations. Again, this highlights the effect of the firm's flexibility with regard to transportation processes and the related costs.

As the preceding paragraphs indicate, flexibility in transportation processes offers potential economic advantages through economies of scale and reduced transportation costs. These advantages can be realized in both forward and reverse logistics processes.

This analysis leads to the following proposition:

> Proposition 2: *Flexibility in transportation processes positively influences the implementation of reverse logistics processes.*

### 3.3. Proactive Motivation to Implement Reverse Logistics Processes

The field of operations management has increasingly embraced the needs of stakeholders other than those with a direct economic interest in the firm. See, *e.g.*, Krajewski, Ritzman, and Malhotra 2010. This gives rise in operations management literature to increasing consideration of corporate social responsibility and the need to operate in an environmentally responsible way. This underscores the desirability of implementing reverse logistics processes *proactively* to support social responsibility initiatives rather than *reactively* to comply with coercive governmental regulations.

The proactive approach to reverse logistics process implementation should encompass concepts such as *life cycle analysis* and *design for environment* that incorporate reverse logistics as a value-added activity that can be used to generate long-term competitive advantage. Under this view, product recycling should not be done only to comply with government regulations, only to respond to pressure from anti-growth environmentalists, or only to match the environmentally responsible actions of competitors.

Responding to such pressures would constitute a reactive strategy where values and processes are not focused on positive outputs. In this situation, reverse logistics activities would be conducted in circumstances characterized by confused and disoriented dynamism.

On the other hand, proactively implementing environmental programs to extract valuable materials from recycled products creates a positive backdrop for the implementation of reverse logistics processes. Applying reverse logistics to reduce costs, improve quality, and increase cleanliness is more likely to yield enthusiastic participation—and therefore succeed—than a program implemented merely to satisfy external pressures (Chandrashekar, Dougless and Avery, 1999).

Given that firms face multiple sources of pressure to meet environmental norms, the optimal response is to create effective reverse logistics processes that will reduce costs and/or boost revenues. It has been argued that firms have increasingly embraced environmental management initiatives and implemented these from an opportunistic perspective. Corbett and Klassen (2006) argued that the acceptance of voluntary environmental programs such as ISO 14000, the Global Reporting Initiative, and various greenhouse gas and other emissions trading schemes, seem to be an immediate consequence of the increased importance attached to the social franchise and its impact on the economic franchise. Handfield, Walton, Seeger, and Melnyk (1997) stated that reacting to regulations is no longer sufficient, and that world-class enterprises must anticipate and pre-empt changing environmental regulations and customer expectations, and must proactively prepare products, processes and infrastructure for these changes without sacrificing competitive advantage.

This brings to mind the following proposition:

> Proposition 3: *Proactive motivation to implement reverse logistics processes positively influences the implementation of reverse logistics processes.*

### 3.4. Knowledge Management Processes

Scholars have respectfully disagreed as to whether the practice of reverse logistics adds value to the firm in generating better performances, or whether reverse logistics processes are implemented in response to coercive, normative and mimetic pressures (DiMaggio and Powell 1983). Evidence is provided by companies like Kimberly Clark, which estimated that US$1 in recycling contributes the same amount to the bottom line as US$14.62 in additional sales (McDermott 1995). Similar successes have been reported by many other organizations including 3M Companies, with their Pollution Prevention Pays (3P) program (Coddington 1993). Other case studies include those by the leading automobile manufacturers who have participated in the Auto Industry Pollution Prevention Project. Blanchard (2007) estimated that product returns cost US manufacturers and retailers $100 billion every year in lost sales, transportation, handling, processing, and disposal. The author further stated that customer returns could reduce a manufacturer's profitability by an average of 3.8% while reverse logistics costs consume 9 cents of every sales dollar. According to Langnau (2001), reverse logistics costs in the United States total approximately $35 billion per year, and analysts have predicted that average cost per product return would be $30–$35 in the near future. Chandrashekar et al. (1999) argued that all case studies, in essence, show that properly administered environmental programs often pay for themselves, and therefore can be considered *free*.

It can be argued that reverse logistics should be implemented with an integrated plan that recognizes the interests of all parties within the supply chain. This should be accompanied by a strategy that is integrated with the launch of new products. New products can be brought to market with recycled materials obtained from reverse logistics processes pursuant to consultation and close cooperation of diverse functional areas within the firm—including marketing, operations, logistics, and finance. The use of recycled materials would lower the cost of these products. This would enable the firm to offer these products at a lower price or a higher profit margin. This application of reverse logistics processes could thus lead to improved performance for the firm.

