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Literature Review on Reverse Supply Chain Mathematical Models for Domestic Refrigerators

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Abstract
Reverse supply chain deals with the collection and treatment of used products. Recent researches in the area of green manufacturing have extended into green supply chain management and reverse logistics. Researcher's addresses issues related to evaluating current or potential suppliers' environmental practices, the environmental/economic benefits of establishing a green supply chain. Nowadays, apart from economic reasons, organizations across the globe are increasingly focusing on setting up reverse logistics networks owing to the adverse environmental effects caused due to the improper disposal of many used products. The environmental processing and effective recycling of waste electrical and electronic equipment WEEE have become a global social problem. In face of this grave situation, WEEE management has been given increasing attention in developing countries, such as China and India, and WEEE-related laws and regulations have been enacted. To establish an effective and long term mechanism of WEEE management in China, the Chinese government issued "Regulation on the Administration of the Recovery and Disposal of Waste Electrical and Electronic Products," which has been implemented since July 1, 2012
An effective procedure in reducing wrongly classified warranty returns, and they also completed a root cause analysis of warranty returns for more efficient product/process improvement. Using a life cycle analysis, Kannan et al., (2009) analyzed the operations and practices involved with specific attention to the product's impact on the environment.

***Keywords*: Reverse Logistics, optimisation, supply chain, Mathematical model**

I. INTRODUCTION

Reverse Logistics can recover economic, environmental, and social value. The economic value includes cost reduction for industrial companies and municipalities. Industrial companies receive returns at low prices and use as raw materials or fuel. It also helps to create and maintain a positive corporate image and to comply with legislation. The environmental value includes reducing the use of virgin materials; the social value includes generating jobs and income for vulnerable populations of poor communities (Pokharel and Mutha, 2009).
Reverse Logistics differs from direct logistics. While direct logistics moves goods towards the customer, Reverse Logistics moves goods from the customer. Reverse Logistics and direct logistics involve the same elements: transportation, warehousing, inventory management, and information systems (Lambert et al., 2011). According to Heese et al., (2005) Reverse logistics operations include waste identification, collection, sorting, compaction, intermediate storage, recollection, transportation, delivery, and value recovery, whereas management stages include the definition of routes and vehicles and the integration with direct channels for resource optimization, which maximizes value recovery and eco-efficiency of the entire operation.
Some evidences from real cases confirms the need for government grants or incentives to make reverse operations affordable for all supply chain players, K Wang et al., (2014) analyzed China's auto part industries and proposed a recycling model for end of life vehicles with the aid of government grants. Rahman and Subramanian (2012) found that factors such as government legislation, incentives and customer demand are the major drivers in the case of computer recycling operations.Yongjian Li et al., find that both governments and formal collectors can implement appropriate governance mechanisms to control or utilize the informal collection channel under different circumstances. Although, governance mechanisms set by the government are unenforceable to informal collection in certain contexts and proposed a two-tariff contract to coordinate the dual-channel supply chain under the incorporation governance mechanism. Yongjian Li et al., contributed a Stackelberg game model, which consists of formal and informal collectors.
According to Amirsaman Kheirkhah & Saeid Rezaei 2015 the problem of designing a reverse logistics network is the process of specifying the number, location and capacity of collection, recovery and disposal centers. Reverse logistics networks include particular specifications in comparison to forward ones one of which is the significant role of collection/inspection centers in such networks. Cross-docking operation is a distribution strategy in reverse logistics which is currently used by many companies in different industries. In this strategy, incoming packages to the cross-docking center are quickly inspected, sorted and classified respectively in the operational sector, and immediately loaded onto outbound trucks in the sending platforms.
Effective implementation of reverse logistics can be achieved only if a proper network design is done for the reverse supply chain activities including collection, inspection, storage, disassembly, recycling, remanufacturing, renovating, repairing and disposal.

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II. RECOVERY NETWORKS AND MODELS

Recovery networks link a “disposer market” of used products available for repair, remanufacturing, or recycling with a “reuse market” which reflects the demand for these products (Saurabh Agrawal et al., 2015). Reverse Logistics activities aim to recover a part of the remaining value or at least give correct disposal to used materials. However, due to the uncertainties involved and the capillarity of the generation points, only a small part of the waste returns to a new use (Beullens, 2004).To facilitate and encourage the return of products from the user to the manufacturer, three main processes must be established the (1) acquisition process, in order to collect the right volumes of products or materials of the right quality and for a reasonable price, (2) recovery process, which aims to refurbish, remanufacture or, at least, recycle the products and materials collected and (3) remarketing process, in order to find markets that want to buy the recovered products (Gianmarco Bressanellia et al., 2017).

