Moderated Influence of Return Frequency and Resource Commitment on Information Systems and Reverse Logistics Strategic Performance

Abstract

Purpose – Reverse logistics (RL) is a strategic instrument across industries. The rapid evolution of online marketplaces has led to frequent product returns with variations across diversified businesses. These marketplaces have caused potential losses due to fraudulent returns, hence requiring a commitment of resources to RL. With information systems (IS) playing a role in improved supply chain performance, this study analyses the impact of a conceptualised IS framework on achieving RL strategic outcomes, under the individual moderating influence of resource commitment and return frequency.

Design/methodology/approach – Data has been collected through a questionnaire from top / middle management executives managing the supply chain, logistics and IS. Moderated-regression analysis was conducted on the collected sample using Hayes (2013) process modeling.

Findings – Study depicts that IS Capability, IS for Logistics, IS Partnership Quality and IS for Value Addition leads to RL strategic benefits. Also, return frequency and resource commitment act as relatively strong moderators with a negative impact. When analysed for the individual IS constructs, resource commitment has a stronger moderating impact than return frequency.

Practical implications – The IS usage framework can be used effectively by practitioners for enhancing strategic RL performances depending on variations in committed resources and return frequency for individual industries.

Originality/value – The study proposes an IS usage framework for achieving enhanced RL strategic outcomes and emphasizes on the moderating role played by resource commitment and return frequency for producing the results.

Keywords reverse logistics; information systems; resource commitment; return frequency; strategic performance; moderation; regression

Paper type Research paper

1. Introduction

Reverse logistics (RL), an area of prime significance in the supply chain, has gained considerable ground in the last decade (Jayant et al., 2011). Industry practitioners and researchers have focussed on RL to enable organizations to attain competitive gain (Bernon and Cullen, 2007). According to Stock (1998), RL:

> "*From a business logistics perspective… refers to the role of logistics in product returns, source reduction, recycling, materials substitution, reuse of materials, waste disposal, and refurbishing, repair and remanufacturing; from an engineering logistics perspective, it is referred to as reverse logistics management (RLM) and is a systematic business model that applies best logistics engineering and management methodologies across the enterprise in order to profitably close the loop on the supply chain.*" (pp. 20-21)

Product returns constitute 20 percent of everything sold to customers (Kumar and Chatterjee, 2011). This varies by product and channel type. Moreover, with challenging economic conditions, addressing returns within the reverse supply chain can help to cut costs, increase profit margins or both. RL is a $12 billion industry in India and contributes 13% of the GDP and with an enormous scope to provide the edge the companies are looking for **(**Anon, 2013**)**. Also, over 92 percent of Indian retail businesses comes from the unorganized retail sector, thus offering tremendous potential for growth, consolidation, and modernization in the Indian context (Atroley and Rajat, 2014**)**. With the degree of returns varying across industrial segments due to different return policies and legal regulations, the frequency of returns becomes essential, which might influence profitability and performance by investing in RL.

There had been a continued focus on the forward supply chain, but with an increase in global competitiveness, it has become increasingly important for organizations to divert its attention towards the reverse chain as well (Kumar and Chatterjee, 2011). With an increasing trend in online marketplaces, the returns have also increased, with an estimated $800 million to $1 billion being returned in the fiscal year 2015-16, thus causing logistical challenges and potential losses (Julka and Ganguly, 2015). Despite well devised return policies, there have been fraudulent returns for which systems need to be devised for tracking customer behaviors (Julka and Ganguly, 2015). To design these systems, organizations need to allocate adequate resources, thus making resource commitment a critical construct in RL.

The shift in organizational attention towards the reverse supply chain was to benefit from the supply chain, including benefits from a strategic perspective. An emphasis on the reverse chain results in greater returns, improved customer satisfaction and increased public perception as a result of handling the product returns efficiently and incorporating

customer feedback (Johns, 2014; Robinson, 2015). Other strategic benefits include greater market share, reduced business risks and environmental sustainability, which might result from environmental regulations for product returns, thus enabling organizations to attain the strategic edge (Johns, 2014).

To acquire the strategic benefits and to address fraudulent product returns, information technology (IT) systems – notably, information systems (IS) – are needed to enable organizations to manage the logistical activities efficiently and reduce losses due to product returns (Julka & Ganguly, 2015). These systems also enable organizations to track customer feedback, allowing them to enhance product quality, hence creating value for the customer. The selection of appropriate IS for the reverse supply chain and the ensuing IS practices are important and research-worthy.

The principal objectives of this study are threefold. First, this study examines the impact of IS on attaining RL strategic benefits through a well devised IS framework. Second, it analyses the moderating influence of both return frequency and resource commitment independently on the above-stated impact. Lastly, this study analyzes the differences in the impact of individual constructs in the IS framework, in the presence of said moderators. Thus, the study aims to provide organizations with different product return patterns and resource commitment levels to RL, a direction to use IS more effectively and efficiently to achieve more strategic RL benefits including collaborative supply chain associations and competitive business gains. The study addresses the moderating effect of product returns and resource commitment to RL for achieving the desired strategic benefits by using IS for carrying out RL operations. With regards to the theoretical contributions, the study elaborates on utilizing RL strategically to make collaborative supply chain gains in a dynamic business environment by implementing an information system-centric framework. This is a significant contribution considering that it overcomes the researchers' and practitioners' mindset of only utilizing the forward chain as a means to achieve a strategic business advantage.

The following sections include the literature review and hypotheses formulation, where the research gaps, the hypotheses for the study and the research model have been proposed. The methods section elaborates on the demography and composition of the participants, data collection processes; the sampling technique used, instrument development and analysis. The following sections discuss the research results and elaborate on its findings, including the managerial implications. The conclusion and future scope section conclude the results of the research and states directions for future studies in the underlying area.

2. Literature Review and Hypotheses Formulation

Organizational emphasis has shifted from manufacturing processes to its supply chain to become sustainable and competitive (Christopher and Towill, 2001). Supply chain has attracted the attention of researchers and practitioners alike. Extensive work has been done in: developing supplier networks (Meixell, 2006; Carvalho and Costa, 2007; Dedrick et al., 2008), analysing the collaborative impact of retailer-manufacturer (Vlachos and Bourlakis, 2006) as well as buyer-supplier relationships (Saeed et al., 2005; Banker et al., 2006; Ross et al., 2009), supply chain performance improvements (Tan et al., 2003; Ravichandran and Lertwongsatien, 2005; Wang et al., 2006) and integration across the chain for competitive gains through investments in IS (Kim and Narasimhan, 2002; Rai et al., 2006; Stevenson and Hendry, 2007; Chandra and Grabis, 2008). Despite researcher interest, most studies are from a forward supply chain perspective. This is largely because the forward supply chain is considered a profit centre and a source for attaining competitive gain for both manufacturing as well as service organizations. However, recent trends reflect a shift towards the reverse supply chain (Jayant et al., 2011). This change can be credited to changing global economic conditions, organizational quest for sustainability (Kumar and Chatterjee, 2011), changing return policies (Julka and Ganguly, 2015), stringent regulations and policies regarding the disposal of the product as well as the intensification of the belief that the reverse supply chain can be used as a profit-enhancing tool (Jayant et al., 2011).

2.1 Reverse Logistics and its Industrial Domains

There have been numerous studies across different industrial domains such as electronics & electrical goods (Autry et al., 2001; Daugherty et al., 2002; Bernon and Cullen, 2007; Jayaraman et al., 2008; Li and Olorunniwo, 2008; Lau and Wang, 2009; Gobbi, 2011; Olorunniwo and Li, 2011), pharmaceutical (Kumar et al., 2009), IT hardware (Knemeyer et al., 2002; Tan et al., 2003; Tan and Kumar, 2006), food processing and chemical (Skapa and Klapalova, 2012), automotive including OEMs (Aitken and Harrison, 2013), apparel & retail (Venkatesh, 2010; Huang et al., 2012) and packaging (Mangla et al., 2012). The reason for RL being prominent in a few industries is due to organization's quality and zero-return policies to reduce losses due to returns (Kumar and Chatterjee, 2011). Hence, to come out with interpretations that can be applicable across domains, an effort has been made to gather data from organizations in the above stated industrial sectors.

