Simultaneous impact of RL drivers and barriers on key RL implementation performance: Evidence from China

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Abstract

The independent effects of the drivers of and barriers to reverse logistics (RL) implementation have reported in developing countries. Using structural equation modelling approach, this study empirically examines the simultaneous impact of established RL drivers and barriers on key performance indicators in a sample of 167 local Chinese manufacturing firms.

Keywords: Reverse Logistics, Drivers, Barriers

Introduction

Environmental concerns and legislations, resource depletion, increasing costs of landfilling and liberal return policies of retailers have led to the prominent importance of reverse logistics (RL) among worldwide manufacturers. These developments have pushed firms to find economically efficient and sustainable ways of dealing with end-of-life issues for their products (Shankar, 2005; Streicher-Porte and Geering, 2010). The industries involved in early take-back and reuse/recycling had discovered long ago that the recovery of such products is economically more attractive than their disposal (Jayaraman and Luo, 2007; Sarkis et al., 2010).

However, RL implementation is not free from implementation barriers (Rogers and Tibben-Lembke, 2001; Ravi and Shankar, 2005; Chung and Zhang, 2011). This is why much of the attention and research into RL over the past decade has been directed towards understanding RL implementation barriers and finding possible alleviating strategies (Ravi Shankar, 2005; Lau and Wang, 2009; Chung and Zhang, 2011).

Most prior research on RL focused on examining the impact of selected barriers and drivers on RL implementation and profitability of firms (Kapetanopoulous et al., 2010). No study has examined the simultaneous effects of RL drivers and RL barriers on performance outcomes of RL implementation. Also, there are relatively few studies that have used empirical data to investigate RL in the Chinese context (Liu, et al., 2006; Lai and Wong, 2012). Liu et al., (2006) only examined barriers to household electrical and electronic waste in China. Similarly, the study by Lai and Wong (2012), examined the green logistics management (GLM) in China to identify the institutional and operational conditions for adopting GLM by exporting companies in China. However, most of the RL literature in China is based on case studies using small sample sizes that limit the ability to generalize the results. This study empirically examines the effects of RL drivers and RL barriers on performance outcomes of RL implementation in 167 Chinese manufacturing companies.

The rest of the paper is organized as follows. In the next section, the related literature on RL implementation drivers, barriers and performance outcomes is reviewed, following which is the section that details the conceptual model and hypotheses development. This is followed by a description of the methodology and sample characteristics of the study. The section that then follows presents the data analysis and results, which is followed by the discussion section. The last section provides our concluding remarks.

Literature review

RL Drivers

The green or environmental driver for RL remains important and even mandatory in some European countries. These standards mandate that original equipment manufacturers (OEMs) of such products to undertake the collection, treatment, recycling and/or safe disposal after end-of-life (EoL) of their products (Gunasekaran and Spalanzani, 2011; Zhang et al, 2011; Lai and Wong, 2012). In addition to environmental concerns, there are other important drivers of RL implementation that includes, for example, brands and reputation protection through recalling defective and/or accepting unwanted products from consumers (RedPrairie, 2008; Souiden et al., 2009).

The most immediate benefits for companies that have established efficient RL practices is the recovery of materials (assets) which was found to be highly profitable (Sarkis et al., 2010; Giannetti, et al., 2012). Asset recovery is “the classification and disposition of surplus, obsolete, scrap, waste and excess material products, and other assets, in a way that maximizes returns to the owner, while minimizing costs and liabilities associated with the dispositions” (Rogers and Tibben-Lembke, 2001). In this study, ‘assets’ refers to physical substances recovered that are capable of being reused, refurbished and remanufactured to return them to full functionality. Table 1 provides a summary of RL drivers considered for this study based on a literature review.

