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The Role of Reverse Logistics in E-Waste Management: An Assessment of the East African Community

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Abstract

This article focuses on return management process in supply chain context. A review of the definition, role and drivers of reverse logistics management are discussed in depth in line with the consideration of returns process management being considered as a strategic process in supply chain management. It takes the form of desktop research in which in-depth literature review is done with emphasis on return process management with four theories being discussed and a review of the impact assessment of e-waste management in the East African context being done from the assessment that has been conducted. The role of return process management is apparently well grounded as a key process in the supply chain management processes. However, there is an apparent need to contextualise reverse logistics in the large returns management process for the purpose of being comprehensive and exhaustive. The research also draws the conclusion that there is a dire need for legislation in e-waste management; and supply chain experts are also called upon to design a proper returns management process in order to curb the e-waste. On the practical implications of the findings, the insights and learning of the return process management can be considered as a competitive advantage strategy in the various product returns being considered. The learning demonstrates that return process management, as a supply chain management process, can contribute immensely if the consideration of closed loop supply chain process management is put in place whereby design and measures to undertake product returns is appreciated from the initial stages of product processing as a deliberate value add even after being consumed.

Key words: Reverse Logistics, e-Waste Management.

Introduction

Reverse logistics plays a vital role in e-waste management particularly as a key process in the supply chain management. Conventionally, forward logistics that sees the transformation of materials to finished products has been the focus of most supply chain management studies. However, in recent years, emphasis has been placed on reverse logistics that deals with the returns of life products downstream from the ultimate consumers up the stream to retailers, manufacturers and suppliers for repair, refurbishment, remanufacturing and recycling.

Reverse logistics is defined by Rogers and Tibben-Lembke, (2002:2) as "the process of planning, implementing, and controlling the efficient, cost effective flow of raw materials, in-process inventory, finished goods and related information from point of consumption to the point of origin for the purpose of recapturing value or proper disposal". The impact of globalization and communication enabled most business stakeholders to rely more increasingly on e-mail and e-commerce. The rapid increase in the usage of the technology and economic activities in the industrialised and the developing world has caused new environmental problems such as electronic waste management. The pressure on developing countries to try and catch up with the industrialised countries has led their people to the consumption of second-hand products

that have a short utility life span before they become electronic waste. Electronic waste, also known as e-waste, is a term considered in this article as any electrical or electronic appliance that has reached its end-of-life (EoL).

This article considers role of reverse logistics as a supply chain strategy in normalising e-waste management in the East African Community (EAC). It thus proposes principles embraced in the larger supply chain framework in tracking and tracing products with both feed forward and feedback mechanisms. The article starts by reviewing the literature on reverse logistics as a supply chain process and framework in e-waste management. Later, an assessment of e-waste management in the East African Community is considered in line with the Pan African action areas for promoting trans-boundary and environmentally sound management of e-waste. Finally, we conclude and make recommendations based on the Pan African Unified actions as required for harnessing synergies in the EAC region and beyond.

Background Literature

Theoretical Background

Four prevailing theories, namely, Transaction Cost Economics (TCE), Resource Based View (RBV), Business Strategy and Performance, and A Grounded View, can be applied to study reverse logistics. Two Supply Chain Models -- Supply Chain Operations Reference (SCOR) and Global Supply Chain Forum Model (GSCF) -- are proposed as the reference models.

Transaction Cost Economics (TCE) specifies the conditions under which a firm should manage an economic exchange internally within its boundary or externally through inter-organizational arrangement (Lau and Wang, 2009) TCE focuses on minimising the total transaction costs of producing and distributing a particular good or service. These costs are determined by limited rationality, an asset specificity, opportunistic behaviour and frequency. The theory helps determine a firm's boundary and accounts for the efficiency-seeking behaviour of the firm through inter-organizational arrangements governed by contracts. Reverse logistics application of TCE theory is applicable in discussions of employing third party logistics providers. Some of the transaction costs that a contracting firm may consider is in relation to technical knowledge dealing with returns, economies of scale, visibility of information and support of returns authorizations(Bernon, Rossi and Cullen, 2011).