According to Mohit Sharma 2017, HFC emissions in India can be expected to grow at a rapid pace with increasing incomes and population, there are studies focusing on Indian carbon dioxide emissions, but clearly less number of researches are made on India’s potential HFC emissions. Reverse logistics includes the logistics activities all the way from used products no longer required by the user to products again usable in the market. Reverse logistics in e-waste also involves material recovery since these contains valuable metals.(Fleischmann et al., 2004). It is complicated due to the presence of driving forces, return reasons, product types, and uncertainty around the reverse flow. Also, how the material is recovered and who will execute and manage the various reverse operations are important issues. Since reverse logistics includes a series of processes involving product return, repair, dismantling, refurbishing, recycling, remanufacturing, and disposal of used or end-of-life products, the implementation of a reverse logistics network is a strategic decision. (Tsai-Yun Liao 2018)

According to Responsible Appliances Disposal Program of Environmental Protection Agency (EPA), releasing of refrigerants and other harmful substances to the environment is against federal law (Ijaiya & Hakeem 2018). Federal law requires that all refrigerant be recovered prior to dismantling or disposal and that universal waste including mercury as well as used oil and PCBs be properly managed and stored. According to EPA there are 20-50 million metric tons of electronic e waste alone generated worldwide every year.Green Supply chain management to incorporates the environmental idea in each and every stage of the product and service in a supply chain. Hence Supply chain managers have a great role in developing innovative environmental technologies to tackle the problems faced by the economy on environmental problems and communicate this to every stake holder in the supply chain and society. It includes the use of a reverse logistics system for the recovery of used materials and products.

Mutha and Pokharel 2009 developed a mixed integer linear programming (MILP) model for handling product returns by considering modular product structures with different fractions of product recovery. El-Sayed et al., 2010 developed a stochastic mixed integer programming model for connecting manufacturing and remanufacturing activities and found that inventory control is of considerable interest in joining the manufacturing and remanufacturing systems in the CLSC network. Das and Chowdhury (2012) considered a modular product design architecture for supporting recovery processes and using integrated recovery service providers for handling product recovery.

Customers are becoming more knowledgeable about environmental pollution and this affects their purchasing decisions So, having a proper mechanism in place for a reverse supply chain not only helps firms reduce the negative environmental impact of its used products but also enhances its green image (Kara et al., 2010).

Supply chain management and optimization aims at reducing costs and inventories. One way to increase the supply-chain efficiency is to use cross-docking forconsolidating shipments from different suppliers. Crossdocking is a strategy used in logistics that consists on moving goods from suppliers to customers through a crossdock facility(Amirsaman Kheirkhah & Saeid Rezaei 2016).

Chung et al. examined used products and presented a CLSC system for remanufacturing. Demirel and Gökçen proposed a new model for a remanufacturing system including both forward and reverse. Mutha and Pokharel developed a mixed integer linear programming (MILP) model for handling product returns by considering modular product structures with different fractions of product recovery. Reverse logistics can be a double-edged sword. It can be a source of savings or a source of additional expense reducing the effectiveness of the company instead of supporting it (Mimouni, Abouabdellah & Abouabdellah, 2016). It is for this reason that there are many companies that work to formalize their RL processes, from the point of view of establishing rules, procedures and communications, so that all stakeholders understand how to act in each moment (Huscroft, Hazen, Hall, Skipper & Hanna, 2013). There is a lot of research related to reverse logistics network design and closed-loop supply chains (CL SC) combined with forward and reverse logistics. Several studies have been focused on remanufacturing the returned products. Kim et al. developed a mathematical model for the remanufacturing process of reusable components in reverse supply chains. El-Sayed et al. developed a stochastic mixed integer programming model for connecting manufacturing and remanufacturing activities and found that inventory control is of considerable interest in joining the manufacturing and remanufacturing systems in the CLSC network. Das and Chowdhury considered a modular product design architecture for supporting recovery processes and using integrated recovery service providers for handling product recovery. Soleimani et al., developed a remanufacturing model incorporating three risk measures. Abdulrahman et al. developed a framework for the strategic decision of remanufacturing for Chinese auto parts manufacturers. Qiang proposed a CLSC production planning model to evaluate the remanufacturing sector.

According to Kannan (2009) implementation of reverse logistics would allow not only for cost savings in inventory carrying transportation and waste disposal but also for the customer loyalty and future sales, for the treatment of multi-source hazardous wastes by formulating a linear multi objective analytical model to minimize the total reverse logistic operating costs and corresponding risks. Fleschmann(2004) proposed a general quantitative model for product recovery network design based on the recovery network coordination requirement of two markets, supply uncertainty and disposing task.