In seeking to differentiate firms that leverage reverse logistics processes to improve firm performance from firms that do not, the knowledge-based view of the firm may be relevant (Nonaka, 1994; Nonaka and Konno, 1998; Nonaka and Takeuchi, 1995). Knowledge creation theory involves continuous interaction of the epistemological and ontological dimensions of knowledge (Linderman, Schroeder, Zaheer, Liedtke, and Choo 2004), as shown in Figure 2 below.

Explicit knowledge has been defined as that which is transferred through training or communication, while tacit knowledge includes technical and cognitive knowledge which may not be easy to transfer. The epistemological definition of knowledge includes both explicit and tactical elements.

"The ontological dimension of knowledge begins with individual knowledge, and then moves to higher levels including group, organizational, and inter-organizational" (Linderman et al., 2004). The spiral interaction of epistemological and ontological factors yields four patterns: socialization, externalization, combination and internalization; the interaction of these patterns represents the phenomenon of existing knowledge giving rise to new knowledge. Nonaka and Takeuchi (1995) observed that *whenever knowledge is converted through one of the four modes of knowledge conversion, it is amplified and moved to higher ontological levels.* The process of knowledge conversion in the context of reverse logistics is presented in Figure 3. Reverse logistics practices that foster contact and interaction between supply chain members allow knowledge to be created through socialization. Reverse logistics practices that help articulate or conceptualize customer needs so that the desired products can be brought in the market allow knowledge to be created through externalization. Reverse logistics practices that support analysis of information allow knowledge to be created through combination. Reverse logistics practices that promote monitoring and feedback of customer information allow knowledge to be created through internalization.

It is thus conceivable that reverse logistics can positively influence firm performance as the value recovered from recycled materials are reused in new products. These benefits can flow from the generation of new levels of knowledge among the employees of the firm and across the supply chain due to the practice of reverse logistics. This would indicate that reverse logistics and the elevated level of knowledge could lead to better coordination among functional departments within the firm, and among trading partners within the supply chain. The resulting advantages could include efficient practices for the design and launch of new products, and better overall recovery and reuse of reused materials.

The essence of this argument is that knowledge created through the design and implementation of reverse logistics processes supports and enhances organizational performance. Applying the knowledge-based view of the firm provides insight that can help to distinguish organizations that are more successful at deploying reverse logistics practices from those that are less successful. The posited relationship between reverse logistics and firm performance, as mediated by knowledge, is shown schematically in Figure 4 below.

The proposition that flows from this argument is presented as follows:

> Proposition 4: *Knowledge enhancement of firm employees, as suggested by the knowledge-based view, mediates the relationship between reverse logistics and firm performance.*

| | Tacit | Explicit |
|---|---|---|
| Tacit | Socialization | Externalization |
| Explicit | Internalization | Combination |