2.2 Reverse Logistics, Strategic Performance Outcomes and IS Usage Framework

RL has recently been associated with improved organizational performance and competitive benefit. Studies have encouraged the use of RL to generate profit (Jayant et al., 2011), and improve operational and financial performance (Shepherd and Gunter, 2006; Bakar et al., 2009; Cuthbertson and Piotrowicz, 2011; Tajbakhsh and Hassini, 2015; Ülgen and Forslund, 2015). Also, improvements in the form of better customer relations (Autry et al., 2001; Shepherd and Gunter, 2006; Cuthbertson and Piotrowicz, 2011; Tajbakhsh and Hassini, 2015), environmental regulatory compliance (Autry et al., 2001), competitive edge (Bhagwat and Sharma, 2007), strategic partnerships with the supply chain partners and reduced customer query times (Subramani, 2004; Bhagwat and Sharma, 2007; Shepherd and Gunter, 2006; Cuthbertson and Piotrowicz, 2011; Tajbakhsh and Hassini, 2015) have been observed, which augments the strategic orientation of the RL. With organizations incurring enormous costs as a result of fraudulent returns, the strategic perspective of RL, if utilized well by the organizations, will not only enhance the frequent presence of RL in the firm's tactical plans but also will enable them to have sustained high-level performances.

One of the ways through which enhanced performances in RL can be attained is through investment in technological resources, specifically IS. Different constructs have been analyzed for improved performances in the supply chain. McLaren et al., (2004) for instance, emphasized the use of IS capabilities for improvements in operational efficiency, operational flexibility, internal and external planning & analysis, but from a forward supply chain context. Similarly, Richey et al., (2005) used system capability in the form of customized technology, which was found to have a significant impact on RL performance. Kim and Narasimhan (2002) examined the use of IS for integrating the forward supply chain in the manufacturing sector and concluded that a shift of focus from IS infrastructural support to the use of IS for value addition and logistical operations would lead to greater competitiveness. Ravichandran and Lertwongsatien (2005) stated that IS capability, IS partnership quality and IT support for core competencies in the form of usage for value creation, leads to improved firm performances in the supply chain context. Gunasekaran et al., (2007), while enlisting performance metrics for supply chain, emphasizes on the utilization of resources for value addition as a critical measure. The quality of IS across the supply chain partners have been considered significant by a few other studies as well (Wang et al., 2006; Zhang et al., 2011). With all of them having an impact (Kim and Narasimhan, 2002), either in the forward or the reverse supply chain, they are being included in the IS usage framework for analysing their impact on RL performance from a strategic context. These constructs along with their descriptions and supporting references have been tabulated in the form of an IS usage framework (see Table 1).

[Table 1 – IS Usage Framework: Description and Supporting References]

The literature reviewed thus far suggests organizational use of technology and IS to improve supply chain performances. However, whether the identified IS constructs individually, or its aggregate as the IS usage framework, impact achievement of strategic benefits in RL, remains to be seen. Hence the following hypotheses are proposed:-

H_{1a}: IS capabilities in RL has a significant impact on the achievement of RL strategic benefits.

H_{2a}: IS for logistics in RL has a significant impact on the achievement of RL strategic benefits.

H_{3a}: IS partnership quality in RL has a significant impact on the achievement of RL strategic benefits.

H_{4a}: IS for value addition in RL has a significant impact on the achievement of RL strategic benefits.

H_{5a}: IS usage framework in RL i.e. the aggregate of all IS constructs in RL, has a significant impact on the achievement of RL strategic benefits.

2.3 Reverse Logistics and the Frequency of Returns

RL involves many product returns. These can result from warranty returns (Teng, et al., 2005), product lifecycle returns (Tibben-Lembke and Rogers, 2002), product (Stock, 1992) and container recycling (Kroon and Vrijens, 1995), operational systems (Knemeyer et al., 2002; Tibben-Lembke, 2002; Tibben-Lembke and Rogers, 2002), the ordering of inappropriate products, changing customer preference, and delivery to the incorrect destination (Olorunniwo and Li, 2011). Due to industry-specific return and quality policies and varying business environments, the frequency of returns vary across industries (Tan and Kumar, 2006). The more frequent the returns, the greater the probability that the organization has standardised and well established RL processes. Studies have used the frequency of returns as a critical dimension in RL. For instance, French and Discenza (2006) used the return frequency to measure product degradability timing and observed that reverse networks for external returns must consider storage

conditions and timing due to degradability for better efficiency. Similarly, Tan and Kumar (2006) used the frequency and volume of product returns and developed a dynamic decision model for RL to evaluate new RL policies.

However, the product return frequency (low or high), which can be critical in the RL context due to variations across industries (French and Discenza, 2006; Julka and Ganguly, 2015), is an area which needs researcher's attention as not enough emphasis has been given to its moderating impact. Thus, in the RL context, it becomes pertinent to analyze the effect of the level of return frequency as it might play a role in achieving improved strategic performance outcomes in the RL context. With the current study making an effort to analyze the role of a conceptualised IS usage framework for achieving RL strategic benefits, the moderating effect of return frequency on the said impact needs to be analysed. Hence, the following hypotheses have been proposed:-

H_{1b}: The frequency of product returns moderates the relationship of IS capabilities in RL on the achievement of RL strategic benefits.

H_{2b}: The frequency of product returns moderates the relationship of IS for Logistics in RL on the achievement of RL strategic benefits.

H_{3b}: The frequency of product returns moderates the relationship of IS partnership quality in RL on the achievement of RL strategic benefits.

H_{4b}: The frequency of product returns moderates the relationship of IS for value addition in RL on the achievement of RL strategic benefits.

H_{5b}: The frequency of product returns moderates the relationship of IS usage framework i.e. the aggregate of all IS constructs in RL, on the achievement of RL strategic benefits.

2.4 Reverse Logistics and Commitment of Resources

With organizations using RL strategically, it becomes all the more important to allocate resources to overcome logistical hurdles due to product returns (Kumar and Chatterjee, 2011). These organizational resources can be financial (Richey et al., 2005; Li and Olorunniwo, 2008), personnel (Richey et al., 2005; Olorunniwo and Li, 2011) as well as technological (Bayraktar et al., 2010; Huang et al., 2012) and needs to be utilized well to achieve the desired performance outcomes. There have been researches in the supply chain literature which have emphasized that resource commitment makes RL networks more efficient and effective but must be used in a manner so as to develop innovative capabilities for handling product returns (Richey et al., 2005). Li and Olorunniwo (2008), while studying RL practices in three companies, concluded that the resource commitment is required to support the RL efforts across the chain. Huang et al., (2012), through an empirical analysis, stated that the resource commitment positively and significantly influences the economic and environmental performances of RL separately.

Although RL performance specific impacts have been observed, the commitment of resources to RL is still a concern due to a gradual shift in attention from forward to reverse supply chain (Jayant et al., 2011), due to which there are variations in the commitment of resources to RL across organizations and industries. With firms across industrial sectors still not committed to allocating resources to RL, the degree of resources allocated (low or high) might have an influence on RL performance. Hence, in the current context, the moderating influence of resource commitment towards achieving strategic performance outcomes in RL though utilization of the developed IS usage framework, is an area that needs further probing. Hence, the following hypotheses have been proposed:-

H_{1c}: The resource commitment to RL moderates the relationship of IS capabilities in RL on the achievement of RL strategic benefits.

H_{2c}: The resource commitment to RL moderates the relationship of IS for logistics in RL on the achievement of RL strategic benefits.

H_{3c}: The resource commitment to RL moderates the relationship of IS partnership quality in RL on achievement of RL strategic benefits.

H_{4c}: The resource commitment to RL moderates the relationship of IS for value addition in RL on the achievement of RL strategic benefits.