Table 1: Drivers to RL Implementation

Drivers	Source
Assets Recovery (AR)	Rogers and Tibben-Lembke (2001), Jayaraman & Luo (2007), Kapetanopoulous, P. et al., (2010); Sarkis et al., (2010), Giannetti, et al., (2012)
Brand protection (BP)	Blumberg (1999), RedPrairie (2008), Dinnie et al. (2006), Souiden et al., (2009)
Reputation protection (RP)	RedPrairie, (2008), Souiden et al., (2009), Mollenkopf, (2010)
Margin Improvement (MI)	Giannetti, et al., (2012), Jayaraman & Luo (2007); Kapetanopoulous, P. et al., (2010), Jayaraman and Luo (2007)

The predominant and critical drivers of RL implementation based on a literature review that are included in this study are: asset recovery (Sarkis et al., 2010; Giannetti, et al., 2012), brand protection (Dinnie et al. 2006; RedPrairie, 2008; Souiden et al., 2009), reputation protection (Blumberg, 1999; Mollenkopf, 2010) and margin protections (Stock, 2006; Jayaraman & Luo, 2007; Giannetti, et al., 2012).

RL Barriers

The literature lists barriers to RL implementation that we broadly classify into management barriers (Rogers and Tibben-Lembke, 1999; Ravi and Shankar, 2005; Lau and Wang, 2009), financial barriers (Ravi and Shankar, 2005; Lau and Wang 2009; Zhao *et al*., 2010), policy barriers (Ravi and Shankar, 2005; Lambert et al., 2011; Zhang, et al., 2011) and infrastructure/technological systems barriers (Dibenedetto, 2007; Jack, et al., 2009; Lau and Wang, 2009; Rahman and Wu, 2011). Table 2 presents a summary of RL implementation barriers. Based on literature review, we selected the predominant barriers as: management, finance, policy and infrastructure that are likely to adversely affect the implementation of RL in China and its details are shown in table 2.

Table 2: Barriers of RL implementation

Reverse logistics Barriers	**Details /Types**
Management	Management inattention/lack of top management commitment (M1)
	Lack of trained personnel (M2)
	Lack of personnel resources/ lack of knowledge in best RL practices / poor level of technical knowledge (M3)
	Lack of expert at management level (M4)
	Lack of awareness at operations level (M5)
	Lack of understanding of RL significance/ little appreciation of RL as a competitive factor (M6)
	Lack of strategic planning (M7)
Financial	Lack of initial capital /high initial cost of RL implementation (F1)
	Lack of financial resources (F2)
	Lack of funds to monitor return systems (F3)
	Lack of funds to train personnel (F4)
	Lack of funds for storage and handling (F5)
Policy	Lack of government / company supportive policy (P1)
	Lack of laws/ regulations and directives on End of Life products (P2)
	Lack of in-house green design policy (P4)
	Lack of insight between RL and performance (P5)
Infrastructure	Lack of information/monitoring/technological systems / EDI standards / underdeveloped of recycling technologies (I1)
	Lack of cost-effective recycling technologies (I2)
	Lack of in-house facilities (I3)

RL implementation outcomes

The literature review on RL implementation outcomes revealed that companies considered both tangible and intangible performance outcomes. As a result of their rapid and effective service recovery actions in response to returns and recalls, companies were able to use RL to attract customers and employees who were environmentally conscious, increased customer satisfaction, loyalty and repeat purchases (Souiden and Pons, 2009; Rahman and Subramanian, 2011; Lai and

Wong, 2012). These performance outcomes have resulted in significantly improved financial outcomes and increased profits margins for these companies (Stock, 2006; Jack et al., 2010; Giannetti, et al., 2012). RL implementation performance outcomes measures considered in the study is reported in Table 3.

Table 3: RL Implementation Outcomes

Performance	**Source**
Improved Financial Returns (IFR)	Johnson (1998), Stock (2006), Jayaraman & Luo (2007), Giannetti, et al., (2012)
Increased Profit Margins (IPM)	Johnson (1998), Jayaraman & Luo (2007), Jack et al., (2010), Giannetti, et al., (2012)

Research hypothesis

Based on the review of literatures on environmental management, supply chain management, operations and production management, retailing and consumer service, marketing and, business strategy above, this study examines the theoretical relationships of the combined effect of RL drivers and RL barriers on the performance outcomes of RL implementation as shown in figure 1

