

Strategies and Analysis of Green Supply Chain Management with Help of Internet of Things

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Abstract— Green Supply Chain Management has appeared as an environmental innovation which integrates environmental concerns into supply chain management. It shows that Green Supply Chain Management is the advance change to improve to conventional supply chain management method. To facilitate the growth of Green Supply Chain Management some implementation guidelines to help academicians, researchers, and practitioners in better understanding integrated Green Supply Chain Management with Internet of Things to enhance growth and effectiveness and improved customer satisfaction. The purpose of the paper is to briefly review the research status of the Internet of Things as applied to supply chain management and the concept of the Green Supply Chain Management and also determine the new direction area of this emerging field.

Keywords— Supply Chain Management; Internet of Things; Green Supply Chain Management; Strategies & review of Green Supply Chain Management.

I. INTRODUCTION

Environmental impacts should be considered cumulatively over the stages of the supply chain life cycle of a product or service to avoid shifting adverse environmental effects from one stage of the life cycle to another. It involves considering the impacts of extraction of raw materials, distribution, operation and disposal. Supply chain has now become such an important function that embedding environmental issues in day to day. Environmental awareness is increasing day by day. A supply chain issue has become inevitable for sustainable development. This has led to the interest in Green Supply Chain Management. The concept of supply chain includes the flow of materials from the source to the point of use. Patrick Penfield of the Whiteman School of Management defines Green Supply Chain Management as "the process of using environmentally friendly inputs and transforming these inputs into outputs that can be reclaimed and re-used at the end of their lifecycle thus, creating a sustainable supply chain. Organizations are investing in managing the supply chain effectively. Green Supply Chain Management has become the core of sustainable development. Going green is also becoming a socially relevant concept today. Green Supply Chain Management encompasses Green Design, Green Manufacturing, Green Logistics and Green marketing too. Distribution that is an important wing of supply chain plays an important role in the success of marketing efforts. If a green product has been manufactured in an environmentally responsible manner, then it needs an efficient distribution mechanism for the product to reach out to the customer. Reducing waste and environmental pollution, using less energy and material resources is not only good for the environment but are best for supply chain because they cut operational costs. A company's performance is going to be measured by resource productivity. Waste minimization is an integral component of green supply chain. Waste is any activity that does not add value to a business. When a company manages waste efficiently, it means that its resource productivity is high and the business is able to manage cost efficiencies very well. This leads to operational efficiency and increase in the profit margins. As the company gains exposure and experience in managing the resources efficiently, the business becomes more sustainable and over a period of time the company is able to achieve competitive advantage in the market place. A green supply chain strategy has become essential for a business that wants to be future ready.

So with help of Internet of Things one can reduce use of paper

that will generate less waste. Internet of things is use, manage, and operate of internet on computer based devices. With use of various technology like GPS, GIS, RFID, Email, Cloud computing, Wireless network devices one can achieve. In general, the Internet of Things is based on the expansion and extension of the Internet to reach a certain communication standard. In particular information sensing equipment is used to allow information exchange and communication on people to people (h2h), people to things (H2t) and things to things (t2t) bases. The core aim is to achieve interconnection and hence communication between various 'things', such as mobile telephones and computers; this facilitates the collection and exchange of information between these things. The Internet of Things can use the Internet to set up a simple or complex network of devices.

II. LITERATURE REVIEW

A. Sustainable supply chain management

Kumar Rajesh (2012); defines green supply chain management as the process of using environmentally friendly inputs and transforming these inputs into outputs that can be reclaimed and re-used at the end of their lifecycle, creating a sustainable supply chain.

B. Green Supply Chain Management

Srivastava (2007); defines green supply chain management as integrating environmental thinking into supply chain management, including product design, material sourcing and selection, manufacturing processes, delivery of final product to consumers and end-of-life management of the product after its useful life.

C. Performance and quality of supply chain management

- Firstly, Rao & Holt, (2005): besides improvement in environmental performance, adoption of green supply chain management should also be profitable for the business.
- Broek, (2010): Green supply chain management has to be an organization wide process just like other supply chain processes like Total quality management or Environmental management systems.
- Kumar Rajesh (2012); Srivastava (2007); Rao & Holt (2005): The environmental impacts of a supply chain should be considered cumulative over all the stages. Thus, if you buy greener raw materials that do not cause any harmful effect on the environment but continue to waste energy during the manufacturing process, the effect of green supply chain

management ceases to be cumulative. Greening of the different phases of supply chain leads to an integrated green supply chain.