H_{5c}: The resource commitment to RL moderates the relationship of IS usage framework i.e. the combined impact of all IS constructs in RL, on the achievement of RL strategic benefits.

The proposed research model illustrating the above stated hypotheses is given in Fig. 1 below. A brief context of strategic performance benefits, return frequency and resource commitment along with their supporting references from the supply chain literature is provided in Table 2.

[Fig 1 – IS Usage Framework for RL Strategic Performance]

[Table 2 – Dependent and Moderating Constructs: Description and Supporting References]

Based on the above discussion, the research gaps identified and the hypotheses proposed, the following three research questions are being introduced and would be addressed in the current study undertaken, through a detailed regression analysis involving return frequency and resource commitment as moderators. The 'Results and Discussion' section discusses these research questions in the context of the results obtained through moderated regression analysis.

a) Considering variations in return frequency and commitment of resources to RL, which constructs in the IS usage framework tend to contribute more towards the achievement of strategic RL benefits?

b) Does the commitment of resources to RL moderate the individual and the aggregated impact of IS usage framework constructs in RL on achieving strategic RL benefits?

c) Does the frequency of product returns in RL moderate the individual and the aggregated impact of IS usage framework constructs in RL on achieving strategic RL benefits?

3. Methods

3.1 Survey Instrument and Procedure

A questionnaire was developed on a 5-point Likert scale (1 - Strongly Disagree, 5 – Strongly Agree) to analyse the proposed research framework. Survey items were adopted / developed from existing studies in the supply chain literature (Tallon et al., 2000; Kim and Narasimhan 2002; Subramani 2004; Zhu et al., 2004; Daugherty et al., 2005; Ravichandran and Lertwongsatien 2005; Zhu and Kraemer 2005; Beheshti et al., 2007; Bhagwat and Sharma 2007; Chang and Shaw 2009; Genchev et al., 2011; Yeh et al. 2012) and rephrased to be used in the RL context as illustrated in the Appendix section. The twin criterion used to focus on above mentioned studies for the purpose of identifying / developing scale items were the relevance of these studies in the RL context and the high number of citations of these studies on Google Scholar. The survey instrument was then distributed to organizations through electronic emails, personal visits as well as postal letters. Frequent follow-ups were conducted, and reminders were sent to facilitate the process and ensure that the respondents respond to the survey instrument.

3.2 Participants

The sampling method used was a combination of convenience and snowball sampling although an effort was made to send it to organizations across varied geographical locations in India. To analyse the variation in resource commitment and return frequencies, the developed questionnaire was distributed to organizations across industrial sectors (as stated in the literature review section). The sample for the survey involved middle and top management executives in the supply chain, logistics and IS domains. A total of 1186 questionnaires were sent out of which 306 were returned by the respondents. Out of the returned responses, 51 were deemed incomplete as a result of missing values and hence rejected, leading to 255 valid responses for an overall response rate of 21.50% which is considered acceptable as per literature (Gosain et al., 2004-5; Fynes et al., 2005). The industry-wide composition of the collected sample is being illustrated in Table 3 below.

[Table 3 – Industry Wide Sample Composition]

3.3 Analysis

3.3.1 Reliability Analysis

Before subjecting the dataset collected to multiple linear regression using moderators by using the Hayes (2013) process methodology in SPSS, the reliability of the collected sample was tested using the Cronbach Alpha reliability analysis. The overall Cronbach Alpha value for the designed instrument was found out to be 0.935 with each of the constructs in the instrument also measuring above the accepted levels of 0.60 (Cronbach, 1951; Romano, 2002; Hsu et al., 2009). The low Cronbach Alpha value for RL strategic benefits (Cronbach Alpha = 0.659) is supported by the fact that sectoral differences regarding the ability of organizations across industries to utilize RL for achieving strategic benefits have emerged. This highlights the tremendous scope for organizations

involved in RL activities to use RL strategically for attaining collaborative supply chain benefits. The results of the reliability analysis conducted have been tabulated in Table 4 below.

[Table 4 – Reliability Analysis]

3.3.2 Descriptive Statistics and Correlation Analysis

Table 5 below displays the descriptive statistics and zero-order correlation matrices of the constructs in the proposed research model. As shown in the table, each of the IS constructs is highly significantly correlated with the strategic benefits variable ($p < 0.01$). The correlations of the IS constructs with return frequency and resource commitment was also significant ($p < 0.01$) although for IS for Value Creation, it was significant at 0.05 level. Overall, all correlations were found to be significant.

[Table 5 – Descriptive Statistics and Correlation Analysis]

3.3.2 Moderation & Hayes (2013) Process Modelling

Moderation takes place when "the effect of an independent variable on a dependent variable varies according to the level of a third variable, termed a moderator variable, which interacts with the independent variable" (Edwards and Lambert, 2007). It measures situational conditions that influence the strength of the relationship between a predictor and an outcome. Statistically, when the strength of the relationship between two variables is dependent on a third variable, moderation is said to be occurring. The third variable, or moderator (W), interacts with X (the independent variable) in predicting Y (the dependent variable) if the regression weight of Y on X varies as a function of W (Preacher et al., 2007). Mathematically, the regression equation involving moderation is stated as below:-

$$Y = a_0 + a_1X + a_2W + a_3XW + r;$$

Hayes (2013) has developed PROCESS macro to measure the indirect moderation and mediation effects involving standardized model templates for 76 unique and highly complex scenarios, specifically for SPSS and SAS. For the current analysis, Model 1 involving a single moderator is being utilized separately for return frequency and resource commitment.

3.3.3 Moderated Regression Analysis

After the reliability analysis, regression involving moderation analysis was conducted for each of the constructs in the IS usage framework individually as well as in aggregate. This lead to the development of five research sub-models i.e. IS Capability model, IS Logistics model, IS Partnership Quality model, IS Value Addition model and IS RL model as stated in Table 6. The methodology used for the moderated regression is the Hayes (2013) regression methodology for moderation and mediation. The results of the regression analysis have been compiled and presented in Table 6 given below.

[Table 6 – Regression Analysis Summary]

4. Results and Discussion

The regression analysis conducted on the collected dataset using individual IS constructs as independent variables, and RL strategic benefits as a dependent variable while resource commitment and return frequency acting as moderators has resulted in some interesting results and findings for the researchers and practitioners alike. The mixed sample composition across the industrial sectors has led to the desired variation in terms of frequency of returns and resource commitment for the purpose of analysis. To make the analysis comprehensive, the aggregate impact of reviewed IS constructs has been analysed on the RL strategic benefits by using the moderators individually. This has resulted in more meaningful insights for the researchers and industry practitioners.

a) *Considering variations in return frequency and commitment of resources to RL, which constructs in the IS usage framework tend to contribute more towards the achievement of strategic RL benefits?*

The independent variables considered in each of the five models for analysis have been found to have a statistically significant impact on the resulting RL strategic benefits for the organizations ($p < 0.05$) for each of the moderators individually. Thus, the proposed hypotheses, H_{1a}, H_{2a}, H_{3a}, H_{4a} and H_{5a} hold true. This implies that each of the constructs considered in the IS usage framework i.e. IS capabilities, IS for logistics, IS partnership quality and IS for value addition, significantly contributes towards organizations attaining their RL strategic benefits, considering the

presence of the two moderators. The analysis also indicates that the constructs in the IS usage framework contribute 53.8% and 54.7% respectively towards explaining the attainment of the RL strategic benefits, using the return frequency and resource commitment individually as moderators, which can be vital in the current business environment. Deducing further, it has been found out that the degree of IS used for logistics and value addition activities are more critical towards the realization of RL strategic benefits as compared to the other two constructs. It is indicated by the R^2 (R^2 values for LO and VC with RF as moderator: 0.531 and 0.543; R^2 values for LO and VC with RC as moderator: 0.561 and 0.557) and coefficient values (coefficient values for LO and VC with RF as moderator: 0.753 and 0.757; coefficient values for LO and VC with RC as moderator: 0.594 and 0.620) as illustrated in Table 6.

