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Closed-loop supply chain collaboration: A study of the packaging industry

Abstract

Proactive sustainable manufacturing practices across forward and reverse supply chain (SC) is a key to achieve sustainable SC performance. Firms need to champion sustainable practices through committed involvement of collaborating SC members. The success of collaboration decides how capable focal companies are to transform sustainable operational practices into sustainable SC performance. Successful collaborative factors are not well understood in the sustainability literature, hence this paper attempts to understand and answer the question of what are the dominating factors that could enable focal companies to successfully collaborate with its supply chain members to improve operations in closed-loop supply chain (CLSC) activities. The study uses mixed-methods including case study and empirical survey to develop and validate a framework of collaborative CLSC. Two main findings of our research are: (1) although the success of CLSC collaboration lies in the involvement of SC members in supply chain collaboration, the actual commitment of the SC members in CLSC operations is equally important; (2) members involved in CLSC activities are not necessarily committed for sustainability investment, resource sharing and incentive sharing. The proposed collaborative CLSC framework will be helpful for focal companies to retain value from the product returns, avoid future risk of landfills, and also adhere to sustainable operational approach.

Keywords: Closed-loop supply chain, sustainable manufacturing, collaboration, product returns

Track: Inter-organizational Collaboration

Word count: 7,712

1. Introduction

One of the solutions to achieve triple-bottom-line in industries, which have attracted increasing attentions from lead practitioners and researchers, is to create closed-loop supply chains (CLSC) covering the entire life cycle of products, which integrate classical forward supply chain processes from raw materials to customers and the reverse supply chain processes including, recycling, reusing, repairing, remanufacturing, and disposing, triggered by faulty products, product returns, or end of product life disposal (Daugherty et al., 2001; Mondragon et al., 2011; Govindan et al., 2015).

Although some businesses (for example, perishable food products and lingerie products) impose specific conditions on product returns, for majority of businesses, accepting product returns has become almost mandatory due to the higher consumer rights than ever before. In order to maximize profit, effective handling and disposition of returned products before the value erode, is highly crucial and challenging for businesses. This task requires a high level of collaboration and effective coordination among firms in the supply network for planning and logistics to support quick reselling and handling of the returned products (Ramanathan, 2013; Beh et al., 2016).

In order to streamline the recycling processes, the SC necessitates close collaboration and support from SC members. For example, Dell is recycling its products on collecting directly from the customers or through waste collectors in collaboration with local city councils. However, factors such as supply uncertainty, testing and sorting and, interrelation between forward and reverse flows make the reverse logistics a complicated task (Fleischmann et al., 2004). Effective recycling needs collaborative involvement and support from other SC members.

In this study, we aim to investigate the collaborative relationship among SC members in forward and reverse supply chain activities as part of the CLSC aiming to improve business performance to create win-win situations. In this research we develop a collaborative CLSC framework that focuses on supply chain members' involvement and commitment in CLSC activities in facilitating business successes of the SC collaboration.

To support our research, we carried out a two stage empirical study. In stage 1, we conducted an exploratory case study in a manufacturing company producing packaging materials and dealing with end-of-life products and product returns. We have chosen the packaging industry as it poses a great threat to the environment and sustainability practices of supply chains and also has high volume of reverse logistics for returned products and end-of-life products, while performing forward logistics for new or reprocessed products. We align the literature review to verify the case findings in the following areas – the role of stakeholders' pressure in SC operations, resource sharing, causes and challenges of product returns. In stage 2, based on the literature and the case study observations we have developed a collaborative CLSC framework and the research hypotheses. We conducted a questionnaire survey to test these hypotheses.

2. Literature and research background

Traditionally, the main objective of SC collaboration is to bring supply chain players, including suppliers, manufacturers and wholesalers/retailers together to provide better product and service to buyers at lower costs (VICS, 2002). For example, resource sharing between SC

members is evident in the form of third party logistics (3PLs), shared truck spaces, and shared warehouse facilities. These approaches improve deliveries while the cost of operation is shared among all players and hence the cost of each transaction is kept low.
Nowadays, environmental regulations and stakeholders' pressures bring SC players together to collaboratively adopt best operational programmes to reduce environmental impacts (Ramanathan et al., 2017). For example, some SCs use resource sharing as a strategy to reduce waste, while others use incentive sharing as a tool to encourage collaborating members to take part in new cleaner operational initiatives. Both these approaches are well recognized in the literature drawn on theories such as resource-based view and transaction cost theory (Barney, 1991; Frauendorf, 2006, p.53).

Although SC collaboration is a common phenomenon in forward SCs, the concept of SC collaboration in reverse SC has gained attention from researchers only since the last two decades (e.g., Fuente et al., 2008; Bai and Sarkis, 2013; Beh et al., 2016). In this paper, we follow Dowlatshahi's (2000) definition of reverse SC, which refers to a cost effective flow of material and information from the consumer to the point of origin for the purpose of recapturing value (recycling/remanufacturing) or disposal triggered by product returns.
In general, all SC collaborations (especially in forward SCs) have material flow and basic information flow at the initial stage of collaboration (Ramanathan et al., 2011); meanwhile the financial flow will be taken care of by proper incentive alignment in front-end agreement of the companies (VICS, 2002). Although, both forward logistics and revere logistics share some commonalities in terms of flow of materials and information, SC collaboration in reverse SCs is fundamentally different from those in the forward SCs. In reverse SCs, it is hard to identify the responsibilities and roles of SC players, as boundaries of activities of reverse SCs are blurring. This is because the reasons for product returns and chances of reselling may determine the actual involvement of each SC player. As a result, the SC collaboration in reverse SCs also becomes hugely complex.

Previous research studies have identified numerous reasons for product returns specific to retail sales. For example, in catalogue retailing, specific reasons for product returns have been identified as wrong product, wrong address and customers' change of mind about the purchase (Daugherty et al., 2001; Shaharudin et al., 2015). The product returns can also happen due to consumer rights, so that customers are allowed to return the product within a limited period of purchase. There are also other reasons for product returns – customers' attitude, end of lease period, end-of-life, improper information, defective product etc.

Nowadays, reverse SC is getting more and more important in modern supply chain management, due to regulations, stakeholder influences, and requirement of value retaining of businesses. It is of important business interest that every returned product are sold or recycled or remanufactured before the value erodes. For example, Aldi is managing its customer product returns within their stores by reselling the product in the same packaging or repacked to sell at a reduced price. Hence, handling of the product returns and end-of-life returns are two parts of reverse logistics operations that need attention of the whole supply chain to improve the overall operational performance (Dowlatshahi, 2000). In achieving good operational performance in reverse logistics, internal commitment of all players is the main driver, but uncertainty in product return is the foremost constraint (Carter et al., 1998). While this uncertainty is unavoidable, the situation can be better managed with the help of collaborative efforts of supply chain members.

Nevertheless, the lack of any specific theory on reverse SC has motivated many academicians to work on construction of one of its kind with more holistic view on practical applicability (Dowlatshahi, 2000; Carter et al., 1998; Anderson, 1993). For example, some recent articles discussed the role of reverse logistics and the impact of governmental pressure on performances of Chinese manufacturing sectors (Abdulrahman et al., 2014; Lai et al., 2013). However, the integration of reverse SC activities within the forward supply chain operations is rarely discussed in the literature (Beh et al., 2016). One possible reason could be a lack of strong theoretical background and clear views on reverse logistics operations (Carter et al., 1998).