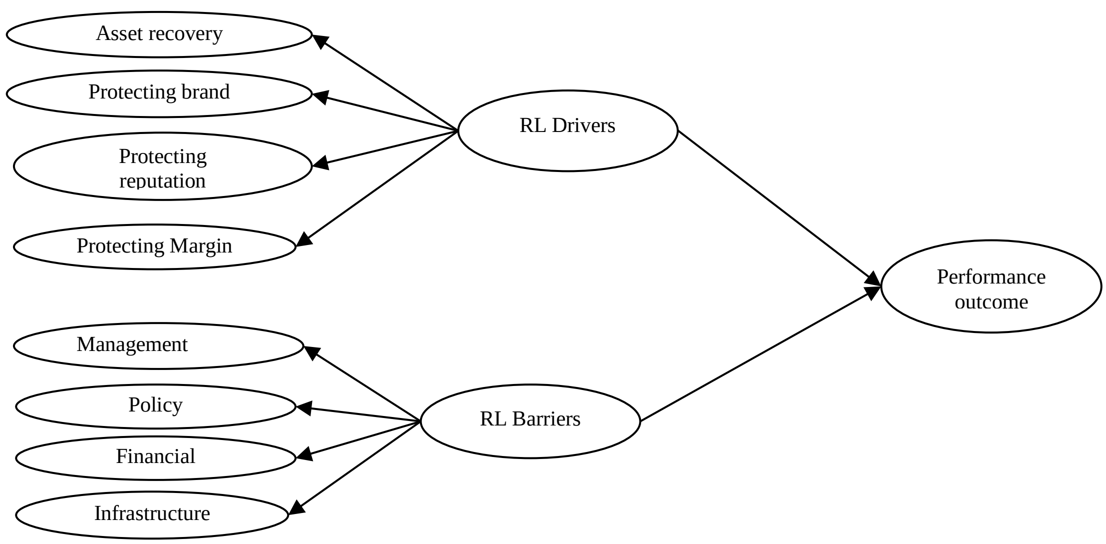

Figure 1: Conceptual model

For RL drivers, the key relationships are expressed in the following hypothesis:

Hypothesis H1: *RL drivers of asset recovery, brand protection, reputation protection, profit margin protection and improved financial returns are positively associated with the firm's RL implementation performance outcomes of increased return customers; improved financial returns; and increased profit margins.*

For RL barriers, the key relationships are expressed in the following hypothesis:

Hypothesis H2: *RL barriers of top management commitment, financial, regulation and policies are negatively associated with the firm's RL implementation performance outcomes of increased return customers; improved financial returns; and increased profit margins.*

Methodology

Research Sample

The selected companies for this study are from the key coastal cities of Ningbo, Shanghai, Guangzhou, Foshan and Shenzhen which have the highest concentration of major industries. We targeted the industrial sectors of automobile, steel/construction, electronic/computer, textile, plastics and paper based products.

Data Collection

A self-administered questionnaire was used to gather the data from 167 local Chinese manufacturing companies for this study. All measures were on a five point Likert scale (end points of 1 = Strongly disagree, and 5 = strongly agree). Data collection was conducted through a personal administration of the survey instrument at selected organizations using intermediaries who were either representatives of private entrepreneur associations or local government officials during a three month period from August to October 2011. The use of intermediaries is typical in the Chinese context and highlights the challenges faced in using representative sampling techniques in China, where a general distrust of outsiders could result in low response rate to mail-based surveys (Tabachnick and Fidell, 2000; Zheng *et al*., 2006). The targeted manufacturing companies were identified and randomly chosen from the China manufacturer directory (china-manufacturer-directory.com). The questionnaires were mostly answered by middle line managers (approximately 52%), followed by top managers (approximately 29%).

A total of 650 questionnaires were distributed and a total of 315 were returned and after surveys with excessive missing responses were excluded, 167 surveys were included in the final sample (25.69% response). The response rate is far better than previous empirical studies which typically had a response rate of around 17% (Lai and Wong, 2012). Details of the respondents are shown in Table 4.

The final sample comprised of respondents from the cities of Ningbo (30.0%), Foshan (38.3%), Guangzhou (15.6%), Shenzhen (5.4%) and Shanghai (10.7%). When judged by their business volume, most of the companies fell into the SMEs category (over 91%), while over 9% of the respondents were larger companies. Over 65% of the companies have been established for over five years.