Resource Based View (RBV) emphasizes the internal capabilities of the organization in formulating strategy to achieve a sustainable competitive advantage in markets and industries. Resources are considered central to understanding firm performance. Resources include all assets, capabilities, organizational processes, firm attributes, information, knowledge, among others, controlled by a firm that enables to conceive and implement strategies that improve its efficiency and effectiveness (Skinner, Bryant and Richey, 2008). Autry, Daugherty and Richey (2001) directly addressed resource commitment in reverse logistics context while answering the questions on difference in reverse logistics performance as compared to firm's size, internal and external satisfaction.

Business Strategy and Performance theory relies on the fundamental characteristics of the match that an organisation achieves among its skills and resources and the opportunities and

threats in its external environment that enables it to achieve its goals and objectives (Skinner et al, 2008). Competitive strategy decisions need to be made by firms in order to achieve and sustain positional advantage. The different approaches to reverse logistics and recycling adopted by different organisations reflect the various degrees of strategic significance they have placed on reverse logistics. While others resort to outsourcing to reduce cost of operation, some use a full-scale self-support system that requires heavy capital investment (Lau and Wang, 2009).

A grounded view or theory is a research method from which a theory is derived inductively as opposed to deductive means. Mollenkopt, Russo and Frankel (2007: 572) argue that grounded theory "has its roots in social sciences and is focussed on understanding how people receive and interact with the dynamic world." Grounded view/theory is based on three issues, namely: concepts, categories and propositions. Concepts are the key elements used since theories are generated through conceptualization. Grounded theory in reverse logistics disposition is related to what an organization adopts in relation to its return policy -- this process is conducted through interviews and later coded. This is a component of customer service offering or needs. Reverse logistics strategy such as destroying, recycling, refurbishing, remanufacturing or repackaging of returned products might have different requirements for the condition of the product upon customer return. As a result, the organization's returns policy is an opportunity for competitive advantage and a strategic tool for organisations in giving customer confidence subject to customers' willingness to adapt to the policy on the returned products (Skinner et al, 2008).

Supply Chain Operations Reference Model (SCOR) is a product of the Supply Chain Council and captures the council's consensus view of supply chain management. Five Key Steps are distinguished as follows: Plan - establishment of the course of action in appropriation of supply chain resources to meet supply chain requirements; Source- procurement process; Make: make to stock, make to order and engineer to order process; Deliver - process of delivering a product to a customer; Return: return is documented in two locations - source and deliver. Source-return activities relate to the processes that connect an organization with its suppliers (Business to Business) and those activities that connect an organization with its customers (i.e. receipt of returned finished goods) are documented as deliver return activities (Janse, Schuur and De-Brito, 2010). "Reverse logistics is explicitly referred to in three parts of SCOR Model, namely: Plan return, deliver return and source return. For the processes, deliver return and source return, the SCOR model distinguishes between: Return of defective products, return of maintenance, repair, and overhaul products, return of excess products." (Janse, Schuur and De-Brito, 2010: 511)

Global Supply Chain Forum Model (GSFC) is a framework that defines supply chain management as the integration of key processes from end user though original suppliers that provides products, services and information that adds value for customers and other stakeholders. Implementation is carried out through the interaction of three primary elements, namely: the supply chain network structure, the supply chain business processes, and the management components. GSCF considers eight supply chain management processes as follows: customer relationship management, customer service management, demand management, order fulfilment, manufacturing flow management, product development and commercialization, and returns management (Rogers, Lambert, Croxton and Garcia-Dastugue, 2002).

Empirical Literature

Supply chain management (SCM) has increasingly been appreciated as an integration of business processes across the supply chain. Efficiency and effectiveness are thus driven through the seamless links of supply chain processes. Croxton, *et. al.*, (2001) identified eight business processes that need to be implemented within and across firms in any given supply chain.