**FIGURE 2. MODES OF KNOWLEDGE CONVERSION (SOURCE: NONAKA 1994)**

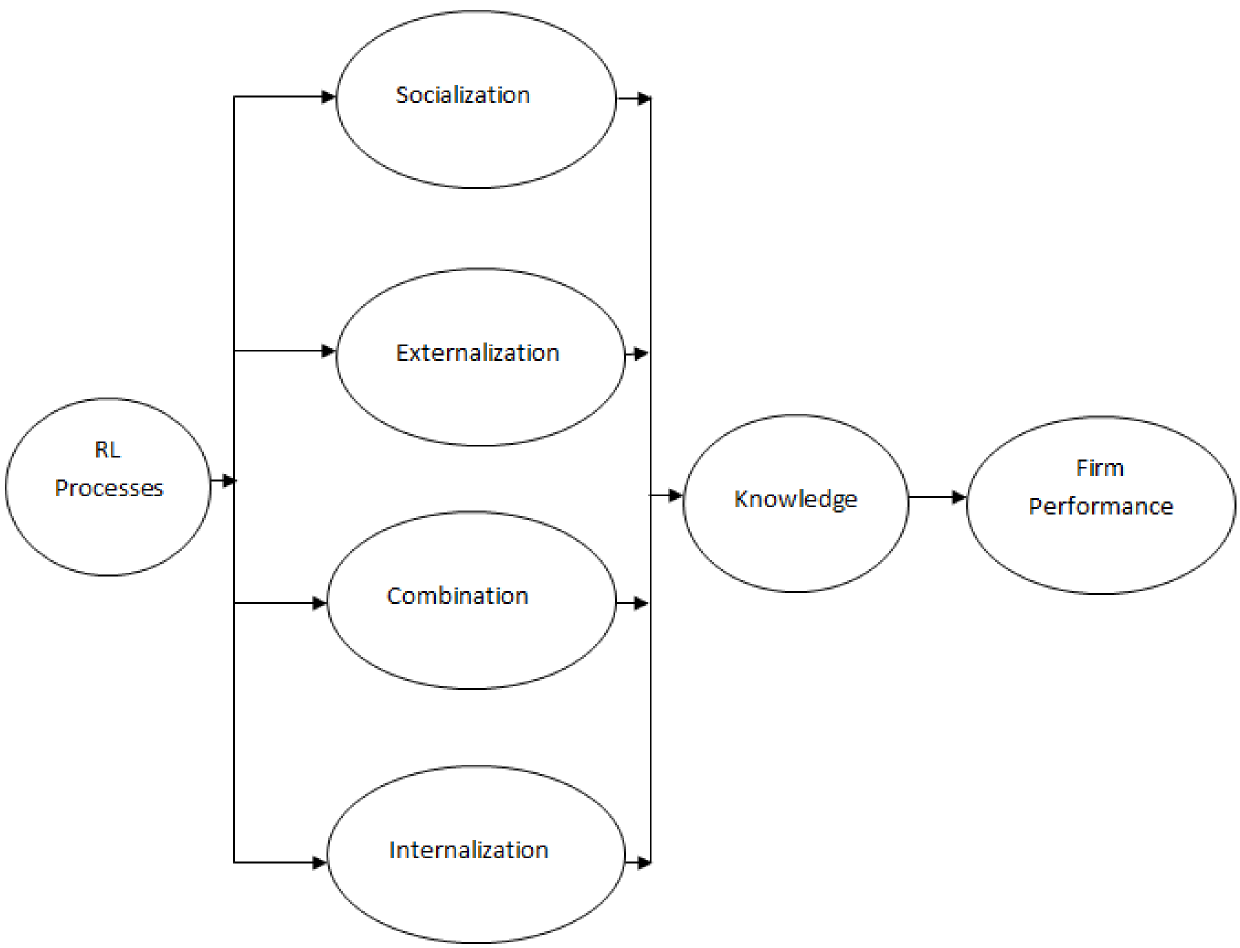


**FIGURE 3. REVERSE LOGISTICS, KNOWLEDGE BASED VIEW AND FIRM PERFORMANCE**

Reverse Logistics → Knowledge → Firm Performance

**FIGURE 4. KNOWLEDGE BASED VIEW MEDIATING THE RELATIONSHIP BETWEEN RL AND FIRM PERFORMANCE**

## IV. DISCUSSION

This paper presents conceptual insights of interest to both researchers and practitioners regarding the reverse logistics and the implementation of reverse logistics processes. The four propositions developed in this paper are summarized below.

> Proposition 1: Successful implementation of forward logistics processes positively influences the implementation of reverse logistics processes.
> Proposition 2: Flexibility in transportation processes positively influences the implementation of reverse logistics processes.
> Proposition 3: Proactive motivation to implement reverse logistics processes positively influences the implementation of reverse logistics processes.
> Proposition 4: Knowledge enhancement of firm employees, as suggested by the knowledge-based view, mediates the relationship between reverse logistics and firm performance.

These propositions, taken as a whole, provide a useful conceptual framework for understanding the antecedents of effective reverse logistics process implementations and the effect of effective reverse logistics on firm performance.

At this point it is useful to consider potential future extensions of this research.

First and foremost, it will be helpful to extend this research by testing the propositions presented in this paper with empirical data. Alternative approaches such as survey research and case studies would be well-suited to test and evaluate the relationships of reverse logistics process implementation to forward logistics processes, transportation flexibility, proactive motivation, and knowledge management. Archival data, including published news articles and financial statements, can be used to test and confirm the relationship between reverse logistics and firm performance. Comments on appropriate methods and data collection approaches for extending this research follow.

With regard to survey research, the methodology set out by Forza (2002) would be appropriate for evaluating the propositions developed in this paper. This would include detailed construct development, survey design and development of measurement instruments, pilot testing with a preliminary sample survey, data collection from the relevant target population, data analysis and hypothesis testing, and generation of the empirical research report. We would regard members of one or more logistics-focused professional associations such as the American Society of Transportation and Logistics (ASTL) or the Council of Supply Chain Management Professionals (CSCMP) as an appropriate target population for survey research to test the propositions.