Dowlatshahi (2000) tried to develop a theory on reverse logistics from the existing literature. According to the author, good knowledge and the best practices on operational factors will assist a company to use reverse logistics. In the context of Canadian pharmaceutical industry, Anderson (1993) emphasized the need for collaborative integration among various players to develop new organisational strategies in order to survive the market competition. Fuente et al. (2008) tried to integrate the forward and the reverse SC operations in a case of metal-mechanic firm to redefine the company's management procedures. Interestingly, Östlin et al., (2008) classified the relationship between SC players based on the type of returns and also on the available remanufacturing opportunities. Some researchers used case study method to explore the diversity of eco-innovations and environmental impact (Carrillo-Hermosilla et al., 2010). Büyüközkan and Arsenyan (2012) presented a detail literature review on the role of collaboration in product development programmes. A few studies discussed the moderating role of product complexity in new product development under SC collaborations (Caniato and Größler, 2015; Garengo and Panizzolo, 2013). However, in the previous literature, not many empirical studies have discussed the role of SC collaboration in CLSC activities in improving the business performance of the SC players. The findings of previous studies were largely fragmented and offered limited substantive theoretical implications.

In an attempt to provide a good insight to companies that are involved in SC collaboration in both forward and reverse SC operations, we first try to understand the current SC collaboration practices of a packaging company engaged in reverse SC activities. We then use the knowledge gained from the case study observations to develop a theoretical framework and research hypotheses which are verified using an empirical survey questionnaire. By analysing the data, we aim to identify the role of SCs collaboration and its impact on CLSC performance objectives.

3. An exploratory case study

In an effort to develop a collaborative CLSC framework, we conducted a case study of a packaging company to gain insight into CLSC activities in practice on the basis of current literature on sustainability practices of companies. We attempt to acquire new insight into CLSC operational practices and challenges faced by the companies during SC collaboration. To understand the adaptability of collaboration in the reverse SCs, we have chosen to conduct a case study in an Indian packaging company – JuteCo – which is dealing with companies in many other industries. As packaging materials are widely used in manufacturing, distribution, wholesale and retail sectors, the packaging company needs a high level of recycling capability. Building on the literature and the analysis of case observations of JuteCo, we attempt to identify the importance of collaborations in CLSCs.

In this case study, we use ‘case observation’ method (Voss et al., 2002) as a primary way of identifying the current practices in the case company with CLSC activities, including logistics processes involved in recycling. We conducted case observations by multiple field visits to the case companies combined with in-depth interviews with company personnel over three years to form triangulation of data and to enhance validity of the case findings. Multiple in-depth semi-structured interviews were conducted with one CEO (or equivalent) and two operations managers of the company. One of the operations managers was responsible for remanufacturing and recycling of products sold outside Asia (mainly European countries) and the other operations manager was in-charge of recycling within India. Each interview lasted for one to two hours.

3.1 Supply chain collaboration in packaging industry

JuteCo is an Indian manufacturing company producing ‘ultraviolet’ (UV) treated Jumbo bags that could be used in multiple industries, such as petrochemical, mineral, dyes and pharmaceutical industries. Chemical and herbal products are delivered using these bags across countries in big packaging bags. These big bags are then transferred to many small bags to be transported locally for various sites to make different chemicals or medicinal products. In such cases, UV treated bags have great functional values to maintain quality of the products. Each Jumbo bag can carry up to 2,000 kg materials. The company operates from India, with an annual turnover of about 25 million US Dollars. The company holds nearly 20% of market share in the local packaging industry. JuteCo maintains a healthy relationship with its customers and currently the company is managing more than 100 regular customers from around the world. For the past five years the company is collaborating with their downstream supply chain members for sales and product recycling.

Previously, green agendas of the local government have forced the JuteCo to introduce reverse logistics in the SC processes to handle product returns and the end-of-life product recycling. Here end-of-life products refer to products which are non-usable in its original form. To reduce cost while satisfying the environmental regulations, the company uses the same logistics providers for the forward and the reverse SC operations, because JuteCo expects that the same logistics provider understand the nature of product and returns better and can more quickly respond to reverse logistics requests. Such arrangement helped the companies to form close collaborative relationships over the years.

The product returns of Jumbo bags are mainly due to three reasons: misspecification, end-of-life or end of UV effect (see Figure 1). The recycled packaging product is highly encouraged by local government and also by JuteCo’s collaborating partners. Products returned for reasons of misspecification will normally be sold in another market. Instead of disposing the used bags, the company is trying to extend the life of the used bags by giving UV treatment and also by increasing the thickness of the bag. Bags that have the possibility of being upgraded (for example, bags that need UV treatment) will be processed with UV rays and will be resold in the same market for cheaper prices or sold to other customers with smaller profit margins. Other end-of-life product returns are recycled and used as a raw material for further production of Jumbo bags.

Insert Figure 1 about here

From 2004, JuteCo has adopted a new recycling programme by entering into the engineering field of backward integration process. The backward integration is a process of converting polypropylene into fabric, which is one of the main raw materials for Jumbo bags. This programme has helped JuteCo to save cost on raw materials and also made the company to be partially self-sufficient on raw materials. The method of backward integration has helped the company to reduce lead time by up to 20-25% and also to improve production flexibility. JuteCo has been enjoying the freedom of scheduling of production of Jumbo bags based on their own raw material – fabric production; this indeed has helped to reduce inventory cost and freight charges.

These approaches of recycling and remanufacturing are not only environmental friendly allowing continuous operational improvement in CLSCs, but also allowing the company to improve customer satisfaction by offering incentives across the SC in a variety of ways. For example, SC members with good long term commitment are rewarded with discounted price for involving them in the reverse SC operations. This discount accounts for a minimum of 10 percent to a maximum of 15 percent of the sales price, which served a very good incentive for supply chain members to continue to be involved in the reverse SC operations.

During the SC collaborations, information exchange with SC partners was found to be essential for the company to be more responsive to future orders. However, not all the information exchanged is actionable without prior planning. For example, requirement of bags with ‘variable thicknesses’ cannot be produced immediately without planning and scheduling, because it may also require additional machinery in production to avoid lost in sales. At times JuteCo fails to match customers’ requirements at demand. This may result in product returns. For this reason, JuteCo is interested in establishing intensive collaboration with customers during the planning stage for product specification, which can continue through production and replenishment. For production planning, JuteCo uses informational input from their customers for design, size and other specifications like weight tolerance and UV treatment. Such collaboration between JuteCo and their customers enables the company to produce more precisely according to customers’ requirements and also replenish on-time.

Most of JuteCo’s communication with their upstream and downstream SC members is made through iMail Server. This is one of the advanced low cost communication technology works well independently or with the presence of other servers, such as Email server, SMTP, POP3 and IMAP. The company’s recent upgrade of ICT technology was proved effective in reducing the complexity in communication with SC members. JuteCo believes that their recent investment will improve the communication and help avoiding replenishment delays.

The case of JuteCo clearly specifies that CLSC activities help the company to reduce cost and to improve profitability. For example, after implementing CLSC collaboration JuteCo has benefited from nearly 50% growth in the sales (see Figure 2). Finding and secure sales opportunities in primary and secondary market has once been a challenging task for JuteCo before SC collaboration. Now SC collaboration helped the company to manage this task effectively by collaborative efforts of SC members.