Data Analysis and Results

Given the multivariate nature of the model, Structural Equation Modelling (SEM) was employed using AMOS Version 20 to investigate the simultaneous effects of RL drivers and RL barriers on the firms' RL implementation performance outcomes as hypothesized above. Using two-step approach recommended by Anderson and Gerbing (1988, 1992), we first assessed the factor structure of each of the three measurement models by conducting Confirmatory Factor Analysis for the construct of interest (drivers, barriers, and performance) to determine measurement fit. We then examined the measurement model with all latent and observed factors included in one full measurement model. Second, we examined the complete structural model by identifying causal relationships among the three latent construct to determine the fitness of the complete structural model.

We tested the proposed structural equation model and the fit indices of them are shown in table 4. Chi-square, comparative fit index, incremental fit index and root mean square error of approximation are within the suggested cut-off. The full structural model results with standardized weights are given in figure 2. A summary of the confirmation/rejection of the hypothesis is shown in Table 5 below. H1 hypothesis that RL drivers of asset recovery, protection of brand, protection of reputation and protection of margin are positively associated with performance outcomes of increased return customers, improved financial returns and increased profit margins. This was confirmed (β = .22, p < .01). H2 hypothesis that RL barriers of management, financial, policy and infrastructure are negatively associated with the firm's RL implementation performance outcomes of increased return customers, improved financial returns and increased profit margins. This was confirmed (β = -.32, p < .01).