With respect to case study research, a useful approach for logistics and related fields is provided by Ellram (1996). This approach would be appropriate for gathering firm-specific data and qualitative information from multiple companies to evaluate the propositions developed in this paper. This would include design of the case study, selection of firms to be included in the study, development of the research protocol and interview questions, completion of a pilot study, evidence collection, data analysis and coding, evaluation of the propositions, development of additional findings, and preparation of the case study report. Single-site case studies could be useful for exploratory research in this area (Dowlatshahi 2010, citing McCutcheon and Meredith 1993), while multiple sites would be preferred in order to use case study results to rigorously evaluate the propositions (Eisenhardt 1989).

With regard to firm performance measures to be used in empirically testing the propositions offered in this paper, we would propose to use archival financial data from published financial statements. More specifically, we would follow the example of Jiang et al. (2006) and use ratios that measure aspects of operational performance such as efficiency, productivity, and profitability. This choice is consistent with comments offered in Hendricks and Singhal (1997) and Jiang et al. (2006) to the effect that it is preferable to measure firm performance with archival financial statement data—as opposed to using managers' self-reported and perceptual opinions (survey responses) for this purpose.

The selected firm performance measures are specified in Table 1. The formulas in Table 1 vary slightly from the formulas used by Jiang et al. so that the contemplated ratios are calculated in a manner consistent with practices that are widely used in managerial accounting (e.g., Horngren et al. 2009).

## TABLE 1. FIRM PERFORMANCE METRICS

| Metric Categories and Descriptions | Calculation Formulas |
|---|---|
| 1. Cost efficiency | |
| 1a. Selling, General & Admin Expense / Sales | SG&A / Sales |
| 1b. Operating Expense / Sales | (SG&A + COGS) / Sales |
| 2. Productivity | |
| 2a. Asset Turnover | Sales / Average Total Assets |
| 2b. Fixed Asset Turnover | Sales / Average PP&E Net of Depreciation |
| 2c. Inventory Turnover | COGS / Average Inventory |
| 2d. Sales per Employee | Sales / Average Number of Employees |
| 3. Profitability | |
| 3a. Return on Assets | (Net Income / Average Total Assets) × 100% |
| 3b. Net Profit Margin | (Net Income / Sales) × 100% |

Source: Jiang, Frazier, and Prater 2006.

Other empirical studies can be conducted to support additional extensions of this research as they are discussed below.

Location and facility layout issues with regard to reverse logistics process implementations could be examined in future studies. It would be useful to identify and study factors that distinguish situations where collection points for returned products should be (a) in retail stores or other primary customer service locations, (b) co-located at major customer sites, or (c) subject to site-specific dispatch of transportation vehicles for on-demand pick up.

The effect of delivery *speed* and *reliability* issues on the effectiveness of reverse logistics process implementation would be another promising avenue of investigation. From the perspective of reverse logistics processes as a source of competitive advantage, it would be useful to identify and study the tradeoffs among delivery speed or reliability versus the cost advantages of accumulating returned product to container or truckload quantities before shipping them to a recycling facility. In many cases it will be economically advantageous to use open vehicle capacity following a forward delivery to transport returned goods in what would otherwise be an empty or "deadhead" return trip.

Notwithstanding the attention devoted to reverse logistics in peer-reviewed literature and in the business press, many companies have yet to design and implement optimal processes for reverse logistics. It would be useful to conduct exploratory research, such as case studies and action research projects, to understand what prevents firms from embracing reverse logistics and to define frameworks for cost-benefit analyses focused on reverse logistics implementations. It is possible that the *cost not to solve* methodology presented by Napier and Prater (2011) could be applied in the context of reverse logistics process proposals. One variant of this exploratory research could assess and compare the nature of specific problems encountered as reverse logistics processes are designed and implemented.

The research highlights a number of significant issues regarding reverse logistics process implementations, but it is appropriate to recognize the limited nature of this study. The primary limitation is that the paper addresses conceptual issues without empirical verification. It is intended that this paper will define and guide the execution of a research agenda that will include empirical research along the lines set out in the preceding paragraphs.

## V. CONCLUSIONS

The effects of reverse logistics on supply chain operations are potentially significant and should not be overlooked. This paper develops four propositions concerning the successful implementation of reverse logistics processes, and the potential effect of effective reverse logistics on firm performance. Factors considered include successful implementation of forward logistics processes, flexibility in transportation processes, proactive motivation for the adoption of reverse logistics processes, and knowledge management processes. Potential future extensions of this research, including empirical studies to validate or refute the propositions, are identified. Insights from this research can inform future research in reverse logistics, and can guide the design and implementation of reverse logistics processes by practicing managers.

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