Insert Figure 2 about here

Moreover, the company's incentive policy encourages the SC members to be involved in reverse SC activities as part of their operations. Committed suppliers are rewarded with discounted price for involving them in the reserve logistics operations. This has helped the company to attract and retain many customers from around the world. The case of JuteCo shows the importance of SC collaboration to effective CLSC activities. Despite that effective communication are essential for companies to collaborate for successful reverse SC operations. Moreover, the collaboration between JuteCo and its SC partners creates its own virtuous cycle, as the more involved the SC partners are in CLSC activities, the more committed they became. Because, both sides of the SC partnership tend to share more incentives for collaboration and higher levels of investment in the relationship.

4. Collaborative CLSC framework and hypothesis development

The concept of collaboration in supply chain strongly recommends involvement of members in all possible operations for planning, forecasting and replenishment. It was found that a formal agreement on SC collaboration helps to improve the operational performance of involved members in a structured framework with the aim of maximizing profit through improved planning and logistics services (Stank et al, 2001).

SC collaboration in forward SC and related operations are well discussed in the literature but this is not the case for the operations of reverse SC (Stank et al., 2001). One of the main reasons is that till 20th century, it was believed that the reverse SC flow is required only for products that contain plastics, papers, metals and other materials (Dowlatshahi, 2000). Due to increasing environment concerns, wider recycling and waste disposal have become the norm for almost all the industries as required by government regulations and consumer groups.

Apart from being environmentally friendly, reverse SC are also treated by many companies as a second chance to profit and reclamation of asset (Daugherty et al., 2002; Beh et al., 2016) to generate higher returns on investment (Melbin, 1995). However, the involvement into reverse SC by supply chain members can be limited due to complex processes, potential unequal distributions of costs and benefits between partners, and the lack of regulation clarities in the reverse SC (Daugherty et al., 2002). As a result the collaboration between supply chain members becomes a necessary condition for involving supply chain members into reverse SC operations and in CLSC activities. In this paper, the involvement refers to active participation of SC members in forward and reverse SC operations as parts of the CLSC.

In the reverse SC operations, it becomes very important that the value of items returned to the original seller or the original equipment manufacturer (OEM) should be higher than the operational costs incurred, such as shipping and customs costs (Tan et al., 2003). According to Kulp et al. (2004) the holding cost of a returned item is dependent on physical size, perishability and value of the product. It is argued that if the same players of the forward SC operations are used for handling reverse SC operations, the cost of operations (e.g. sorting/logistics) will be reduced (Olorunniwo and Li, 2010). This is also reflected from the case study of JuteCo, as JuteCo effectively reduced the cost of handling returns when same logistics providers are used for its forward and reverse SCs through financial incentives. Therefore, supply chain collaborations will lead to higher level of involvement of supply chain members in both forward and reverse supply chain operations. We use the above discussed points on SC collaboration to support the development of the first two research hypotheses:

Hypothesis 1: Forward supply chain collaboration is positively related with the involvement of supply chain members in the CLSC.
Hypothesis 2: Reverse supply chain collaboration is positively related with the involvement of supply chain members in the CLSC.

Because purposes and reasons for product returns vary greatly, there are many uncertainties involved in forecasting the timing and quality of product returns, as well as the exact quantity or volume of product returns. As a result, product returns will pressurize the inventory systems of companies by unpredictable building up of inventories. Previous studies provided evidence that collaborative information sharing and joint decision-making on product sales and inventory position as in the forward SC helps accurate planning and forecasting of many leading companies (Ramanathan and Muyldermans, 2010). For example, sharing of inventory information and conducting collaborative forecasting of demand between supply chain partners can help the future planning and replenishment so that to improve the value of SCs (Kulp et al., 2004; Ramanathan and Muyldermans, 2010). Similarly, information sharing on product returns among SC partners as in a reverse SC can also help to increase the rate of reselling or to reduce wastes (Wiengarten et al., 2010) and thus having a positive impact on planning and production and related cost savings. For example, if SC members collectively plan the warehouse facilities and the return centres, some costs of inventory, transportation and waste disposals will be reduced (Marien, 1998). From the case of JuteCo, we understand that the performance of product returns handling (e.g. for repairing/reselling/recycling) will be improved if the supply chain members have gained prior knowledge through collaborative information sharing. Such operational improvement reinforces the positive expectations of the SC members and the commitment of SC members to continue the collaboration in CLSC activities. Our interaction with ten SC members of JuteCo showed that they all highlight the importance of collaborative information sharing and decision making for both forward and reverse SC operations for better commitment with the forward and reverse supply chain collaborations. In essence, it is understandable that collaborative decision-making in the form of information sharing enhances the committed participation of SC members in both forward and reverse SCs and thus in CLSC operations. This argument helps formulating our next hypothesis:

Hypothesis 3: Collaborative decision-making is positively related to the commitment of supply chain members in the CLSC.

According to Daugherty et al. (2001), SC players’ invest into information technology, warehousing, logistics, and other SC activities reflect their responsibilities, share of risk and profit and the specific role to play in the SC collaboration. For example, to reduce costs and losses in value, many SC players make strategic safety-stock decisions by taking into account the additional inventories arise from ‘return-reuse’ activities (Minner, 2000). In high priced digital electronics industry, the investment strategy of supply chain players is highlighted where rapid price erosion is common in the supply chain process (Sciarrotta, 2003). Previous research suggested that resource sharing and incentive sharing as well as information sharing among SC members play a key role in encouraging the participation and further investment into the collaboration and thus the committed relationship (Daugherty et al., 2001; Ramanathan and Muyldermans, 2010).

According to Giannetti et al. (2013) ‘logistics structure’ is one of the important factors in managing the reverse SC in steel manufacturing, so that the sharing of responsibilities and incentives will shape the performance of the reverse SC. Such structure can be further developed into a well-connected network creating value to the organisations involved (e.g., Romero and Molina, 2011). Nyaga et al., (2010) found that SC partners' investment on collaborative activities will have a positive impact on trust and commitment between partners. From the existing literature, we draw that interests of collaborating partners in improvement programmes, such as investments in sustainable operations and resource and incentive sharing, will encourage commitment of the SC members in CLSC activities. Based on the above discussion, we formulate the next research hypothesis as follows:

Hypothesis 4: Interest in sustainable investments, resource and incentive sharing between supply chain members is positively related to the commitment of the supply chain members in the CLSC.

Previous research suggests that collaborative activities between supply chain partners will lead to higher level commitment and trust between the partners (Nyaga et al., 2010), which are important indicators of embedded relationship (Uzzi and Lancaster, 2003). Such embedded relationship is normally coupled with higher levels of knowledge sharing and reciprocal exchanges (Uzzi and Lancaster, 2003). More involvement in collaborative activities will facilitate the willingness of partners for further interaction and collaboration. In this study, we argue that there is positive influence of supply chain members' involvement in forward and reverse supply chain activities on the level of commitment of supply chain members in such activities. Higher levels of involvement between supply chain members are more likely to facilitate joint problem identification and problem solving. For example, the case of JuteCo suggests that customers of JuteCo are more likely to participate into cost saving reverse supply chain initiatives when they have previously involved in such initiatives or has ongoing collaborations with the JuteCo. These discussions formulate our next hypothesis:

Hypothesis 5: Supply chain members' involvement in the CLSC is positively related with the commitment of supply chain members in the CLSC.

There is general consensus that the SC collaboration will enable better inventory management and better supply chain performance (e.g., Cousins et al., 2008; Ireland and Crum, 2005). Such a positive relationship will apply not only to firms' forward supply chains but also to the reverse supply chains. From the case of JuteCo, it is evident that the commercial returns will have more opportunity to resell with the help of the same collaborative SC members in forward and reverse SCs, for example through discount sales. Similarly, end-of-life returns will have better rate of recycling when same collaborative SC members are used. For both commercial returns and end-of-life returns, the manufacturer (JuteCo) would expect sufficient levels of involvement and commitment from its SC members.