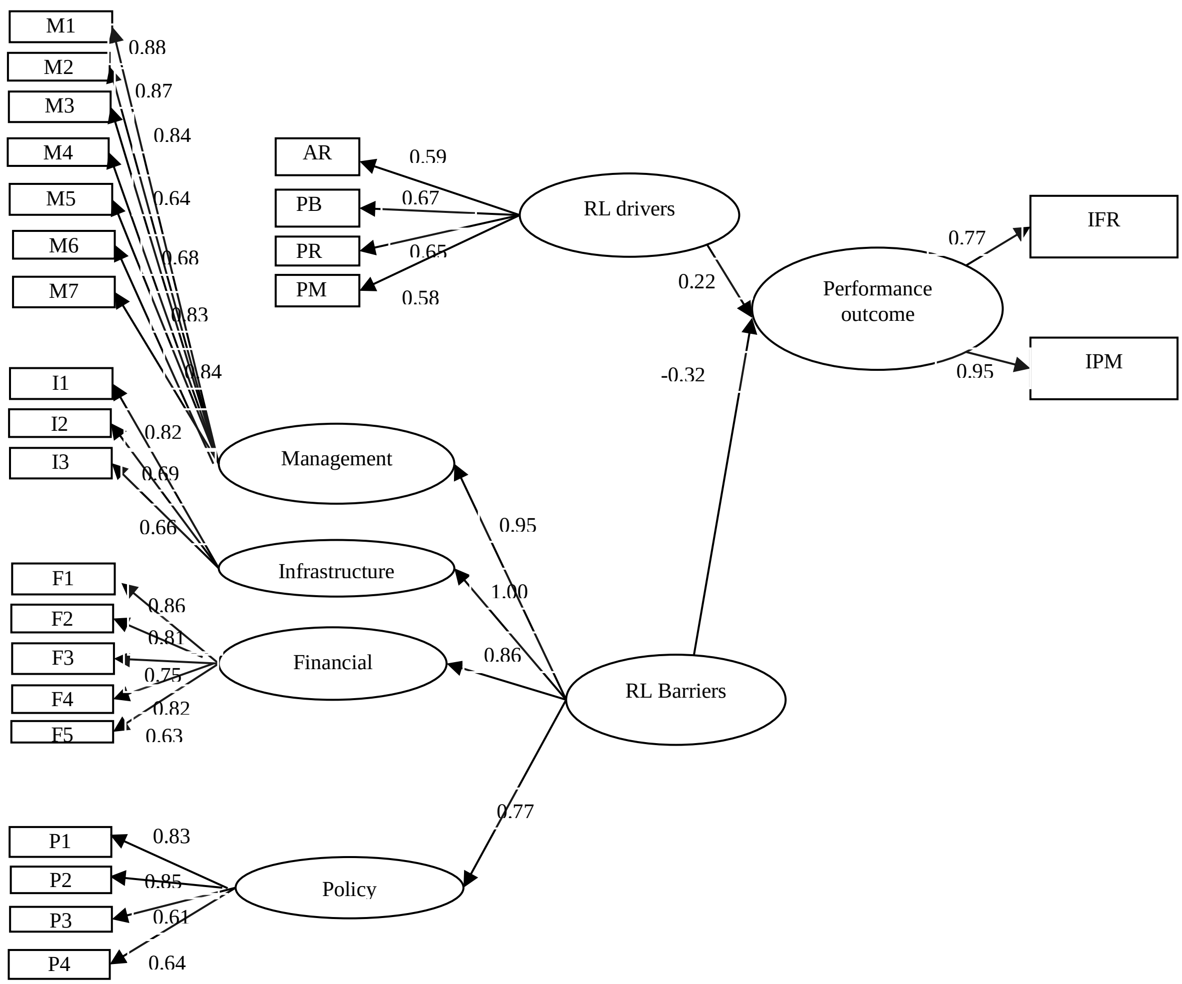

Figure 1- Full structural model results with standardized regression weights

Table 4: Fit indices

	x^2(df)	Normed x^2	CFI	RMSEA(% CI)	IFI
Model 1	788.84(274)	2.878	0.800	0.106	0.792

Table 5: Summary of Hypothesis Test Results

Hypothesis	β	*p*	Accept/Reject
Hypothesis H1: RL drivers are positively associated with the firm's RL implementation performance outcomes	.22	< .01	Accept
Hypothesis H2: RL barriers are negatively associated with the firm's RL implementation performance outcomes	-.32	< .01	Accept

Discussion

The two broad hypothesis outlined in this study were both accepted. First, on the RL drivers, protecting brand and protecting reputation are the main contributors to the RL drivers. That is, firms that protect their brands through RL activities such as recalls/returns from customer and/or take-back of end-of-life products could enjoy increased return customers and financial returns but not increased profit margins. This finding is in line with the literature that suggests that a liberal return policy as an integral part of customer relationship management keeps customers satisfied and loyal and enables companies to benefit from customer lifetime value (RedPrairie, 2008; Souiden and Pons, 2009).

The results shows that assets recovery, i.e., the recovery and reuse/ recycle, refurbish and/or remanufacture is certainly a better option for manufacturers than disposal, as recovery definitely improve financial returns and increase profit margins of firms. This finding is supported in the literature that recovery through recalls/returns and take-back improve economic performance of firms (Jayaraman & Luo, 2007; Sarkis et al., 2010; Giannetti, et al., 2012). Protection margins have equal weighting with assets recovery driver. That is, firms that engaged in RL practices to protect their margins gained significantly in the outcome measures of improved financial returns and increased profit margins but not on increase in return customers. Previous studies support this finding (Jayaraman & Luo, 2007; Sarkis et al., 2010).

The results indicate that the key management barriers to RL implementation in Chinese manufacturing sector are the low commitment to RL practices and a general lack of personnel resources in terms of lack of trained personnel, lack of knowledge in RL practices and lack of RL expertise at the management level in the manufacturing firms that were investigated. These findings are in line with previous studies (Rogers and Tibben-Lembke, 1999; Ravi et al., 2005; Lau and Wang, 2009). A high commitment and/or presence of RL expert at management level should lead to a full realization of the importance of RL to business operations and its potential for firms' future competiveness.