D. Performance and quality of supply chain management

- Kumar Sanjeev (2012): The implementation of green supply chain strategies faces a road block in terms of lack of clear understanding and having a clear strategy for implementing it.
- Sarkis (2010): Organizational complexities like size and relationships, product returns, recycling etc make implementation of green supply chains a cumbersome affair. Additionally, when a customer has doubts about how green a product is, it becomes another stumbling block. Customer perception about recycled materials also impacts implementation of green practices in logistics.

E. Internet of things with Supply Chain Management

- Jing Liu, Russell Higgs2, Li Zhou (2017): In this paper, the authors briefly consider the Internet of Things and then the research status of the Internet of Things as applied to supply chain management.

III. STRATEGIES FOR GREEN SUPPLY CHAIN MANAGEMENT

Electronic data interchange is a computerized system whereby customers, suppliers and a firm can share and transmit information electronically in real time. This helps in maintaining an optimal level of inventory. As the information is available on a real time basis, decisions are faster and production and shipping schedules become more efficient.

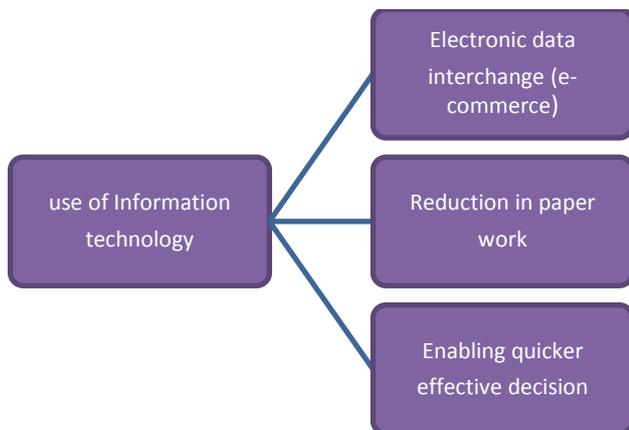


Fig 1: use of IT

Decisions regarding the materials a company purchases and disposes can have a significant impact on the environment and on the company's bottom line. Recycling of materials such as paper, aluminum and glass has received considerable attention in recent years. Broadly, the reverse logistics strategies are classified as Reduce, Reuse and Recycle.

Increasing energy efficiency also reduces the waste. In the chemical industry, refillable containers are being increasingly used. Both products and packaging are being recycled or returned for proper disposal. Several companies now buy used computers, salvage the parts and sell them for use either as replacement parts or for assembling new computers. Purchasing of reusable materials eliminates the entire recycle process.

Reduce involves a better environmental approach. This involves using no more materials than necessary. For example; rather than use solvents in excess for cleaning the machines, it makes better sense

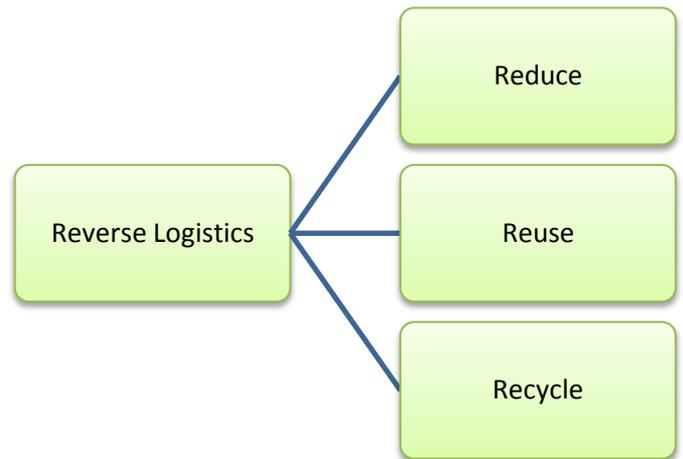


Fig 2: Reverse Logistics for management

Reverse flow logistics requires management attention in developing a logistics network, establishing distinct inventory management systems and measuring the impact of this across the entire supply chain. There are international regulations that will require that companies track their environmental legislation across the entire supply chain. This has become more pronounced after globalization.