The analysis also indicates that all four constructs in the IS framework i.e. IS capability, IS for logistics, IS partnership quality and IS for value addition, leads to the attainment of RL strategic benefits, although some of them were found to have a greater impact than the others. In the RL context, using IS for value creation and logistics activities was found to be more impactful and should be harnessed to the full potential by the organizations to achieve strategic benefits through improved customer relations, strategic collaborations with their supply chain partners and enhanced environmental sustainability through a quicker return, recycle and re-use of end-of-life products. On the other hand, the other two constructs, although having a lesser effect, cannot be neglected as they also do contribute towards achieving strategic outcomes. The said finding is found to be in line with a recent report (Kumar and Chatterjee, 2011) which suggests that the use of IS in RL has led to improved customer satisfaction and an increase in consumer trust through efficient and effective product return processes, which ultimately enables organizations to achieve its strategic objectives.

b) *Does the commitment of resources to RL moderate the individual and the aggregated impact of IS usage framework constructs in RL on achieving strategic RL benefits?*

The use of return frequency and commitment of resources to RL as moderators in the analysis has resulted in some key findings which can be utilized by organizations while formulating and implementing IS-focused strategies in the domain of RL. Overall, resource commitment to RL has been found to have a more dominant effect as compared to the frequency of returns. This can be attributed to the attained p-values for the resource commitment (RC) interaction variable which has been found to be statistically significant ($p < 0.05$) for all cases except for IS Capability construct where the moderating effect is statistically insignificant.

Considering IS Logistics Model, resource commitment has been found to have a negative moderating impact as far as the achievement of strategic RL benefits is concerned ($\beta = -0.095$) and the same hold true for IS Partnership Quality ($\beta = -0.124$) and IS Value Addition Model ($\beta = -0.099$). Overall, in the case of the IS Usage Framework Model where the aggregate impact has been analysed, the moderation impact is negative ($\beta = -0.103$). This signifies that with an increase in resources committed towards RL, the tendency of the organization to achieve greater RL strategic benefits by using the constructs in the IS framework decreases. Although these results are significant ($p < 0.05$) and validates the hypotheses H_{2c}, H_{3c}, H_{4c} and H_{5c}, it contradicts the literature which states resource commitment ought to result in enhanced RL performances. A line of reasoning can be the differences in the degree of resources committed by the top management to RL and its utilization for RL. This can be due to a greater prevalent focus on the forward supply chain and the utilization of resources in the stated domain as it is still considered a profit center as compared to RL. Secondly, there might be gaps in resource utilization due to technological innovations, which might require particular training and skill development programs for the employees.

The moderating impact of dedicated resources to RL is not statistically significant as far as IS capabilities are concerned. This can be due to the reason that the capabilities of the IS implemented are majorly dependent on the vendor providing the IS packages/service. Hence, whether the organization has committed resources for the reverse logistic operations will have a quite insignificant impact on the way the IS capabilities can be utilized towards attaining strategic benefits through RL.

Hence, with regards to the commitment of resources to RL, it can be concluded that organizations allocating human, financial and technological resources specifically for RL, are not able to attain their strategic objectives through investments in IS due to inefficient resource utilization as reasoned above. Although there have been incidents of e-commerce firms investing in technological resources to devise methods to overcome fraudulent returns in RL which has enabled them to track and hunt down shopping behavior patterns (Julka and Ganguly, 2015), these can be assumed to be one off incidences.

c) *Does the frequency of product returns in RL moderate the individual and the aggregated impact of IS usage framework constructs in RL on achieving strategic RL benefits?*

The results also show that although, the frequency of product returns do not have the same degree of moderating effect on achieving benefits strategically through the use of IS, still it cannot be ignored altogether. Out of the four constructs in the IS framework, it has been observed that only the impact of IS capabilities on achieving strategic benefits get significantly moderated by the frequency of product returns, as indicated by the statistically significant p-value of 0.022 ($p < 0.05$). For the other constructs in the IS usage framework, the interaction variable has statistically insignificant p-values ($p > 0.05$).

The interaction coefficient for IS Capability ($\beta = -0.104$) indicates that the frequency of returns has a negative moderating influence i.e. the lower the return frequency, the more emerging is the contribution of IS capability towards the achievement of RL strategic benefits. Hence, out of the proposed hypotheses for the individual IS constructs with respect to return frequency, only H_{1b} holds true. A line of reasoning for this observation can be the relation between the capabilities of the IS implemented for RL versus the frequency of product returns. Despite having highly capable systems for handling returns, organizations and industries where the frequency of returns is high, might not be able to achieve its strategic objectives as compared to industries where the rates are lower due to the increasing complexity regarding the frequent handling of returns. Therefore, if organizations can develop a mechanism to keep their returns lower and use highly capable systems for RL activities, it can lead to the achievement of enhanced strategic benefits.

With respect to the other factors, the usage of IS for value addition or logistical activities although strongly impacts achievement of strategic RL outcomes, its impact is not moderated by the frequency of returns, as indicated by the insignificant p-values ($p > 0.05$). And the same holds for the partnership quality of IS across the reverse supply chain as well.

While analyzing the combined effect of the IS Usage Framework, a negative moderation effect of the frequency of product returns on the accomplishment of strategic benefits is observed which is statistically significant ($\beta = -0.089$, $p < 0.05$). This signifies that achievement of the strategic benefits through RL would be greater in the case of industries with lower return frequencies or if organizations can lower their return frequency levels. Thus, H_{5b} also holds true. This is in stark contrast to the previous observations when each IS construct other than IS Capability was taken individually and the results were found to be insignificant ($p > 0.05$). A possible line of reasoning can be the superseding impact of the capabilities of IS being utilized for RL over the other IS framework constructs, as far as its contribution towards getting a strategic advantage is concerned. Thus, in the automotive industry, which have comparatively longer product life cycles and low return frequencies, usage of Business Intelligence (BI) tools in RL has led to the evaluation of the cause of returns and development of methods to control cost and return rates, thereby creating a greater degree of strategic advantage for the firms involved (Kumar and Chatterjee, 2011).

The research carried out has resulted in some very interesting findings and confirms resource commitment and frequency of returns as significant moderators towards the attainment of strategic RL benefits. Regarding the impact on the RL strategic performance, it states that both resource commitment and frequency of product returns negatively moderates the achievement of RL strategic benefits from an information system context. This is an enhancement on the work done by Autry et al. (2001) wherein sales volume was found to impact the overall RL performance while industry type was found to significantly affect the satisfaction performance measure in RL, although they were not considered as possible moderators in the stated context. From an information system perspective, it differs significantly from the outcomes stated by Daugherty et al. (2002) where no relationship was found between IS support and RL performance, specifically operating & financial performance. The explanation for the same may centre on the erratic nature of RL and relatively unpredictable demands at the given time, considering it took place more than a decade ago. Then, the IT systems being used to support RL were not used by managers for decision making but rather for recording transactions (Tan et al., 2003), which is in stark contrast to the current usage of the IS wherein they are used extensively for strategic decision-making.

5. Conclusion and Future Scope

The study provides in-depth insights on how organizations, which wish to use RL for achieving strategic benefits, can utilize an IS-centric framework based on the degree of their product returns and the amount of resources committed to various RL activities. While resource commitment has been found to have a more critical moderating impact, the impact of return frequency also comes out to be significant enough in influencing the achievement of strategic RL outcomes. The logistics and value creation activities handled by organizations by utilizing IS will gain

further emphasis towards making the firms competitive if the resources are committed and subsequently used as well for RL. Organizations need to shift from the continued focus on the forward chain to attain larger competitive benefits by committing and subsequently using a greater amount of human, financial and technological resources to RL activities carried out by the firm. Allocating and using organizational resources specifically for investing in technology will enable these businesses to implement systems that are not only capable of handling returns and logistics efficiently but also have the ability to analyse customer feedbacks to enhance product quality. Moreover, these systems can reduce product returns thereby resulting in additional strategic benefits in terms of quicker response times and greater customer satisfaction. Management can arrange trainings for their employees to help them utilize the resources optimally. Moreover, organizations specifically from e-commerce domain need to invest in highly capable IS for detecting fraudulent returns and analysing return patterns that can help them to achieve additional cost savings, thereby leading to enhanced RL strategic outcomes and sustainability.