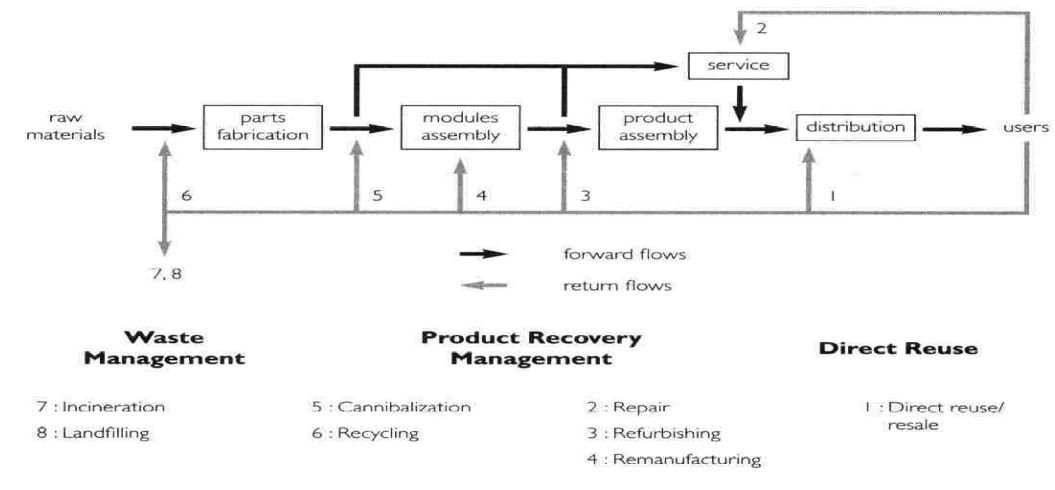
The eight business processes in any given supply chain include: *Customer Relationship Management* that provides the structure for how relationships with customers are developed and maintained; *Customer Service Management* provides the firm's face to the customer, including management of the product/service agreements (PSAs), and provides a single source of customer information; *Demand Management* provides the platform for balancing the customers' requirements for with supply chain capabilities; *Order Fulfilment* includes all activities necessary to define customer requirements design the logistics network, and fill customer orders; *Manufacturing Flow Management* includes all activities necessary to move products through the plants and to obtain, implement and manage manufacturing processes in the supply chain; S*upplier Relationship* provides the structure for how firms relationships with suppliers are developed and maintained; *Product Development and Commercialisation* provides the structure for developing and bringing to market new products jointly with customers and suppliers; *Returns Management* includes all activities related to returns, reverse logistics, gate-keeping, and avoidance (Rogers, *et. al.*, 2002: 2).

Each process cuts across firms in the supply chain and the corporate functions within each firm. It is through customer relationship management and supplier relationship management processes that most inter-firm activities are managed. The latter process of returns management is focussed as the propelling force in discernment of e-waste management.

There are many types of returns that need to be managed within the supply chain process. Global Supply Chain Forum (GSCF) broadly classifies returns into five: Consumer Returns, Marketing Returns, Asset Returns, Product Recalls and Environmental Returns (Rogers, et al, 2002). According to Rogers et al, (2002), consumer returns are prevalent due to buyers' defects; Marketing returns consist of products returned from a position forward in the supply chain, often due to slow sales, quality issues or need to reposition inventory. Asset returns consists of recapturing and repositioning of an asset. These returns are typically characterized as items that management wants to see returned especially reusable containers (crates, pallets, or tote boxes); product recalls are a form of return that is usually because of a safety or quality issue; lastly, environmental returns include the disposal of hazardous materials or abiding to environmental regulations. De-Brito (2003) suggests three types of returns namely: Manufacturing returns (Raw-materials surplus, Quality Control Returns & Production left-over); Distribution returns (Product Recalls, B2B commercial Returns, functional returns & stock adjustments); and Customer returns (Reimbursement guarantees, warranty returns, service returns, end-of-use and end-of-life returns). Compared to Rogers et. al., (2002), the two types of returns of product recall and asset returns are both incorporated in the distribution returns as per De-Brito's view.