Nyaga et al. (2010) examined the supply chain collaboration from the perspective of both suppliers and buyers. They identified that higher level of commitment of collaborating partners will lead to better relationship performance. Ramanathan (2012) suggested that high level of collaboration namely 'futuristic collaboration' will support the success of supply chain operations. However, this 'futuristic collaboration' will be possible only when the collaborating partners trust each other and also ready to share quality information with full commitment (Wiengarten et al., 2010; Nyaga et al., 2010). In this study, we argue that supply chain members' involvement and commitment in the CLSC activities are preconditions for superior SC collaboration performance. Based on this understanding, we posit our next two hypotheses:

Hypothesis 6: Supply chain members' involvement in the CLSC is positively related with supply chain collaboration success.
Hypothesis 7: Supply chain members' commitment in the CLSC is positively related with supply chain collaboration success.

These research hypotheses are presented in the theoretical framework shown in Figure 3. To test these hypotheses we have carried out an empirical survey which is explained further in the next section.

Insert Figure 3 about here

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5. Empirical survey

Following the case observation and the establishment of the theoretical framework, we conducted a structured questionnaire survey with senior managers of JuteCo and its SC partners to collect further information on the importance of collaborations in the CLSC. The theoretical framework was further tested based on structural equation modelling (SEM).

5.1. Survey administration

JuteCo has around 10 suppliers and 140 buyers with longer term business relationships. Unlike Nagya et al., (2010), who conducted the survey with both suppliers and buyers, we have restricted our focus only to buyers' collaboration with JuteCo. This is because the supplier base of JuteCo is only 10, which is too small to form a meaningful comparison with the collaboration with buyers. Moreover, in our study, we only consider customers of this case company operating in the packaging industry which are either buyers or direct users of packaging. This approach ensures better focus to bring out different perspectives of customers on similar SC collaborative arrangement while avoiding confounding effects when comparing different arrangements in different sectors.

The list of buyer companies are obtained from JuteCo, which use UV treated bags from the JuteCo. The contacts of the buyer companies are further verified and complemented with public databases. The questionnaire was pilot tested with field experts and a small sample of JuteCo's managers to ensure clarity, accuracy of wording, and ease of understanding by the respondents. Following the pilot test, we sent a structured survey instrument with 20 items to 140 buyers of JuteCo.

With the assistance of the focal company, response rate of the questionnaire was very high (above 78.6%). The responses did not contain any common response bias because all the responses were collected through the focal company from its buyers at different times when they are placing the orders (Podsakoff et al., 2003). We obtained 110 responses from 140 delivered questionnaires; remaining 30 respondents had not responses or were not reachable because their businesses were out of market. The final dataset consists of 101 completed responses from 110 respondents. Non-response bias was checked using the 'means difference' test to the early and late responses (Armstrong & Overton, 1977). No significant mean differences were evident, thus suggesting non-response bias is not an issue.

5.2. Measurement items, reliability and validity

Based on the case study and the relevant literature we have developed the questionnaire survey instrument. Total of 20 measurement items are used to construct 5 first order latent variables. These variables are named as: forward supply chain collaboration – FSCC (Ireland and Crum, 2005), reverse supply chain collaboration – RSCC, collaborative decision-making – CDM, and interest in investments and sharing – INT (Ellinger et al., 2000). We measure collaboration success through sales growth and new business initiatives (Ramanathan and Gunasekaran, 2014). Commitment – CMM (Nyaga et al., 2010) and involvement – INVM (Wiengarten et al., 2010) are indicated as second order constructs through the first order latent variables. We used 5-point Likert type scale (1 – strongly disagree and 5 – strongly agree) for all measurement items. Table 1 reports the inter-correlations among constructs and composite reliability. Composite reliability for all first order latent constructs are above 0.9 (diagonal elements in Table 1) and hence proves the extent to which the items in each construct consistently measures the latent variables (Hair et al., 2006).

Insert Table 1 about here

The first order constructs FSCC (5 observed variables) and RSCC (5 observed variables) explain the involvement of SC players in collaboration for CLSC (INVM). The first order constructs CDM (5 observed variables) and INT (3 observed variables) explain the commitment of CLSC collaboration by members of supply chain (CMM).

Principal component analysis with the varimax rotation method with Kaiser normalization was conducted based on SPSS 15 to identify and confirm the different observed measurement items underlying each latent construct in the theoretical framework (Ramanathan and Muyldermans, 2010). An eigenvalue of one or more was used to identify the number of factors. Any variable with a factor loading smaller than 0.4 was not considered for further analysis as it will not measure a specific construct (Hair et al., 2006). Table 2 shows the measurement items and also reports the descriptive statistics, Cronbach's alpha values, as well as the factor loadings.

As shown in table 2, all the Cronbach's Alpha values are above 0.8. Similarly all composite reliability values are above the threshold of 0.7 (Fornell and Larcker, 1981) (see table 1), hence suggesting the satisfactory reliability of the constructs (Nunnally, 1978; Hair et al., 2006). As shown in table 2, all the observed variables under four constructs, namely FSCC, RSCC, CDM and INT are found to be significant with factor loadings above 0.7 (Fornell and Larcker, 1981; Hair et al., 2006). Moreover, the percentage of variance explaiend is used to examine the construct validity of the model (Fornell and Larcker, 1981). The total variance explained by each construct is in the range of 77.70% to 97.73% (see Table 2). The result shows that the measurement items have satisfactory convergent validity (Hair et al., 2006).

Insert Table 2 about here

The measurement items are further tested for discriminant validity to check how each first order construct is distinct from the others (Anderson and Gerbing, 1988). Since none of the confidence intervals for the inter-construct correlations contains 1.0, we conclude that each construct is distinct (Mishra and Shah, 2009). Moreover, each of the constructs described in the model has explained well by the measured items. This is also explained by the high values of R2 (see Table 2). Furthermore, since we used a single set of industry data, we have checked the data for common method bias using Harman's single factor test in SPSS. A single factor has explained less than 27% of total variance. Thus suggested that no general factor is apparent and common method bias is not a threat to the analysis (Andersson and Bateman, 1997).

5.3. Hypothesis testing

Similar to Llach et al., (2013) who used Structural Equation Modelling (SEM) to establish the relationship between quality management and firm's environmental performance, we used SEM approach to test the relationship between various constructs of CLSC collaboration model specified in Figure 1. We used Amos 18 for developing structural equation models and PASW Statistics 18 for descriptive analysis.

The models' fit is evaluated by normed chi-square (χ^2/df), comparative fit index (CFI), goodness-of-fit index (GFI), and root mean square error of approximation (RMSEA) at 90% confidence interval (CI). The test statistics show in Table 3 suggest a satisfactory model fit (Kline, 1998). Table 3 also lists the estimated coefficients of structural paths and the significance level as indicated by p-values.