Regarding theoretical contributions, this study makes an effort to address and establish the role RL can play to achieve strategic benefits in the reverse supply chains. Literature suggests the presence of continued organizational focus on the forward supply chain for attaining profits and competitive benefits, and hence the forward chain became a part of the value chain for organizations (Jayant et al., 2011). This study adds to the literature, the considerable change in emphasis towards the reverse chain through the lens view of IS for attaining larger strategic benefits. Through this study, an IS-centric framework has been proposed that can be used to analyse the utilization of RL strategically. Emphasis has been put to include and explain the influence of return frequency and resource commitment, which seems to hold a lot of significance in the RL context.

The current study has used regression analysis technique to establish the relationships between the IS usage framework constructs and RL strategic benefits with resource commitment and return frequency acting as relatively strong moderators in the said relationships. To validate and to create a structure among these constructs, advanced research methodologies such as analytical hierarchical process (AHP) and structural equation modeling (SEM) can be used for future studies. As discussed in the discussion section, resource utilization can be an equally important construct and thus can be included as a moderator as well to analyse further. Moreover, efforts can be made to enhance the framework by adding few additional constructs such as the scale of operations, type of industry, government regulations and management's orientation towards RL. Also, other RL performance metrics including operational and financial performances could be added to the analysis to create a more comprehensive framework. Industry specific comparisons in the RL segment can also lead to some very useful interpretations for the industry practitioners and can help them channelize their organizational resources to achieve the desired strategic goals and objectives based on the sector-specific economic policies, government regulations, and business environments.

References

1. Aitken, J. and Harrison, A. (2013), "Supply governance structures for reverse logistics systems", *International Journal of Operations & Production Management,* Vol. 33 No. 6, pp. 745-764.
2. Anon. (2013), "Reverse Logistics in India become $12 billion industry", available at: http://www.cii.in/PressreleasesDetail.aspx?enc=o6o9nFFRCqbk73N1CBUtjgP1IwG0CMLSLkrIYUqfbJw73xIOQ4zQbUWgx4mUsxc3aEbLlnQMSYEcao1/jgD6Gg== (accessed 05 February 2016).
3. Atroley, N. and Rajat, W. (2014), "Indian retail The next growth story", available at: https://www.kpmg.com/IN/en/IssuesAndInsights/ArticlesPublications/Documents/BBG-Retail.pdf (accessed 22 February 2016).
4. Autry, C. W., Daugherty, P. J. and Richey, R. G. (2001), "The challenge of reverse logistics in catalog retailing", *International Journal of Physical Distribution & Logistics Management,* Vol. 31 No. 1, pp. 26-37.
5. Bakar, A. H. A., Hakim, I. L., Chong, S. C. and Lin, B. (2009), "Measuring supply chain performance among public hospital laboratories", *International Journal of Productivity and Performance Management,* Vol. 59 No. 1, pp. 75-97.
6. Banker, R. D., Kalvenes, J. and Patterson, R. A. (2006), "Information Technology, Contract Completeness, and Buyer-Supplier Relationships", *Information Systems Research,* Vol. 17 No. 2, pp. 180–193.
7. Bayraktar, E., Gunasekaran, A., Koh, S. C. L., Tatoglu, E., Demirbag, M. and Zaim, S. (2010), "An efficiency comparison of supply chain management and information systems practices: a study of Turkish

and Bulgarian small- and medium-sized enterprises in food products and beverages", *International Journal of Production Research,* Vol. 48 No. 2, pp. 425–451.

8. Beheshti, H. M., Hultman, M., Jung, M. L., Opoku, R. A. and Sangari, E. S. (2007), "Electronic supply chain management applications by Swedish SMEs", *Enterprise Information Systems*, Vol. 1 No. 2, pp. 255-268.
9. Bernon, M. and Cullen, J. (2007), "An integrated approach to managing reverse logistics", *International Journal of Logistics: Research and Applications,* Vol. 10 No. 1, pp. 41-56.
10. Bhagwat, R. and Sharma, M. K. (2007), "Performance measurement of supply chain management using the analytical hierarchy process", *Production Planning & Control,* Vol. 18 No. 8, pp. 666-680.
11. Carvalho, R. A. D. and Costa, H. G. (2007), "Application of an integrated decision support process for supplier selection", *Enterprise Information Systems,* Vol. 1 No. 2, pp. 197-216.
12. Chandra, C. and Grabis, J. (2008), "Information technology support for integrated supply chain modeling", *Human Systems Management,* Vol. 27, pp. 3-13.
13. Chang, H. L. and Shaw, M. J. (2009), "The Business Value of Process Sharing in Supply Chains: A Study of RosettaNet", *International Journal of Electronic Commerce*, Vol. 14 No. 1, pp. 115-145.
14. Chan, F. T. S., Bhagwat, R. and Wadhwa, S. (2009), "Study on suppliers' flexibility in supply chains: is real-time control necessary?", *International Journal of Production Research,* Vol. 47 No. 4, pp. 965–987.
15. Christopher, M. and Towill, D. (2001), "An integrated model for the design of agile supply chains", *International Journal of Physical Distribution & Logistics Management,* Vol. 31, pp. 235-246.
16. Cronbach, L. J. (1951), "Coefficient alpha and the internal structure of tests", *Psychometrika,* Vol. 16, pp. 297-334.
17. Cuthbertson, R. and Piotrowicz, W. (2011), "Performance measurement systems in supply chains", *International Journal of Productivity and Performance Management,* Vol. 60 No. 6, pp. 583-602.
18. Daugherty, P. J., Myers, M. B. and Richey, R. G. (2002), "Information Support for Reverse Logistics: The influence of relationship commitment", *Journal of Business Logistics,* Vol. 23 No. 1, pp. 85-106.
19. Daugherty, P. J., Richey, R. G., Genchev, S. E. and Chen, H. (2005), "Reverse logistics: superior performance through focused resource commitments to information technology", *Transportation Research Part E*, Vol. 41 No. 1, pp. 77-92.
20. Dedrick, J., Xu, S. X. and Zhu, K. X. (2008), "How Does Information Technology Shape Supply-Chain Structure Evidence on the Number of Suppliers", *Journal of Management Information Systems,* Vol. 25 No. 2, pp. 41–72.
21. Edwards, J. R. and Lambert, L. S. (2007), "Methods for Integrating Moderation and Mediation: A General Analytical Framework Using Moderated Path Analysis", *Psychological Methods,* Vol. 12 No. 1, pp. 1-22.
22. Flowers, S. (1996), *Software failure: management failure*, John Wiley, New York, NY.
23. French, M. L. and Discenza, R. (2006), "Returns in process industries: a managerial perspective", *Management Research News,* Vol. 29 No. 12, pp. 769-781.
24. Fynes, B., Burca, S. D. and Voss, C. (2005), "Supply chain relationship quality, the competitive environment and performance", *International Journal of Production Research,* Vol. 43 No. 16, pp. 3303-3320.
25. Genchev, S. E., Richey, R. G. and Gabler, C. B. (2011), "Evaluating reverse logistics programs: a suggested process formalization", *The International Journal of Logistics Management,* Vol. 22 No. 2, pp. 242-263.
26. Gobbi, C. (2011), "Designing the reverse supply chain: the impact of the product residual value", *Journal of Physical Distribution & Logistics Management,* Vol. 41 No. 8, pp. 768-796.
27. Gosain, S., Malhotra, A. and El Sawy, O. A. (2004-5), "Coordinating for Flexibility in e-Business Supply Chains", *Journal of Management Information Systems,* Vol. 21 No. 3, pp. 7-45.

28. Gunasekaran, A. and Kobu, B. (2007), "Performance measures and metrics in logistics and supply chain management: a review of recent literature(1995–2004) for research and applications", *International Journal of Production Research,* Vol. 45 No. 12, pp. 2819-2840.