The findings of this study revealed a severe lack of RL infrastructure in Chinese manufacturing sector that includes a lack of hardware/software systems to monitor returns, a lack of in-house facilities such as storage, handling equipment and vehicles for the movement of EoL products in the firms investigated ($\beta = 1.0$, $p < .01$). This was not surprising as the absence of good RL has been widely reported (Lau and Wang, 2009; Rahman and Wu, 2011). Specifically, Lau and Wang (2009) reported a severe dearth of RL infrastructure and technology in China citing "primitive tools with no automation in the recycling process" being used in China. The second major RL barrier in China, based on companies investigated, is management barriers that includes a lack top management commitment, lack of trained personnel, amongst others (see fig. 1) ($\beta = .95, p < .01$). A lack of financial resources with key financial measures of lack of initial capital, lack of funds for return monitoring systems are major financial barriers to RL implementation in China. This findings are also supported by literature which suggests a lack of finance invariably leads to a lack of capability to handle, evaluate and /or extract value form returns/recalls (Lau and Wang, 2009; Jack et al., 2010). We believe that this barrier can be overcome by external pressures and support through stringent government policy.

The Chinese manufacturing sector suffered from a number of critical policy barriers ($\beta = -.77, p < .01$). These included a lack of enforceable laws and regulations on EoL products, a lack of government supportive policy, a lack of in-house green design policy and a lack of insight between RL and performance. This finding is support by Lau and Wang (2009) study which found the lack of enforceable legislations and economic incentives from government acted as a major disincentive for the Chinese manufacturers. Managers should realize that effective internal policy of waste minimization, reuse and recycle can provide significant economic and strategic benefits such as increase in profit margins and being considered a socially responsible firm.

Concluding Remarks

This paper identified the drivers and barriers of RL implementation and examined the combined effects of RL drivers and barriers on RL implementation performance outcomes in the Chinese manufacturing firms. Our findings was based on an empirical analysis of the 167 local Chinese manufacturing companies in six key manufacturing sectors of automotive, electronic/computer, plastics, steel / construction, textiles and paper and paper based industries. Our research propositions captured the combined impacts of these RL drivers and barriers on RL implementation performance outcomes in the firms investigated. The results indicate that the key RL drivers in Chinese manufacturing companies (assets recovery, brand and reputation protections and margin protection) are positively associated with RL implementation performance outcomes (of increased return customers; improved financial returns; and increased profit margins). Similarly, RL barriers (of top management commitment, financial, regulation and policies) are negatively associated with the firm's RL implementation performance outcomes (of increased return customers; improved financial returns; and increased profit margins).

Limitations to this research are in terms of the selection of different manufacturing industries. It would be promising to replicate this research on a large-scale data of a given manufacturing industry at a time to establish specific RL drivers, challenges and performance outcomes within the industry. Also, future research frameworks based on the strengths of other methodologies could provide further insights and corroboration (or otherwise) of our results.

References

Anderson, J. C., & Gerbing, D. W. (1988). Structural equation modeling in practice: a review and recommended two-step approach. *Psychological Bulletin*, 103(3), 411e423.

Anderson, J. C., & Gerbing, D. W. (1992). Assumptions and comparative strengths of the two-step approach: comment on Fornell and Yi. *Sociological Methods Research*, 20(3), 321e333.

Blumberg, D (1999). Strategic examination of reverse logistics & repair service requirements, needs, market size, and opportunities. *Journal of Business Logistics*, Vol. 20 (2), pp. 141-159

Mollenkopf, D. A., McCormick, (2010), Supply Chain Management Review, http://scmr.com/article/effective_returns_management_in_an_integrated_supply_chain, assessed Feb, 22, 2012.

Giannetti BF, Bonilla SH, Almeida CMVB, (2012) An emergy-based evaluation of a reverse logistics network for steel recycling, Journal of Cleaner Production, doi: 10.1016/j.jclepro.2012.05.024.

Gunasekaran A & Spalanzani A (2011) Sustainability of manufacturing and services: Investigations for research and applications. *International Journal of Production Economics*. doi:10.1016/j.ijpe.2011.05.011.

Jack, E, Powers, T and Skinner, L (2010). Reverse logistics capabilities: antecedents and cost savings. *International Journal of Physical Distribution & Logistics Management*, Vol. 40 (3), pp. 228-246.

Jayaraman V. and and Luo, Y. (2007). Creating Competitive Advantages Through New Value Creation: A Reverse Logistics Perspective. *Academy of Management Perspectives*, 21(2), 56-73.