Insert Table 3 about here

The path coefficients between the 'forward supply chain collaborations' (FSCC) and 'involvement' (0.71) and the 'reserve supply chain collaborations' (RSCC) and 'involvement' (0.36) are both positive and significant. Therefore, hypothesis 1 and hypothesis 2 are supported. The path coefficients between 'collaborative decision-making' (CDM) and 'commitment' (0.29) and between 'interest in investment and sharing' (INT) and 'commitment' (0.53) are also positive and significant. Therefore, hypothesis 3 and hypothesis 4 are also supported. Since the path coefficient between 'involvement' and 'commitment' is not significant, hypothesis 5 is not supported. The positive and significant path coefficient between 'involvement' and 'collaboration success' (0.68) suggests that hypothesis 6 is supported. Hence, the involvement of SC players in CLSC activities positively influences the collaborative SC performance. Similarly, the significant and positive path efficient between 'commitment' and 'collaboration success' (0.56) suggest that hypothesis 7 is also supported. Therefore, the commitment of SC members in the CLSC activities is positively related to the success of their SC collaboration .

Moreover, because there is positive relationship between 'involvement' and 'collaboration success', but not between 'commitment' and 'involvement'. There is evidence that the involvement of SC members in CLSC activities is not mediating the relationship between the commitment of SC members and the success of their SC collaboration. Therefore, the 'involvement' and 'commitment' are independently influencing the performance of SC collaboration.

6. Discussion

Products with shorter product life cycles produced in a huge quantity become obsolete more quickly and will enter into the waste system causing value losses and environmental impacts (Guide and Wassenhove, 2001; Daugherty et al., 2001). More and more companies nowadays highlight the importance of balancing business performance with social and environmental performance (Lee, 2010). The common understanding on the triple-bottom lines of businesses helped the initiation of SC collaboration in many businesses. According to the transaction cost theory, companies engage in SC collaboration with SC members to reduce cost and to maximize mutual benefits (Dyer, 1997; Bharadwaj and Matsuno, 2006). Consistently, what we found in the current study is that SC members engage in collaborative CLSC to sell the excess products using discount sales and to avoid value loss and maximize value regeneration through better recycling of returned or obsolete products.

SC collaboration is a common practice in all businesses, the success of SC collaboration in forward SCs is evident in cases of Wal-Mart, Sainsbury's, Co-operative and West Marine (Ireland and Crum 2005; Smith, 2006). Limited attention was paid to the returned products and the reverse flow of SC process triggered by product returns until recently. Nevertheless, the volume and value of product returns in the current era is increasing significantly due to various factors like government policies favouring consumer care, severe market competition, and longer business allowance for consumers to return products. Hence, investing in reverse SC solutions and capacities and engaging in SC collaborations become a necessity.

Our empirical study validates a collaborative CLSC framework. Basically, the findings confirms that the collaboration between SC members in forward and reverse supply chains triggers the further involvement of SC members in forward and reverse SC activities. Moreover, the SC members' collaborative decision making and interest in sustainable investment and resources/incentives sharing will also facilitate the commitment of SC members in forward and reverse SC activities. Such involvement and commitment in CLSC activities will further support the ongoing collaboration with better partnership performance.

CLSC activities may not generate immediate financial benefits to firms, especially when the share of benefits and costs are not clarified, which can be a major obstacle to the participation of SC members into such activities. The current study suggests that CLSC activities can generate benefits for the SC members if the right level engagement from SC members is present. Firstly, continued involvement of SC members into CLSC activities is a pre-condition to the better SC collaboration performance. The effective cooperation on forward supply chain planning as well as the establishment of the reverse logistics routines/agreement are needed to pave the way for continued involvement of SC members in the CLSC. Secondly, SC members may not show enough commitment to CLSC activities unless they are engaged in collaborative decision making, and have the willingness to invest in sustainability initiatives and are ready to share resources and incentives (c.f., Olorunniwo and Li., 2010).

The case of JuteCo suggests that explicit incentive sharing schemes, such as discounted sales will help the SC members to build confidence about the reverse SC collaborations. Thirdly, such willingness in sharing and relationship investment can be facilitated when same members are used for both forward and reverse supply chain processes. Mutual understanding and engagement are maximized because the same members are dealing with the same range of products in the forward and reverse process. Not only because of the economy of scales in product handling, but also because of the capability to more effectively tracing and tracking the product returns and underlying issues, the efficiency of the CLSC can be improved at lower cost. Such collaboration will also ensure the root of the problems can be more quickly identified for future product and process improvement.

Common benefits of SC collaboration are identified as reduced inventory level, transportation cost, warehouse cost, short lead time and increased productivity and lower manufacturing costs (Horvath, 2001). Identifying all necessary activities involved in forward and reverse supply network will form a basis to weigh the benefits of combining some of the activities through SC collaboration. In this study, we specify that CLSC operations with both forward and reverse SC collaboration will lead to better collaboration performance as indicated by higher sales growth and better new business initiatives. For example, the benefit of JuteCo after implementing CLSC collaboration is enormous as indicated by nearly 50% growth in sales (see Figure 2). CLSC collaboration helped the JuteCo to secure market opportunities and manage the primary and secondary market more effectively which was once a challengeable task of the company.

The current study confirms the positive role of SC members' involvement and commitment in the CLSC. However, the finding suggests that SC members' involvement in the CLSC does not always lead to their commitment in the CLSC. Accordingly, active participation of SC members in CLSC activities may not automatically lead to commitment in CLSC activities. Companies will participate and show commitment in CLSC collaboration only if incentives are assured on processing/using recycled materials or products. In order to make this commitment happen, long-term plans of incentive sharing need to be in place. As also indicated in the previous studies, trust building is also needed for SC members to show better commitment (Nyaga et al., 2010). For CLSCs which involve more complex operational processes, SC members need to build enough confidence on the fair shares of responsibilities, costs and benefits before they can build long term commitment to the CLSC process. This also means that the managers should pay attention to the establishment of fair agreement and collaboration mechanisms which enhance SC members' trust with the ongoing CLSC collaboration to help the pro-longed collaboration. Such longer-term commitment, as suggested by the findings in this study, will lead to better collaboration performance.

7. Conclusion

This study has tried to explore the concept of CLSC collaboration by having an integrated view of the reverse SC activities and the forward SC activities, through case study and a questionnaire survey. The empirical study has helped us to understand the importance of the collaborative CLSC and to better understand the operations in the case of commercial product returns and end-of-life returns of a packaging company. The results of data analysis have confirmed that the involvement of SC members in CLSC collaboration and their commitment in CLSC collaboration will significantly influence the sales growth and future business initiatives which represent the success of their collaborative relationships. Two main findings of our research are: (1) although the success of CLSC collaboration lies in the involvement of SC members in supply chain collaboration, the actual commitment of the SC members in

CLSC operations is equally important; (2) members involved in CLSC activities are not necessarily committed for sustainability investment, resource sharing and incentive sharing.

The main message for practitioners is that product returns may not be a nuisance and a necessary evil (Daugherty et al., 2001). There is a lot of potential to be tapped in the manufacturing sector to retain and re-generate value through CLSC collaboration especially for companies which produce large volumes of product returns or end-of-life product wastes.

Previous studies advocate that information technology and collaboration in reverse logistics can solve many problems in supply chains and also remove deficiencies (Jayaraman et al., 2008). In this study, we extend from that and found that the commitment from SC players in terms of collaborative decision making, resource sharing, incentive sharing and investment in sustainability activities will enhance the performance of the supply chains. Previous studies also advocate the inclusion of 3PLs in SC activities for SC performance improvements (Jayaram and Tan, 2010). Companies handling reverse supply chains informed by the concept of CLSC, can also use the same 3PLs or logistics services for both forward and reverse SC activities, to retain more values from returned products and to better identify root problems of the product returns.