Reverse logistics process recovers value from products through the process of collection of products, inspection, selection and sorting, reprocessing and finally redistribution. The re-processing can be more or less light. Reprocessing may be lighter through direct recovery where returned products are in as good as new condition and so one can directly re-use, re-sale and proceed to redistribution. The less light process involves recovery. This is where more elaborated re-processing occurs in various levels. According to Thiery, Salmon, Van Numen and Van Wassenhove (1995), these levels include: 1) product level (*repair);* 2) module level (*refurbishing);* 3) component level (*remanufacturing);* 4) selective level (*retrieval, cannibalism)*; 5) material level (*recycling);* and, energy level (*incineration)*. These levels are demonstrated by the following figure adopted from Theiry et al (1995).

Figure 1: Closed loop Supply Chain Process.



Source: Thiery, Nume and Wassenhove, 1995, 117.

Clendenin (1997) emphasises the need for business process benchmarking as a process suited to manage reverse logistics process. The relevance of this process will facilitate the creation of value in the returned products and also create a monetary value. He further proposes the Return to Available (RTA) metric for return channels. Return to Available is a business process metric associated with returns channel. "RTA is a velocity measure of the cycle time required to return as asset to a useful status."

Assessment of E-Waste Management in the East Africa Community

Waste electrical and electronic equipment (WEEE), as described by European Union Directive 2002/96/EC, categorises ten components that are viewed as WEEE, namely: information technology and telecommunications equipment such as personal computers, telephones, mobile phones, laptops, printers, scanners, photocopiers and consumer equipment such as television sets, stereo equipment, electric toothbrushes, transistor radios, lighting equipment. In this research consideration is given to electrical and electronic items that are related to computers, telephones, mobile phones, laptops, printers, scanners and photocopiers.

Technological development in the East Africa Community (EAC) as indicated by the UN Global E-government on Telecommunication Infrastructure Index and its components shows that there has been an improvement in use of ICTs in the region (UNPAN, 2010); necessarily indicating that there is also a rise in e-waste stream. Concerns regarding e-waste management in Kenya were brought into sharp focus through the baseline survey for e-waste management carried out by Waema and Mureithi (2008) in the survey of E-waste Management in Kenya. According to the survey, about 50% of Kenya's computer market is estimated to be made up of second-hand computers and the country generates 3,000 tonnes of e-waste yearly.

Assessment of e-waste management in Uganda was done by Wasswa and Schluep (2008) as a situational analysis of e-waste management and generation with special emphasis on personal computers. The situation depicted the lack of e-waste-specific policy, although the national environmental laws and international conventions signed have a bearing on e-waste. The assessment indicates that 86.2% (25,000) of computers imported into the country are new with approximately 14.8% (4,000) being second-hand computers. As a result, the amount of computers which reached their end of life annually constituted fifty three tonnes. According to Magashi and Schluep (2011), Tanzania in the year 2009 indicated that 87.5% (105,000) of computers imported were new, while second-hand imports constituted 13.5% (15,000). The annual amount of end-of-life computers totalled to 199 tonnes. Burundi like other EAC states is experiencing increase in the number of computer users. However, the rate of adoption and acquisition of ICTs is not as high as that of Kenya, Uganda, Tanzania and Rwanda. E-waste awareness in Burundi is non-existent.

The Pan-African Forum on E-waste calls for action outlining a set of priorities to support the development of a regional approach for the legal transboundary movements and the environmentally-sound management of e-waste for the African continent to protect human health and the environment as well as promote opportunities for social and economic development. This forum provides a common platform for the EAC to conduct a baseline assessment of e-waste problems as currently done by Kenya, Uganda and Tanzania, offer principles for environmentally-sound management of e-waste by the provision of legal, policy and regulatory frameworks while enforcing international, regional and national law(s) concerning imports and exports of used electronic and electrical equipment and e-waste. The success of this endeavour will be through stakeholder financing of environmentally-sound management principles of e-waste and by capacity building and raising of awareness among the citizenry.