Johnson, P. F., (1998). Managing value in reverse logistics systems. *Transportation Research Part E: Logistics and transportation review*, Vol. 34, No. 3, pp. 217-227

Kapetanopoulous, P., Tagaras, G., (2011). Drivers and obstacles of product recovery activities in the Greek industry. *International Journal of Operations and Production Management* 31, (2), 148-166

Lai K-H and Wong CWY (2012). Green logistics management and performance: Some empirical evidence from Chinese manufacturing exporters. *Omega* **40**:267-282.

Lambert S., Riopel D., and Kader A.W. (2011). A reverse logistics decisions conceptual framework. *Computers & Industrial Engineering* **61**: 561–581.

Lau, K.W. and Wang, Y (2009). Reverse logistics in the electronic industry of China: a case study. *Supply Chain Management: An International Journal*. Volume **14**(6): 447–465.

Liu, X., Tanaka,M., and Matsui,Y. (2006)., Electrical and electronic waste management in China: progress and the barriers to overcome, *Waste Management & Research* **24**(1):92-101.

Rahman S and Wu Y-C J. (2011). Logistics outsourcing in China: the manufacturer-cum-supplier perspective. *Supply Chain Management: An international Journal*, **16** (6): 462-473

Rahman, S., Subramanian, N., 2011. Factors for implementing end-of-life computer recycling operations in reverse supply chains. *International Journal of Production Economics*, http://dx.doi.org/10.1016/j.ijpe.2011.07.019.

Ravi, V. and Shankar, R. (2005) Analysis of interactions among the barriers of reverse logistics. *Technological Forecasting and Social Change*, October, 72 (8), pp. 1011-1029.

RedPrairie, (2008), 2008 SURVEY ON RECALL LEGISLATION: Industry divided as to whether legislation or self-regulation is the right approach. Industry divided as to whether legislation or self-regulation. http://www.redprairie.cn/uploadedFiles/ResourceCenter/Resources/Whitepapers/WP_08RecallSurv.pdf?LangType=2052 (accessed 20 May, 2012).

Rogers, D, Tibben-Lembke, R (1999). Going Backwards: Reverse Logistics Trends and Practices. Reverse Logistics Executive Council, University of Nevada, Reno, NV

Rogers, D and Tibben-Lembke, R (2001): An examination of reverse logistics practices. *Journal of Business Logistics*, Vol. 22 No. 2, pp. 129-48.

Sarkis, J, Helms, M and Hervani, A (2010). Reverse logistics and social sustainability. *Corporate Social Responsibility and Environmental Management*, Vol. 17 (6), pp. 337-354

Souiden, N and Pons, F (2009). Product recall crisis management: the impact on manufacturer's image, customer loyalty and purchase intention. *Journal of Product & Brand Management*, Vol. 18 (2), pp. 106-114.

Streicher-Porte, M., Geering, A.C., 2010. Opportunities and threats of current e-waste collection system in China: a case study from Taizhou with a focus on refrigerators, washing machines, and televisions. *Environmental Engineering Science*, 1 (27), pp. 29–36.

Stock, J., Tomas Speh and Herbert Shear, (2006). Managing product returns for competitive advantage. *MIT Sloan Management Review* Vol 48, No 1.

Tabachnick B.G., Fidell L.S. (2000). Using multivariate statistics, New York: Allyn and Bacon.

Zhang T., Chu J., Wang X., Liu X., and Cui P. (2011). Development pattern and enhancing system of automotive components remanufacturing industry in China. Resources, Conservation and Recycling **55**(6):613-622.

Zhao, X., Lee, Y., Ng, S., Flynn, B.B. (2010). The impact of product recall announcements on stock market reaction: a study of Chinese listed companies [online]. Available at: < http://www.indiana.edu/~rccpb/uschinacooperation/papers/P9%20Flynn%20and%20Zhao.pdf > [18 March 2012].

Zheng, C. Morrison, M., & O'Neill G. (2006). An empirical study of high performance HRM practices in Chinese SMEs. *International Journal of Human Resource Management*, **17**(10): 1772–1803.