29. Gunasekaran, A., Ngai, E. W. T. and Cheng, T. C. E. (2007), "Developing an e-logistics system: a case study", *International Journal of Logistics Research and Applications,* Vol. 10 No. 4, pp. 333-349.

30. Hayes, A. F. (2013), *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach*, The Guilford Press, New York, NY.

31. Hsu, C. -C., Tan, K. C., Kannan, V. R. and Leong, G. K. (2009), "Supply chain management practices as a mediator of the relationship between operations capability and firm performance", *International Journal of Production Research,* February, Vol. 47 No. 3, pp. 835-855.

32. Huang, Y. C., Wu, Y. C. J. and Rahman, S. (2012), "The task environment, resource commitment and reverse logistics performance: evidence from the Taiwanese high-tech sector", *Production Planning & Control,* Vol. 23 No. 11, pp. 851-863.

33. Jayant, A., Gupta, P. and Garg, S. K. (2011), "Reverse Supply Chain Management (R-SCM): Perspectives, Empirical Studies and Research Directions", *International Journal of Business Insights & Transformation,* Vol. 4 No. 2, pp. 111-125.

34. 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 and Applications,* Vol. 11 No. 6, pp. 409-425.

35. Johns, B. (2014), "Reverse Logistics Offers Many Benefits to Corporations", available at: http://rlmagazine.com/edition63p32.php (accessed 10 April 2016).

36. Julka, H. and Ganguly, P. (2015), "Ecommerce sites altering policies to avoid low returns", available at: http://articles.economictimes.indiatimes.com/2015-04-08/news/60942830_1_amazon-india-returns-flipkart-and-amazon (accessed 23 March 2016).

37. Kaihara, T. (2003), "Multi-agent based supply chain modeling with dynamic environment", *International Journal of Production Economics,* Vol. 85 No. 2, pp. 263-269.

38. Kim, J. W. and Kim, E. J. (2009), "The impact of IT investment directions and strategies of supply chain management(SCM) implementing enterprises on business performance", *International Journal of Business Research,* Vol. 9 No. 4, pp. 126-137.

39. Kim, S. W. and Narasimhan, R. (2002), "Information system utilization in supply chain integration efforts", *International Journal of Production Research,* Vol. 40 No. 18, pp. 4585-4609.

40. Knemeyer, A. M., Ponzurick, T. G. and Logar, C. M. (2002), "A qualitative examination of factors affecting reverse logistics systems for end-of-life computers", *International Journal of Physical Distribution & Logistics Management,* Vol. 32 No. 6, pp. 455-479.

41. Kroon, L. and Vrijens, G. (1995), "Returnable containers: an example of reverse logistics", *International Journal of Physical Distribution & Logistics Management,* Vol. 25 No. 2, pp. 56-68.

42. Kumar, N. and Chatterjee, A. (2011), "Reverse Supply Chain: Completing the Supply Chain Loop", available at: http://www.cognizant.com/InsightsWhitepapers/Reverse-Supply-Chain.pdf (accessed 18 March 2016).

43. Kumar, S., Dieveney, E. and Dieveney, A. (2009), "Reverse logistic process control measures for the pharmaceutical industry supply chain", *International Journal of Productivity and Performance Management,* Vol. 58 No. 2, pp. 188-204.

44. Lau, K. H. and Wang, Y. (2009), "Reverse logistics in the electronic industry of China: a case study", *Supply Chain Management: An International Journal,* Vol. 14 No. 6, pp. 447-465.

45. Li, X. and Olorunniwo, F. (2008), "An exploration of reverse logistics practices in three companies", *Supply Chain Management: An International Journal,* Vol. 13 No. 5, pp. 381-386.

46. Mangla, S., Madaan, J. and Chan, F. (2012), "Analysis of Performance Focused Variables for Multi-Objective Flexible Decision Modeling Approach of Product Recovery Systems", *Global Journal of Flexible Systems Management,* Vol. 13 No. 2, pp. 77-86.

47. McLaren, T. S., Head, M. M. and Yuan, Y. (2004), "Supply chain management information systems capabilities. An exploratory study of electronics manufacturers", *Information Systems and e-Business Management,* Vol. 2, pp. 207-222.

48. Meixell, M. J. (2006), "Quantifying the value of web services in supplier networks", *Industrial Management & Data Systems,* Vol. 106 No. 3, pp. 407-422.

49. Olorunniwo, F. O. and Li, X. (2011), "An Overview of Some Reverse Logistics Practices in the United States", *Supply Chain Forum: An International Journal,* Vol. 12 No. 3, pp. 2-9.

50. Preacher, K. J., Rucker, D. D. and Hayes, A. F. (2007), "Addressing Moderated Mediation Hypotheses: Theory, Methods, and Prescriptions", *Multivariate Behavioral Research,* Vol. 42 No. 1, pp. 185–227.

51. Rai, A., Patnayakuni, R. and Seth, N. (2006), "Firm performance Impacts of Digitally Enabled Supply Chain Integration capabilities", *MIS Quarterly,* Vol. 30 No. 2, pp. 225-246.

52. Ravichandran, T. and Lertwongsatien, C. (2005), "Effect of Information Systems Resources and Capabilities on Firm Performance: A Resource-Based Perspective", *Journal of Management Information Sytems,* Vol. 21 No. 4, pp. 237-276.

53. Richey, R. G., Genchev, S. E. and Daugherty, P. J. (2005), "The role of resource commitment and innovation in reverse logistics performance", *International Journal of Physical Distribution & Logistics Management,* Vol. 35 No. 4, pp. 233-257.

54. Robinson, A. (2015), "4 Important Benefits of a Sustainable Reverse Logistics Strategy", available at: http://cerasis.com/2015/08/24/reverse-logistics-strategy/ (accessed 10 April 2016).

55. Rogers, D. S. and Tibben-Lembke, R. S. (1999), *Going Backwards: Reverse Logistics Trends and Practices.* Reverse Logistics Executive Council, Reno, NV.

56. Romano, P. (2002), "Impact of Supply Chain Sensitivity to Quality Management Practices and Performance", *Total Quality Management,* Vol. 13 No. 7, pp. 981-1000.

57. Ross, A. D., Buffa, F. P., Droge, C. and Carrington, D. (2009), "Using Buyer–Supplier Performance Frontiers to Manage Relationship Performance", *Decision Sciences,* Vol. 40 No. 1, pp. 37-64.

58. Saeed, K. A., Malhotra, M. K. and Grover, V. (2005), "Examining the Impact of Interorganizational Systems on Process Efficiency and Sourcing Leverage in Buyer–Supplier Dyads", *Decision Sciences,* Vol. 36 No. 3, pp. 365-396.

59. Shepherd, C. and Gunter, H. (2006), "Measuring supply chain performance: current research and future directions", *International Journal of Productivity and Performance Management,* Vol. 55 No. 3-4, pp. 242-258.

60. Singh, R., Sandhu, H. S., Metri, B. A. and Kaur, R. (2010), "Relating Organised Retail Supply Chain Management Practices, Competitive Advantage and Organizational Performance", *VISION–The Journal of Business Perspective,* Vol. 14 No. 3, pp. 173-190.

61. Skapa, R. and Klapalova, A. (2012), "Reverse logistics in Czech companies: increasing interest in performance measurement", *Management Research Review,* Vol. 35 No. 8, pp. 676-692.

62. Stevenson, M. and Hendry, L. C. (2007), "Improving supply chain integration using a workload control concept and web-functionality", *Production Planning & Control,* Vol. 18 No. 2, pp. 142-155.

63. Stock, J. R. (1992), *Reverse Logistics,* Council of Logistics Management, Oak Brook, IL.

64. Stock, J. R. (1998), *The Development and Implementation of Reverse Logistics Programs.* Council of Logistics Management, Oak Brook, IL.

65. Subramani, M. (2004), "How do suppliers benefit from information technology use in supply chain relationships?", *MIS Quarterly,* Vol. 28 No. 1, pp. 45-73.