According to Janse *et al* (2010), the main trends of managing reverse logistics in the consumer electronics market need to include a more strategic focus on the importance of product returns through intensified collaboration between supply chain partners and the stakeholders involved. This can be done through design for repair and design for recycling.

However as envisioned in literature, reverse logistics can encounter many barriers stemming from: lack of clear return policies in e-waste; lack of appreciation that reverse logistics can be a factor in creating competitive advantage in e-waste management; lack of performance management systems to evaluate the cost benefit analysis of reverse logistics; and also, the lack of forecasting and planning in reverse logistics can then be considered as an vestigial role in many organizations (Janse *et al* (2010).

As evidenced in the state of reverse logistics in e-waste management in the East African Community, there is need to design a well founded returns management system. The process to achieve this goal requires the following to be done:

a. properly identify the role that returns play in the firm's overall customer service strategy and the way returns management can contribute to improved profits. In determining the role of returns management, there is also the need to consider the legal and environmental legislation. Compliance with legal requirements then becomes the minimum baseline;

b. develop a comprehensive network for product collection strategy that puts into consideration cost and environmental impact of the Waste Electrical and Electronics Equipment (Hanafi, Kara and Kaebernick, 2008);

c. develop return avoidance, gate-keeping and disposition guidelines. Return avoidance means developing and selling the product in a manner such that returns are minimized; gate-keeping is the meant to screen both the return request and the returned products. Disposition refers to the decision about what to do with the returned product, which may include resale through secondary markets, recycling, remanufacture or transfer to landfill. Disposition strategy requires product residue value established, hence Gobbi (2011) argues that product residue value plays a central role in determining the appropriate recovery option; and finally,

d. develop returns network and flow options. This is the stage that develops the reverse logistics network and evaluates if it is appropriate to outsource any of the returns management activities to third-party logistics providers (Rogers, *et al*, 2002). The selection of third party logistic providers may entail understanding the cluster in which the providers may be engaged. These clusters include: disposition strategies adopted by a firm, reverse logistics process functions, organizational performance criteria (quality, cost, time and flexibility), product life cycle positioning (stages of the product in the lifecycle as an influence to storage (Meade and Sarkis, 2002).

Conclusion

Poor E-waste management leads to adverse and negative environmental, economic and social consequences, however through proactivity by all stakeholders, these challenges can be converted to opportunities streamlined by the adoption of returns process management.

Returns process management as a key process in supply chain management discusses in length the processed of environmental, economic and social value recovery of consumer, marketing, asset, product or environmental returns.

The EAC baseline survey furnishes important and necessary information and conclusions for the implementation of guidelines either collectively by the member states or by the individual EAC states. Reverse logistics as a strategy therefore provides the philosophy, rationale and the means to actualise the set guidelines by the all the concerned stakeholders. It provides a rich framework through which all the facets of the e-waste management discourse and process can be implemented and value metrics assessed.

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Appendix on Empirical Literature