Generaly, the reverse channels are not operated by the focal company of a network, which subcontracts specialized logistics service providers (Kannan et al., 2012). Reverse Logistics activities aim to recover a part of the remaining value or at least give correct disposal to used materials. However, due to the uncertainties involved and the capillarity of the generation points, only a small part of the waste returns to a new use (Beullens, 2004). There are several environmental and economic concerns that pertain to Reverse Logistics operations, including saturated landfill areas, global warming, rapid depletion of raw materials, increasing amount of customer returns, and a rise in the volume (Gupta 2013). The successful performance of a reverse logisticssystem depends on End of life products and customers' willingness to return their obsolete products to complete the cycle(Shaharudin et al., 2015).

Bastiaan Janse et al., developed a theoretically and empirically grounded diagnostic tool for assessing a consumer electronics (CE) company's RL practices and identifying potential for RL improvement, from a business perspective. Diagnostic tool can access maturity state of CE companies or find them. Here, maturity with respect to a certain reverse logistics aspect denotes the extent to which the company is able to fulfill the specific requirements associated with it. Companies should strive for high maturity states, as there is evidence that high maturity is an enabler of high performance. Since large amounts of reverse operations may not be economically justified, the effects of government interventions are modeled in four different scenarios: (1) Tax exemption donated to the manufacturer, (2) Tax exemption donated to the retailer, (3) Subsidy donated to the manufacturer, and (4) Subsidy donated (ODSs), e.g., chloro-fluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs). Hydrofluorocarbons (HFCs), which do not destroy stratospheric ozone, were considered long-term substitutes for ODSs and are not controlled by the Montreal Protocol. Because most HFCs are potent greenhouse gases (GHGs), they are included in the Kyoto Protocol (Cristofanelli et al., 2018).

to the retailer.(Kannan et al., 2012). Most of the papers related to reverse logistics network design do not consider inventory related costs and environmental costs such as green house emissions (Bazan et al., 2016). Montreal Protocol is the most successful international environmental treaty, responsible for global phaseout of the consumption and production of ozone-depleting substances The Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer are the international treaties for the protection of the Ozone layer.

India became Party to the Vienna Convention and the Montreal Protocol on 18th March, 1991 and 19th June 1992 respectively. According to CFC phase out completed in 2010 and the scheduled phase out of most HCFCs by 2030, HFCs are being used more in applications that traditionally used in refrigeration and air-conditioning equipment, blowing agents for foams, aerosol sprays, fire protection systems, and solvents. The atmospheric abundances of major HFCs used as ODS substitutes are increasing 10 to 15% per year in recent years. Rising use of HFCs is directly attributable to intent and actions of the Montreal Protocol, hence, the HFC contribution to climate change can be viewed as an unintended negative side effect of these actions. The accelerated phase-out schedule for HCFCs adopted at the Nineteenth Meeting of the Parties to the Montreal Protocol, would present unprecedented challenges for an emerging economy like India (Ozone Cell, UNDP). For the exploitation of used SLI batteries, a reverse supply chain must be developed (Daniel et al., 2000). This includes all the stages of the reverse flow of the batteries, from their collection after the end of their life cycle to the production and sale of the materials produced during the recycling procedure. Special guidelines have been developed for the management of SLI batteries. Government regulations that address the environmental issues created by disposal of end-of-life (EOL) products have made organizations focus on acquiring products back from the customer to comply with newly imposed environmental norms (Kannan, 2012).

III. CONCLUSION

This review paper aims to compare five supervised algorithms' performance towards DDoS intrusion. DDoS attack will result Most of the literatures discusses about cost minimization, waste minimization, improving customer loyalty, profit maximization and uncertainties in the reverse supply chain at various echelons. In a supply chain the key variables that have to be considered for each activity are its activity level and timing, the inventory level and lead times and other delays (Bogataj M & Grubbström). Defined as the time that elapses between the placement of an order and the receipt of the order into inventory, time may influence customer service and impact inventory costs (Glock CH 2012). Lead times and integrative dynamics make the inventory control task harder. Therefore, they play an important role in the design of the inventory replenishment strategies. Ray and Jewkes modeled an operating system consisting of a firm and its customers, where the mean demand rate was a function of the guaranteed delivery time offered to the customers and of marketprice, where price itself was determined by the length of the delivery time. A number of authors have proposed quantitative models for inventory systems with remanufacturing. An excellent review is provided by Fleischmann et al., most models consider three types of carry items: non-serviceable items or returned items that are not yet remanufactured, remanufactured items, and manufactured items. Primary focuses of this project is to perform an environmental analysis to find environmental cost in terms of carbon foot print incurred in reverse supply chain through release of used refrigerants from end of life refrigerators and to design a reverse logistic network model with inventory costs for refrigerators for end of life EOL.

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