This paper extends the previous research by explicating the importance of collaboration on CLSC activities in collaboration success. For example, the resource-base view of the firm (Barney, 1991) and transaction cost theory (Williamson, 1981) will support the importance of collaboration in generating collaborative values or to reduce cost in the relationship, but there are no explicit mention of about the reverse SC activities that can fit into the collaboration process model . Our empirical research confirmed that the inclusion of reverse SC operations in the forward supply chain operations will positively improve the SC collaboration performance. Our finding is in line with the previous studies that that the SC collaboration will lead to better SC performance (Albino et al., 2012; Droge et al., 2012), but further suggest that such collaboration should be extended to both forward and reverse SC processes.

Nowadays, the adoption of reusing and recycling in manufacturing is still very uneven across different countries and different industries. It is a common practice nowadays, especially in the developed countries, for focal companies to practice CLSC activities through recycling, re-using, and remanufacturing. The CLSC is also more common for more technology intensive industries such as automobile and computers (Chan et al., 2012), Our study confirms the potential for traditional industries in an emerging economy (in our case, packaging industry in India) to also benefit from collaborative CLSC practices.

It is worth pointing out that our empirical work is context specific, because the study is based on the supply chain of one packaging company in India. However, our study reveals a typical example of CLSC in a traditional industry which can be replicated to other industries as well. Further research with empirical data can convey the impact of collaborative CLSC in different industrial settings. Moreover, our study focused on the CLSC collaboration from an inter-organizational perspective, the impact of other human related collaborative factors in supply chains need to be explored through more in-depth empirical studies.

References

Abdulrahman, M.D., Gunasekaran, A., and Subramanian, N., (2014). Critical barriers in implementing reverse logistics in the Chinese manufacturing sectors. *International Journal of Production Economics*, 147, B, 460-471.

Albino,V., Dangelico. R.M., and Pontrandolfo, P., (2012). Do inter-organizational collaborations enhance a firm's environmental performance? a study of the largest U.S. companies. *Journal of Cleaner Production*. 37, 304-315.

ALDI, (2017). ALDI return policy, URL: http://www.returnsandrefunds.com/ALDI/Returns, accessed on 4 Nov. 2017.

Anderson, J. C., and Gerbing, D. W., (1988). Structural equation modelling in practice: a review and recommended two-step approach. *Psychological Bulletin*, 103(3), 411-423.

Anderson, M. J., (1993). Collaborative integration in the Canadian pharmaceutical industry. *Environment and Planning A*, 25 (12), 1815–1838.

Andersson, L. M., and Bateman. T. S., (1997). Cynicism in the workplace: Some causes and Effects. *Journal of Organizational Behavior,* 18 (5), 449-469.

Armstrong J. S., and Overton. T. S., (1977). Estimating nonresponse bias in mail surveys. *Journal of Marketing research,* 14, 396-402.

Bai, C., and Sarkis, J., (2013). Flexibility in reverse logistics: a framework and evaluation approach. *Journal of Cleaner Production*, 47, 306-18.

Barney, J. B., (1991). Firm resources and sustained competitive advantage. *Journal of Management*, 17, 99–120.

Beh, L-S., Ghobadian A., He, Q., Gallear D., and O'Regan N., (2016). Second-life retailing: a reverse supply chain perspective. *Supply Chain Management: An International Journal*, 21(2), 259–272.

Bharadwaj, N. and Matsuno, K. (2006). Investigating the antecedents and outcomes of customer firm transaction cost savings in a supply chain relationship. *Journal of Business Research*, 59(1), 62-72.

Büyüközkan, G., and Arsenyan, J., (2012) Collaborative product development: a literature overview, *Production Planning & Control*, 23(1), 47-66.

Caniato, F., and Größler, A., (2015). The moderating effect of product complexity on new product development and supply chain management integration. *Production Planning & Control*, 26(16), 1306-1317.

Carrillo-Hermosilla, J., Río, P., and Könnölä, T., (2010). Diversity of eco-innovations: Reflections from selected case studies, Journal of Cleaner Production, 18(10-11), 1073-1083.

Carter, C., Ellram, L., and Ready, K., (1998). Environmental Purchasing: Benchmarking our German Counterparts. *International Journal of Purchasing and Materials Management*, 34(4), 28-39.

Chan, F. T. S., Chan, H. K., and Jain, V., (2012). A framework of reverse logistics for the automobile industry. *International Journal of Production Research*, 50(5), 1318-1331.

Cousins, P. D., Lawson, B. and Squire, B. (2008). Performance measurement in strategic buyer-supplier relationships: The mediating role of socialization mechanisms. *International Journal of Operations & Production Management*, 28(3), 238-258.

Daugherty, P. J., Autry, C. W., and Ellinger, A. E., (2001). Reverse Logistics: The relationship between resource commitment and program performance. *Journal of Business Logistics,* 22(1), 107-123.

Daugherty, P. J., Myers, M. B., Richey, R. G., (2002). Information support for reverse logistics: the influence of relationship commitment. *Journal of Business Logistics,* 23(1), 85-106.

Dowlatshahi, S., (2000). Developing a theory of Reverse Logistics. *Interfaces,* 30(3), 143-15.

Droge, C., Vickery, S. K., and Jacobs, M. A., (2012). Does supply chain integration mediate the relationships between product/process strategy and service performance? An empirical study. *International Journal of Production Economics,* 137(2), 250-262.

Dyer, J. H. (1997). Effective interim collaboration: how firms minimize transaction costs and maximise transaction value. *Strategic Management Journal*, 18(7), 535-556.

Eagan,P. D., and Joeres, E., (2002). The utility of environmental impact information: a manufacturing case study. *Journal of Cleaner Production*, 10(1), 75-83.

Ellinger, A. E., Daugherty, P. J., and Keller, S. B., (2000). The relationship between marketing/logistics interdepartmental integration and performance in U.S. manufacturing firms: an empirical study. *Journal of Business Logistics*, 21(1), 1-22.

Fornell, C., and Larcker, D. F., (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 18, 39-50.

Fleischmann, M., Bloemhof-Ruwaard, J., Beullens, P., and Dekker, R., (2004). Reverse Logistics Network Design in Reverse Logistics - Quantitative Models for Closed-Loop Supply Chains Eds Dekker R, Fleischmann M, Inderfurth K, and Van Wassenhove L N, (Springer-Verlag), 65–94.

Fuente, V.M, Ros L., and Cardós, M. (2008). Integrating forward and reverse supply chains: Application to a metal-mechanic company. *International Journal of Production Economics*, 111(2), 782-792.

Frauendorf, J. (2006). Customer processes in Business to Business service transactions, Springer, UK.

Giannetti, B. F., Bonilla, S. H. and Almeida, C. M. V. B., (2013). An energy-based evaluation of a reverse logistics network for steel recycling. *Journal of Cleaner Production,* 46, 48-57.

Garengo, P., and Panizzolo, R., (2013). Supplier involvement in integrated product development: evidence from a group of Italian SMEs. *Production Planning & Control*, *24*(2-3), 158-171.

Govindan, K., Soleimani, H., and Kannan, D., (2015). Reverse logistics and closed-loop supply chain: a comprehensive review to explore the future. *European Journal of Operational Research*, 240(3), 603-626.

Guide, V. D. R. Jr., Van Wassenhove, L. N., (2001). Managing product returns for remanufacturing. *Production and Operations Management,* 10(2), 142–155.

Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., and Tatham, R. L., (2006). Multivariate Data Analysis 6th edition (Prentice-Hall, New Jersey).