	Empirical Literature			
	Author(s)	**Title**	**Journal**	**Findings**
1	Mondragon,C. E. A., Lalwani, C., and Mondragon,C. E. C	Measures for Auditing Performance and Integration in Closed-Loop Supply Chains	*Supply Chain Management* Vol.16/1/2011 (pp.43-56)	The need for auditing comprises performance Metrics, reverse element of the closed loop supply chains and integration affecting performance. The proposed set of measures for auditing present the need for clear and accurate forecasting of reversed products.
2	Skinner, R. L., Bryant, T. P. and Richey, G. L.	Examining the Impact of Reverse Logistics Disposition Strategies	*International Journal of Physical Distribution & Logistics Management* Vol.38/7/2008 (pp.518-539)	Need for strategic decisions in managing the disposition strategies that involve the choice of destroying, recycling, refurbishing, and/or remanufacturing of product.
3	Srivasava, K. S., and Srivastava, K. R.	Managing Product Returns for Reverse Logistics	*International Journal of Physical Distribution & Logistics Management* Vol.36/7/2006 (pp.524-546)	An integrated framework is suggested in estimating returns for select categories of products, disposition strategies, location and capacity of facilities and flows of returned products are discussed.
4	Hanafi, J., Kara, S. and Kaebernick, H.	Reverse Logistics Strategies for end-of-life Products.	*International Journal of Logistics Management*, Vol. 19. No.3/2008 (pp.367-388).	Best strategy for collection of waste products can be achieved by gathering demographic data and historical sales of a given relevant product in a certain location.
5	Mollenkopf, D., Russo, I. And Frankel, R.,	The Returns Management Process in Supply Chain Strategy	*International Journal of Physical Distribution & Logistics Management* Vol.37/7/2007 (pp.568-592)	A general model of returns management process is developed to cater for functional integration, strategic/operational policies and practices, supply chain orientation and external factors. The need for forward & reverse logistics supply chain flows need to be considered.

	Empirical Literature			
	Author(s)	**Title**	**Journal**	**Findings**
7	Li, Xiaoming, and Olorunniwo, F.	An Exploration of Reverse Logistics Practices in Three Companies.	*Supply Chain Management*, Vol. 13/5/2008. (pp.381-386)	Reverse Logistics (RL) is considered as encompassing an entire reverse product life cycle therefore firms need to consider the RL system, I.T Infrastructure in Place.
8	Bernon, M. Rossi, S. and Cullen, J.	Retail Reverse Logistics: A Call and Grounding Framework for Research	*International Journal of Physical Distribution & Logistics Management* Vol.41/5/2011 (pp.484-510)	Retail reverse logistics are multi-faceted and need to be managed as an integrated supply chain activity. Three overarching management dimensions are proposed: operational performance, organisational integration and management reporting and control.
9	Meade, L. And Sarkis, J.	A Conceptual Model for Selecting and Evaluating Third-Party Reverse Logistics Providers	*Supply Chain Management*, Vol. 7/5/2002. (pp.283-295)	A model is proposed for facilitation of reverse logistics through four clusters: product life Cycle Positioning, organisational performance criteria, Reverse logistics process functions and organisational role of reverse logistics.
10	Clendenin, A. J.	Closing the Supply Chain loop: Re-engineering the Returns Channels Process	*International Journal of Logistics Management*, Vol. 8. No.1/1997 (pp.75-85).	Knowledge in reverse logistics can enhance performance in the overall Closed loop supply chain processes. Return to Available (RTA) as a business process is here developed as a velocity measure of the cycle time required to return an asset to a useful status.
11	Daugherty, J. P., Richey, G. R. Hudgens, J. B. and Autry, W. C.,	Reverse Logistics in the Automobile Aftermarket Industry	*International Journal of Logistics Management*, Vol. 14. No.1.2003 (pp.49-62).	Successful reverse logistics process is a relationship orientation of trust and commitment that eventually improves service and helps cutting cost.
12	Jack, P.E., Powers, L.T., and Skinner, L.	Reverse logistics Capabilities: Antecedents and Cost Savings.	*International Journal of Physical Distribution & Logistics Management* Vol.40/3/2010 (pp.228-246)	Resource commitments and contractual obligations positively influence reverse logistics capabilities and that these results in cost savings.

	Empirical Literature			
	Author(s)	**Title**	**Journal**	**Findings**
14	Janse, B. Schuur, P. and De Brito, P. M.	A Reverse Logistics Diagnostic Tool: The Case of the Consumer Electronics Industry.	*International Journal of Advanced Manufacturing Technology*, Vol. 47/2010. (pp.495-513)	The article generates a reverse logistic diagnostic tool that is adopted to consumers of the electronics industry with the aim of finding the stage of maturation the specific industry is at.