66. Tajbakhsh, A. and Hassini, E. (2015), "Performance measurement of sustainable supply chains: a review and research questions", *International Journal of Productivity and Performance Management,* Vol. 64 No. 6, pp. 744-783.

67. Tallon, P. P., Kraemer, K. L. and Gurbaxani, V. (2000), "Executives' Perceptions of the Business Value of Information Technology: A Process Oriented Approach", *Journal of Management Information Systems*, Vol. 16 No. 4, pp. 145-173.

68. Tan, A. W. K. and Kumar, A. (2006), "A decision-making model for reverse logistics in the computer industry", *The International Journal of Logistics Management,* Vol. 17 No. 3, pp. 331-354.

69. 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,* Vol. 33 No. 1, pp. 59-74.

70. Teng, G. S., Ho, M. S. and Shumar, D. (2005), "Enhancing supply chain operations through effective classification of warranty returns", *International Journal of Quality & Reliability Management,* Vol. 22 No. 2, pp. 137-148.

71. Tibben-Lembke, R. S. (2002), "Life after death: reverse logistics and the product life cycle", *International Journal of Physical Distribution & Logistics Management,* Vol. 32 No. 3, pp. 223-244.

72. Tibben-Lembke, R. S. and Rogers, D. S. (2002), "Differences between forward and reverse logistics in a retail environment", *Supply Chain Management: An International Journal,* Vol. 7 No. 5, pp. 271-282.

73. Ülgen, V. S. and Forslund, H. (2015), "Logistics performance management in textiles supply chains: best-practice and barriers", *International Journal of Productivity and Performance Management,* Vol. 64 No. 1, pp. 52-75.

74. Venkatesh, V. G. (2010), "Reverse Logistics: An Imperative Area of Research for Fashion Supply Chain", *The IUP Journal of Supply Chain Management,* Vol. 7 No. 1, pp. 77-89.

75. Vlachos, I. P. and Bourlakis, M. (2006), "Supply Chain Collaboration Between Retailers and Manufacturers: Do They Trust Each Other?", *Supply Chain Forum,* Vol. 7 No. 1, pp. 70-80.

76. Wang, E. T. G., Tai, J. C. F. and Wei, H. L. (2006), "A Virtual Integration Theory of Improved Supply-Chain Performance", *Journal of Management Information Systems,* Vol. 23 No. 2, pp. 41-64.

77. Yeh, C. H., Lee, G. G., and Pai, J. C. (2012), "How information system capability affects e-business information technology strategy implementation: An empirical study in Taiwan", *Business Process Management Journal*, Vol. 18 No. 2, pp. 197-218.

78. Zhang, X., Donk, D. P. V. and Vaart, T. V. D. (2011), "Does ICT influence supply chain management and performance? A review of survey-based research", *International Journal of Operations & Production Management*, Vol. 31 No. 11, pp. 1215-1247.

79. Zhang, X. and Whang, H. (2011), "Empirical Research on Associations among Information Technology, Supply Chain Robustness and Supply Chain Performance", *International Journal ot Business and Management,* Vol. 6 No. 2, pp. 231-235.

80. Zhu, K. and Kraemer, K. L. (2005), "Post-Adoption Variations in Usage and Value of E-Business by Organizations: Cross-Country Evidence from the Retail Industry", *Information Systems Research*, Vol. 16 No. 1, pp. 61-84.

81. Zhu, K., Kraemer, K. L., Xu, S. and Dedrick, J. (2004), "Information Technology Payoff in E-Business Environments: An International Perspective on Value Creation of E-Business in the Financial Services Industry", *Journal of Management Information Systems*, Vol. 21 No. 1, pp. 17-54.

Appendix

A. Research Questionnaire: Constructs, Items and References

The questionnaire developed for the study includes 7 constructs. There are 29 items which have been adopted / developed to measure these constructs as listed below:

S No.	Construct	Item Code	Item Description	References[1] [Google Citation][2]
1	RL Strategic Benefits	SB1	Carrying out the reverse logistic operations in an organized manner gives the organization an edge over its competitors.	Subramani (2004) [1005]; Bhagwat and Sharma (2007) [110]
		SB2	Having a well-organized product return system helps the organization in forming strategic partnerships with its supply chain partners.	
		SB3	Organization also gets strategic benefits like reduced delivery lead time and customer query time by having a systematic reverse logistics process.	
2	IS Capability	CP1	The process of developing reverse supply chain information systems is flexible to allow infusion of new methodology, tools and techniques.	Ravichandran and Lertwongsatien (2005) [888]
		CP2	The organization has sophisticated information systems to record, track and respond to service requests from the customers.	Ravichandran and Lertwongsatien (2005) [888]
		CP3	Little manual intervention is required to run the reverse logistics information systems since most of the operational tasks are automated.	Ravichandran and Lertwongsatien (2005) [888]
		CP4	Supply chain partners are able to avoid repeated spending or purchase of reverse logistic information systems.	Yeh et al. (2012) [22]
3	IS for Logistics	LO1	The information systems used in the reverse supply chain enables faster product return handling up to the vendors.	Beheshti et al., (2007) [32]
		LO2	The information systems used in the reverse logistic supply chain facilitates faster communication of information from and to the customers.	Beheshti et al., (2007) [32]
		LO3	The supply chain information systems consists of a demand forecasting system for making demand forecasts.	Kim and Narasimhan (2002) [85]
		LO4	For making decisions regarding location selections for warehouses and plants in the supply chain, a plant and warehouse location selection systems is being used.	Kim and Narasimhan (2002) [85]
		LO5	The reverse supply chain of the organization uses information systems for effectively managing orders from and towards the customers.	Kim and Narasimhan (2002) [85]
4	IS for Value Addition	VA1	Information Systems used in the reverse supply chain are being used to establish, sustain and improve customer relationships in the organization.	Tallon et al., (2000) [1091]
		VA2	The IS usage in the reverse supply chain has decreased the cost of transactions being carried out.	Zhu et al., (2004) [511]
		VA3	The usage of IS in the reverse logistics has improved the coordination among the members of the supply chain.	Zhu et al., (2004) [511]
		VA4	Information System usage in the reverse supply chain has led to increase in the efficiency of the staff working on the day-to-day operations of the supply chain.	Zhu and Kraemer (2005) [1025]
		VA5	The reverse supply chain information systems reduces error while handling the transactions during the product return process as compared to manual handling.	Chang and Shaw (2009) [22]
		VA6	The information systems in reverse supply chain improve the timeliness of information delivery across the supply chain.	Chang and Shaw (2009) [22]
		VA7	Customer requests in regard to product / services specifications and quality, delivery time and customer services gets met quickly and efficiently through use of information system in reverse logistics.	Chang and Shaw (2009) [22]
		VA8	Effective communication of orders, inventory, and invoice information with the supply chain partners can be done through the use of IS in reverse logistics.	Chang and Shaw (2009) [22]
5	IS Partnership Quality	PQ1	There is a high degree of trust between the IS / IT department and the organization's supply chain partners.	Ravichandran and Lertwongsatien
		PQ2	The goals and plans of developing IS are jointly developed by the IS	

			department and the supply chain partners.	(2005) [888]
		PQ3	Critical Information and knowledge that impacts IS / IT projects are shared freely between the IS department and the organization supply chain partners.	
6	Return Frequency	RF1	The frequency of product returns to the organization due to the product end of life factor is very high.	Genchev et al., (2011) [51]
		RF2	The frequency of product returns to the organization due to defects in the product is very high.	
		RF3	The frequency of product returns to the organization due to unsold items is very high.	
7	Resource Commitment	RC1	The organization has committed technological resources while handling returns from the customer.	Daugherty et al., (2005) [272]
		RC2	The organization has allocated appropriate manpower to deal with the product returns from the customer.	
		RC3	The organization is focused to dedicate a good amount of its capital for its reverse logistics operations.	

1. The items were adopted / developed from selected references and were rephrased to be used in the reverse logistics context.