Horvath L, (2001). Collaboration: The key to value creation in supply chain management. *Supply Chain Management,* 6(5), 205.

Ireland, R. K., and Crum, C., (2005). Supply chain collaboration: How to implement CPFR and other best collaborative practices (J. Ross Publishing Inc., Florida).

Jayaram, J., Tan, K-C., (2010). Supply chain integration with third-party logistics providers. *International Journal of Production Economics*, 125 (2), 262-271.

Jayaraman, V., Ross, A. D., and Agarwal., A., (2008). Role of information technology and collaboration in reverse logistics supply chains. *International Journal of Logistics: Research Applications*, 11(6), 409-425.

Kline, R. B., (1998). Principles and Practice of Structural Equation Modelling (Guilford Press, New York).

Kulp, S. C., Lee, H. L., and Ofek, E., (2004). Manufacturer Benefits from Information Integration with Retail Customers. *Management Science.* 50 (4), 431-444.

Lai, K., Wu, S. J., and Wong, C. W. Y. (2013). Did reverse logistics practices hit the triple bottom line of Chinese manufacturers? *International Journal of Production Economics*. 146(1), 106-117.

Lee, H. L., (2010). Don't Tweak Your Supply Chain – Rethink it end to end. Harvard Business Review, 63-69.

Llach, J., Perramon, J., Alonso-Almeida, M., and Bagur-Femenías, L., (2013). Joint impact of quality and environmental practices on firm performance in small service businesses: an empirical study of restaurants. *Journal of Cleaner Production*, 11, 96-104.

Marien, E. J., (1998). Reverse logistics as competitive strategy. Supply Chain Management Review, Spring, pp 43-51.

Msanjila, S. S., and Afsarmanesh, H. (2011). On modelling evolution of trust in organisations towards mediating collaboration. *Production Planning & Control*, *22*(5-6), 518-537.

Melbin, J. E., (1995). The never ending cycle. *Distribution*, 94(11), 36-39.

Minner, S., (2000). Strategic Safety Stocks in Supply Chains (Berlin Heidelberg New York: Springer).

Mishra, A., and Shah, R., (2009). In union lies strength: Collaborative competence in new product development and its performance effects. *Journal of Operations Management*, 27. 324-338.

Mondragon, A. E. C., Lalwani, C. and Mondragon, C. E. C. (2011). Measures for auditing performance and integration in closed-loop supply chains. *Supply Chain Management: An International Journal*, 16(1), 43-56.

Nunnally, J. L., (1978). Psychometric Theory, 2nd edition (MaGraw-Hill, New York).

Nyaga, G. N., Whipple J. M., and Lynch D. F., (2010). Examining supply chain relationships: Do buyer and supplier perspectives on collaborative relationships differ? *Journal of Operations Management,* 28, 101-114.

Olorunniwo, F. O., and Li, X., (2010). Information sharing and collaboration practices in reverse logistics. *Supply Chain Management: An International Journal,* 15(6), 454-462.

Östlin, J., Sundin E., and Björkman, M., (2008). Importance of closed-loop supply chain relationships for product remanufacturing, *International Journal of Production Economics,* 115 (2), 336-348.

Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., and Podsakoff, N.P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology*, 88(5), 879–903.

Ramanathan, U., (2013). Aligning supply chain collaboration using Analytic Hierarchy Process. *Omega - The International Journal of Management Science,* 41(2), 431-440.

Ramanathan, U., Gunasekaran, A., and Subramanian, N., (2011). Supply chain collaboration performance metrics: a conceptual framework. *Benchmarking: An International Journal,* 18(6), 856-872.

Ramanathan, U., and Muyldermans L, (2010). Identifying demand factors for promotional planning and forecasting: A case of a soft drink company in the UK. *International Journal of Production Economics,* 128, 538-545.

Ramanathan, R., He, Q., Black, A., Ghobadian, A., and Gallear, D. (2017). Environmental Regulations, Innovation and Firm Performance: A Revisit of the Porter Hypothesis. *Journal of Cleaner Production*, 155(2), 79-92.

Romero, D., and Molina, A. (2011). Collaborative networked organizations and customer communities: value co-creation and co-innovation in the networking era. *Production Planning & Control*, *22*(5-6), 447-472.

Ramos, T R P, Gomes, M. I., and Barbosa-Póvoa, A.P. (2014). Planning a sustainable reverse logistics system: Balancing costs with environmental and social concerns. *Omega: The International Journal of Management Science*, 48, 60-74.

Sciarrotta, T., (2003). How PHILIPS reduced returns. Supply Chain Management Review, 7, 32.

Shaharudin,M.R., Govindan, K., Zailani, S., and Tan, K.C. (2015). Managing product returns to achieve supply chain sustainability: an exploratory study and research propositions. *Journal of Cleaner Production*, 101, 1-15.

Smith. L., (2006). West Marine: CPFR success story. *Supply Chain Management Review*, 10 (2), 29-36.

Stank, T. P., Keller, S, B., and Daugherty, P. J., (2001). Supply chain collaboration and logistical service performance. *Journal of Business Logistics,* 22 (1), 29-48.

Tan, A. W. K., Yu, W. S., and Arun, K., (2003). Improving the performance of a computer company in supporting its reverse logistics operations in the Asia-Pacific region. *International Journal of Physical Distribution & Logistics Management,* 33(1), 59-74.

Uzzi, B. and Lancaster, R. (2003). Relational embeddedness and learning: The case of bank loan managers and their clients. *Management Science*, 49(4), 383-399.

Verdecho, M-J., Alfaro-Saiz, J.J., Rodriguez-Rodriguez, R., and Ortiz-Bas, A., (2012). A multi-criteria approach for managing inter-enterprise collaborative relationships. *Omega: The International Journal of Management Science*, 40, 249-63.

VICS, (2002). CPFR guidelines Voluntary Inter-industry Commerce Standards. URL: www.cpfr.org.

Voss, C., Tsikriktsis, N., and Frohlich, M., (2002). Case Research: Case Research in Operations Management. *International Journal of Operations and Production Management*, 22(2), 195-219.

Wiengarten, F., Humphreys, P., Cao, G., Fynes, B., and McKittrick, A., (2010). Collaborative supply chain practices and performance: exploring the key role of information quality. *Supply Chain Management: An International Journal,* 15(6), 463-473.

Williamson, O. E. (1981). The economics of organization: The transaction cost approach. *American Journal of Sociology*, 87(3), 548-577.

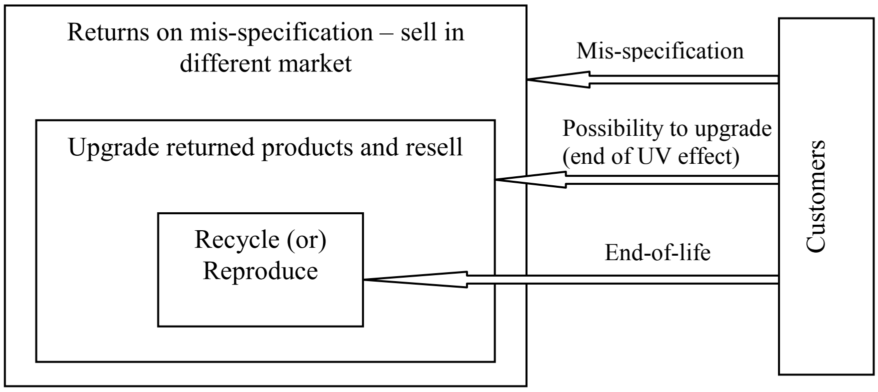

Figure 1: Operational improvement programme in JuteCo

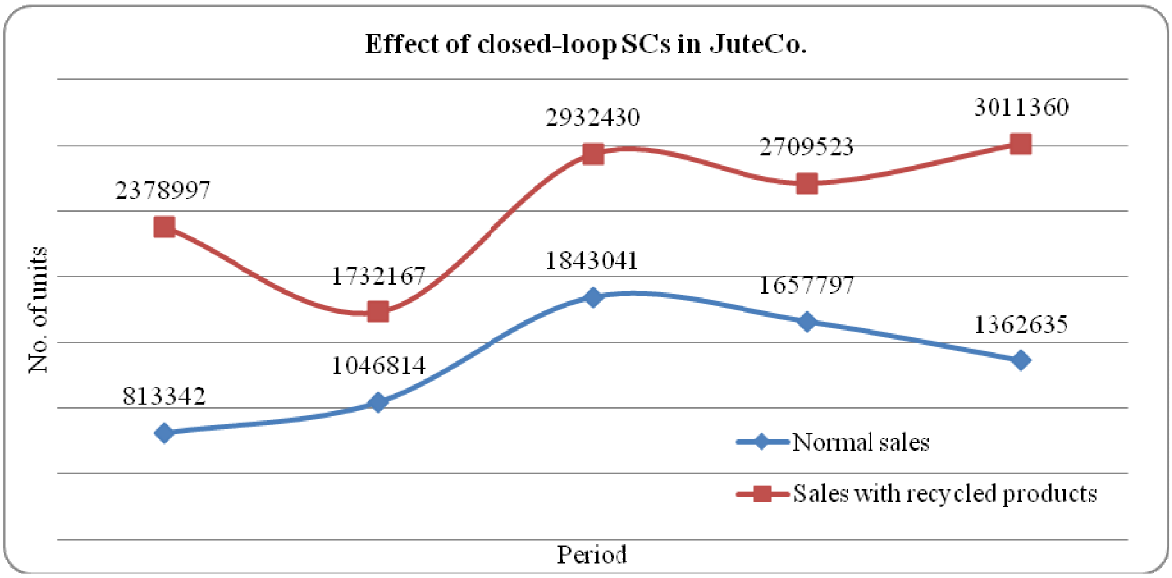

Figure 2: Sales before and after adopting closed-loop supply chain collaboration (period in months)

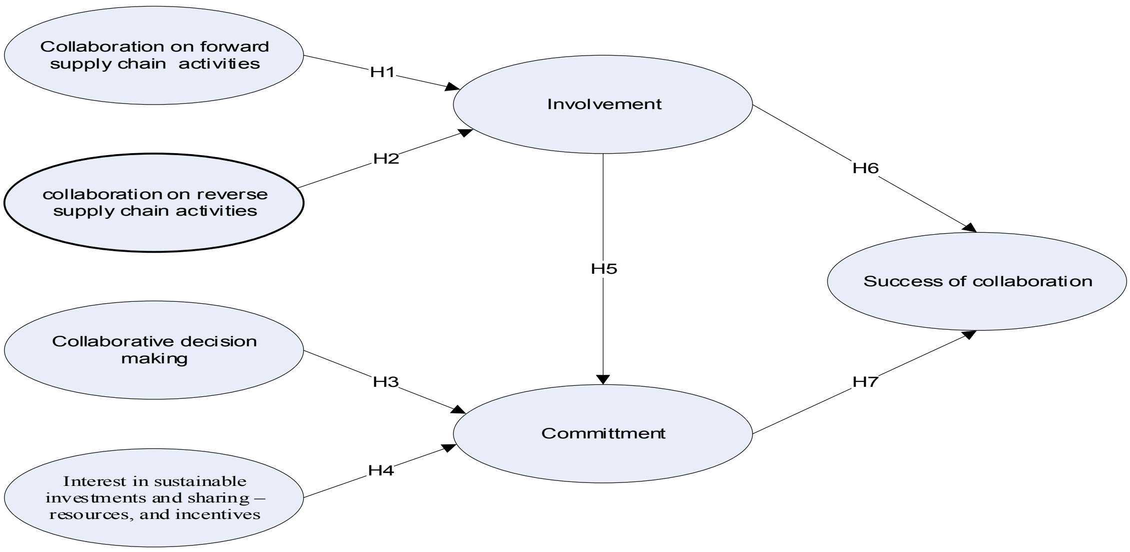

Figure 3: Closed-loop supply chain collaboration model

Table 1: Inter-construct correlations and composite reliability

Constructs	FSCC	RSCC	CDM	INT	Collaboration Success
FSCC	**0.963**				
RSCC	.920**	**0.961**			
CDM	.882**	.955**	**0.957**		
INT	.815**	.745**	.755**	**0.912**	
Collaboration Success	.917**	.877**	.884**	.863**	**0.988**

N = 101. **- Correlation is significant at the 0.01 level (2-tailed). Diagonal elements in bold represent composite reliability

Table 2: Exploratory factor analysis loadings, reliabilities and percentage of variance

Constructs	Variables	Mean	SD	Variance explained (%)	Factor Loadings	Communalities	R-square
FSCC	Front-end agreement	3.40	1.35	84.106	0.923	0.852	0.700
α = 0.952	Collaborative planning	3.58	1.11		0.972	0.945	0.980
	Collaborative production	3.30	0.90		0.881	0.776	0.670
	Information sharing	3.30	1.10		0.935	0.875	0.856
	Collaborative replenishment	3.78	0.87		0.870	0.757	0.696
RSCC	Product returns promise	3.11	1.05	83.126	0.923	0.852	0.700
α = 0.949	Use of same operators/3PL	3.80	0.87		0.841	0.707	0.497
	End of life returns agreement	3.80	0.98		0.906	0.821	0.825
	Information sharing-returns agreement	3.01	1.42		0.940	0.883	0.921
	Product recycling agreement	3.80	0.98		0.945	0.893	0.949
CDM	Warehousing	3.59	0.80	81.668	0.915	0.838	0.841
α = 0.943	Timely delivery	3.90	0.94		0.972	0.944	0.427
	Collaborative forecasting	3.51	1.03		0.849	0.720	0.632
	Joint replenishment	3.31	0.90		0.905	0.820	0.699
	Cost savings	4.30	0.64		0.872	0.761	0.717
INT	Resource sharing	3.51	0.83	77.698	0.795	0.632	0.260
α = 0.854	Incentive sharing	3.39	1.07		0.905	0.819	0.375
	Investment	3.70	1.10		0.938	0.880	0.675
Collaboration Success	Sales growth	3.90	1.04	97.733	0.989	0.977	0.577
α = 0.967	New business initiatives	2.71	1.28		0.989	0.977	0.815

Table 3: Coefficients of structural paths

Structural paths	Coefficient	Significance (p-value)
Forward supply chain collaboration→Involvement	0.71	0.000
Reverse supply chain collaboration→Involvement	0.36	0.000
Collaborative decision-making→Commitment	0.29	0.001
Interest in investment and sharing →Commitment	0.53	0.000
Involvement →Collaboration success	0.68	0.000
Commitment→ Collaboration success	0.56	0.001
Involvement →Commitment	---	Not significant

Note: SEM model fit indices χ^2/df = 3.21, GFI = 0.913, CFI = 0.910, RMSEA at 90% confidence interval = 0.042