2. Figures in square parenthesis ([]) indicate number of citations of these studies on Google Scholar.

Table 1 – IS Usage Framework: Description and Supporting References

S No.	Constructs	Description	Supporting References
1	IS Capability	Capability of the IT systems in terms of carrying out system planning, development, process coordination and operations across the reverse supply chain	McLaren et al., 2004; Daugherty et al., 2005; Ravichandran and Lertwongsatien, 2005; Hafeez et al., 2010; Yeh et al., 2012
2	IS for Logistics	The utilization level of IT-based systems in reverse logistics for carrying out the logistical operations across the reverse supply chain	Kim and Narasimhan, 2002; Gunasekaran and Ngai, 2004; Ravichandran and Lertwongsatien, 2005; Beheshti et al., 2007; Kim and Kim, 2009; Yearwood, 2010
3	IS Partnership Quality	It depicts the quality of the information systems being used in the reverse supply chain, specifically depicting compatibility and coordination among the supply chain partners with regards to flow of relevant information	Ravichandran and Lertwongsatien, 2005; Wang et al., 2006; Gunasekaran and Kobu, 2007; Wadhwa et al., 2010; Zhang and Wang, 2011
4	IS for Value Addition	The utilization of IT-based systems in processes leading to creation of value for the end customer by delivering quality product and service	Tallon et al., 2000; Kim and Narasimhan, 2002; Zhu et al., 2004; Zhu and Kraemer, 2005; Gunasekaran and Kobu, 2007; Chang and Shaw, 2009; Hofmann and Locker, 2009; Konthong and Ussahawanitchakit, 2009

Table 2 – Dependent and Moderating Constructs: Description and Supporting References

S No.	Constructs	Description	Supporting References
1	RL Strategic Benefits	The performance benefits realized in terms of collaborative supply chain partnerships and competitive edge as a result of effective reverse logistics systems.	Subramani, 2004; Bhagwat and Sharma, 2007; Richey et al., 2005
2	Return Frequency	It refers to the frequency of product returns by the customers including factors such as product end-of-life, defects and unsold items	Genchev et al., 2011; French and Discenza, 2006; Mondragon et al., 2011; Autry et al., 2001
3	Resource Commitment	It depicts the degree of financial, human and technological resources committed by organizations specifically for handling reverse logistics operations effectively and efficiently.	Daugherty et al., 2002; Daugherty et al., 2005; Richey et al., 2005; Li and Olorunniwo, 2008; Huang et al., 2012

Table 3 – Industry Wide Sample Composition

S No	Industry	Number of organizations	Percentage
1	Apparel & Retail	18	7.06%
2	Automobile / Auto Parts	70	27.45%
3	Chemical	11	4.31%
4	e-Commerce	5	1.96%
5	Electric / Electronic Goods	48	18.82%
6	Food & Beverages	25	9.80%
7	IT Hardware	21	8.24%
8	Logistics	5	1.96%
9	Natural / Domestic Gases	8	3.14%
10	Pharmaceutical	28	10.98%
11	Others	16	6.27%
	Total	**255**	**100%**

Table 4 – Reliability Analysis

S. No	Constructs	No. of items	Cronbach Alpha
1	Instrument	29	0.935
2	RL Strategic Benefits (SB)	3	0.659
3	IS Capability (CP)	4	0.700
4	IS for Logistics (LO)	5	0.737
5	IS for Value Addition (VC)	8	0.887
6	IS Partnership Quality (PQ)	3	0.791
7	Return Frequency (RF)	3	0.848
8	Resource Commitment (RC)	3	0.616

Table 5 – Descriptive Statistics and Correlation Analysis

S No	Constructs	Mean	SD	1	2	3	4	5	6	7
1	IS Capability	3.736	0.702	1						
2	IS for Logistics Operations	3.820	0.653	.731**	1					
3	IS for Value Creation	3.888	0.651	.758**	.829**	1				
4	IS Partnership Quality	3.837	0.748	.682**	.708**	.700**	1			
5	Return Frequency	2.902	1.086	.191**	.179**	.122*	.235**	1		
6	Resource Commitment	3.722	0.717	.643**	.642**	.629**	.628**	.198**	1	
7	Strategic Benefits	4.007	0.705	.693**	.723**	.728**	.571**	.149*	.599**	1

**. Correlation is significant at the 0.01 level.

*. Correlation is significant at the 0.05 level.

Table 6 – Regression Analysis Summary

Parameter	Regression Models									
	IS Capability Model		IS Logistics Model		IS Partnership Quality Model		IS Value Addition Model		IS Usage Framework Model	
Moderator(s) →	**RF**	**RC**	**RF**	**RC**	**RF**	**RC**	**RF**	**RC**	**RF**	**RC**
Independent Variable	CP		LO		PQ		VC		IS Factors	
Dependent Variable	SB		SB		SB		SB		SB	
R	0.609	0.665	0.729	0.749	0.579	0.659	0.737	0.746	0.734	0.740
R^2	0.371	0.442	0.531	0.561	0.335	0.434	0.543	0.557	0.538	0.547
Adjusted R^2	0.364	0.435	0.525	0.556	0.327	0.427	0.538	0.552	0.533	0.542
β Coefficient	0.569	0.343	0.753	0.594	0.513	0.274	0.757	0.620	0.807	0.683
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Interaction β Coefficient	-0.104	-0.092	-0.081	-0.095	-0.071	-0.124	-0.085	-0.099	-0.089	-0.103
Interaction p-value	0.022	0.076	0.061	0.020	0.154	0.017	0.078	0.013	0.041	0.007
Significant Moderation	Y	N	N	Y	N	Y	N	Y	Y	Y

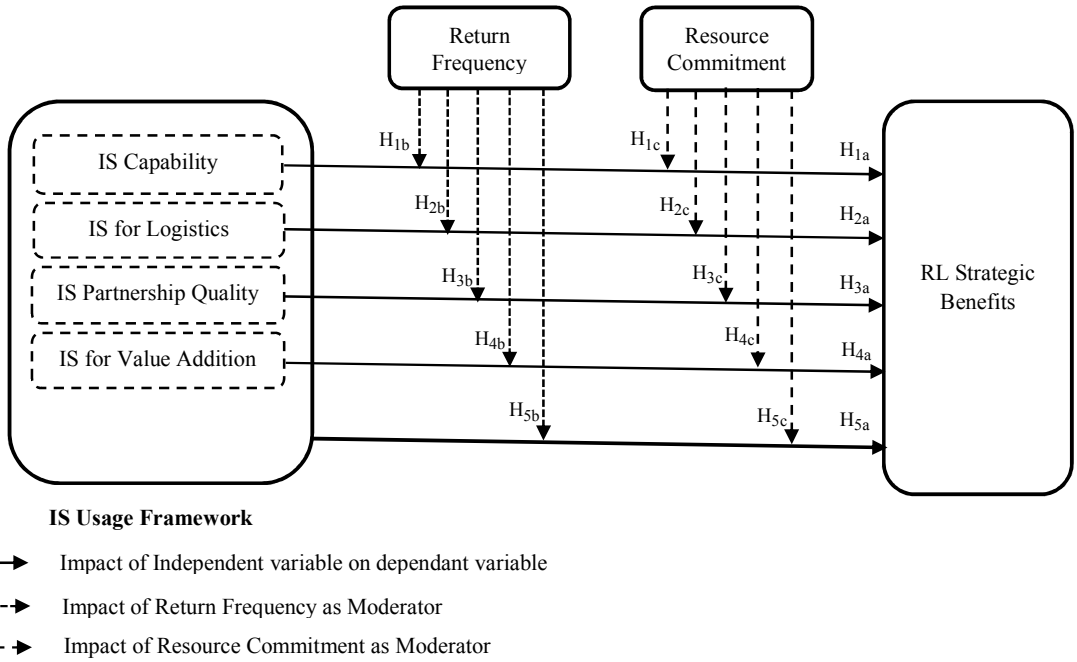

Fig 1 – IS Usage Framework for RL Strategic Performance