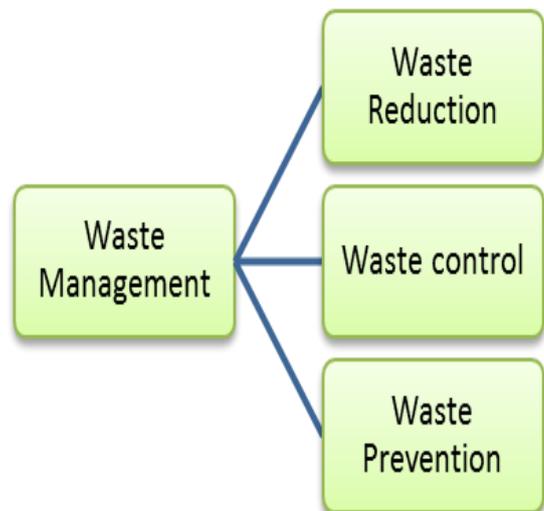


Fig 3: Reduction of waste for GSCM

Reduction of waste or controlling it is more of a corrective initiative. Waste prevention or avoidance is more of an idealistic goal. All the strategies mentioned above are interdependent and can impact each other. For instance, waste management leading to improved quality of finished products can lead to lesser sales returns and so lesser effort for reverse logistics. Better information sharing among all the stakeholders can reduce excess inventory and therefore wastage of resources. Implementation of each of these strategies thus leads to a synergistic output.

IV. ROLE AND FUTURE OF GREEN SUPPLY CHAIN MANAGEMENT

Use Green marketing dates back to the early 1970s, however, many different aspects of green marketing were discussed academically in the early 1990s. Although it is mostly believed that green marketing refers solely to the promotion or advertising of products with environmental characteristics, in general, green marketing is a much broader concept which should comprise product modification, changes to the production process, packaging

changes, as well as modifying advertising. In the green marketing context, green advertising is of prime importance. Green advertising I defined as any advertisement that presents a corporate image of environmental responsibility, supports a green lifestyle with or without highlighting a product/service and clearly and understandably addresses the relationship between a product/service and the biophysical environment. A learning organization has to be prescient and keep itself abreast of latest changes in technology. It has to adopt the techniques by which these changes can be leveraged to achieve customer satisfaction of the highest order. Escalating costs of doing business, changing technologies, complex regulations, unpredictable markets and the impact of globalization are affecting the way businesses have to be transacted across the globe. Enterprises have to implement smarter analytics, smarter technologies and smarter processes in their Endeavour to become a solutions provider. Future ready firms can anticipate the needs of the future and demonstrate remarkable agility buttressed by their capability to innovate. For instance, instead of asking how to meet a challenge, future ready organizations find out how they can obliterate this challenge altogether and may be convert this into a potential business opportunity. Such firms believe in reengineering their processes to face the future much before. This gives such firms a distinct competitive advantage. Companies all over the world are taking steps to be ahead of global competition in producing world class quality and providing excellent service. These companies want to be known as environmentally responsible companies.

There is a greater desire now to comply with requirements of environmental regulations, to satisfy their global customers who place exacting demands. Reduced waste leads to reduced cost which leads to greater competitiveness. Greening efforts can't be confined to the four walls of a factory; it has to extend beyond. But challenges faced by external stakeholders need a greater understanding. The drivers for green supply chain management implementation range from reactive to proactive. Companies become responsible for environmental liabilities of suppliers. Hence, integration of environmental concerns across the entire supply chain has to become part of long term strategy.

The Internet of Things technology architecture is divided into the perceptual layer, network layer and application layer as shown in Fig. 4: (1) Perceptual layer: This is composed of various types of sensors and a sensor gateway; its main function is to identify items and collect data and is analogous to the body's five senses. (2) Network layer: This is composed of the access layer and bearer network. The main function of the access layer is to efficiently relay information collected through the access gateway into the bearer network. The bearer network (such as a mobile network, Internet or radio and television network) should then be fast, reliable and provide secure transmission to the world, facilitating long-range, large-scale communications. This layer is analogous to the human nervous system. (3) Application layer: This is composed of a variety of application servers. Its main functions are to summarize items and then provide sharing, interoperability, analysis and finally assist in decision-making. This is the control and decision-making level of the Internet of Things and is analogous to the human brain. The application layer completes the final interaction of things with people, so as to achieve the ultimate aim of providing a service to the public.

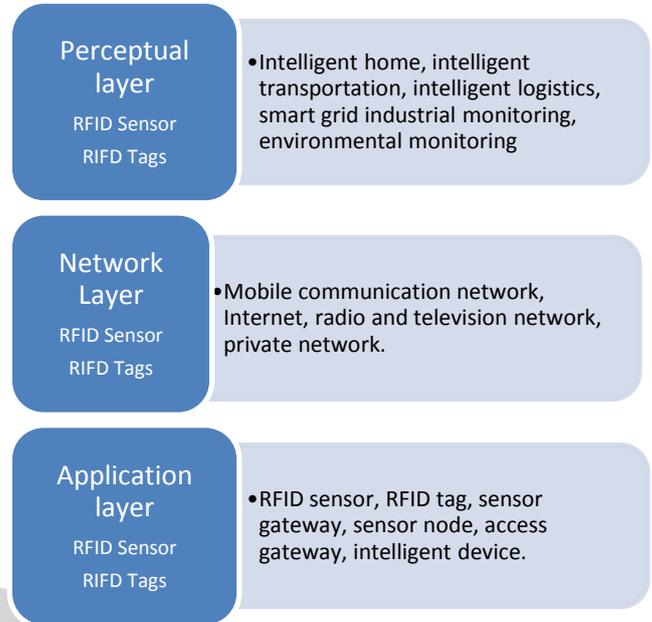


Fig 4: The Internet of Things technology architecture

B. The Internet of Things Technologies

1) Coding Technology:

At present, the international standard of Radio Frequency Identification (RFID) coding has not been formed into a single unified standard

2) Electronic Tags:

An electronic tag consists of a coupling element and a chip; each tag has a unique electronic code attached to the surface of the target object. The electronic tag stores specified information about the object, this information can be automatically loaded into the system by means of wireless data communication.

3) RFID Technology

This is a wireless communication technology that utilizes radio frequencies to enable contactless information transmission through space and hence achieve identification. Its system structure consists mainly of a host system, reader and electronic label.

4) GIS/GPS Technology

- Geographic Information System (GIS) is composed of computer hardware and software and a geospatial database.
- It utilizes the theory of system engineering and information science to scientifically manage and analyze the spatial data to provide information technology systems for management and decision-making. Global Positioning System (GPS) refers to a satellite positioning system that uses navigation satellites for time measurement and ranging on a global scale to achieve user positioning and navigation.

5) Wireless Sensor Network Technology

Wireless Sensor Network (WSN) is a wireless network composed of a large number of static or dynamically distributed sensors. It is composed of task management nodes, sink nodes and a large number of sensors scattered in the monitoring area.

6) Network Communication Technology

The Internet of Things networking technology is divided into two categories: wide area network communication technology and short-range communication technology. Wide area network communication technology consists (mainly) of the Internet, mobile network and satellite communication technology. The short distance communication technology includes BlueTooth, ZigBee,

WirelessFidelity (Wi-Fi), NearField Communication (NFC) and Ultra-Wideband (UWB).

7) Cloud Computing

Cloud Computing is a computing resource that is dynamic, scalable and virtualized, based on the growth, usage and delivery patterns of Internet-related services. The IOT requires a lot of computing resources, with the load changing rapidly; as a service, cloud computing should provide adequate computing resources for the application of the IOT in the future.

V. THE PROBLEMS IN THE APPLICATION OF THE INTERNET OF THINGS TECHNOLOGY

Due to the huge volume of orders, delivery-delays have occurred, seriously affecting the customer's experience. There are some problems in the application of the Internet of Things technology. Using advanced Internet of Things technology has greatly improved the efficiency of self-built-logistics-system in Jingdong Mall. But Jingdong is still facing the high cost, delivery-delays, and poor service-levels in the supply chain management

A. Lack of Awareness of The Internet of Things

They lack the overall understanding of all aspects of the Internet of things in the supply chain management. Middle-level staff and grass-roots workers still lack the basic knowledge of the Internet of Things. In addition, there is no effective internal training to improve staff's awareness

B. Having Not Mastered the Core Technology of The Internet of Things

The hardware technology of the Internet of Things is less, and it lacks the close cooperation with the vendors of the Internet of Things. This not only leads that the enterprise cannot achieve a higher level of applications about the Internet of Things, but also is not conducive to promote the Internet of Things technology in the upstream and downstream of the supply chain.

C. Lack of Innovation in Commercial Model of The Internet of Thing

With less investment, its own business model lacks innovation. For example, the mode of cooperation with suppliers fails to go beyond the traditional model level and it lacks the consumer oriented applications of the Internet of Things .

D. Having Not Established Effective Security and Privacy Protection System

The security and privacy issues of the Internet of Things technology mainly include corporate secrets and personal privacy. The RFID tag of goods usually contains the operator information and user information. If the protection of transmission is improper, it will lead to serious threats about security [8]. At present, the Internet of Things security issues include data permissions, data leakage, data tampering, etc. In the applications of the Internet of Things

VI. THE SOLUTIONS TO THE PROBLEMS IN THE PROBLEMS IN THE APPLICATION OF THE INTERNET OF THINGS TECHNOLOGY

A. Strengthening The Personnel Training about The Internet of Things

Strengthen the training of internal management on the understanding of the Internet of Things to make them aware of the

importance of the Internet of Things strategy for future development. This company also needs to strengthen the training of upstream and downstream partners on the understanding of the supply chain to make them take an active part in the construction of the ecological environment of the Internet of Things.

B. Strengthening The Research Work of Related

Technology about The Internet of Things At the same time, it should strengthen the research of the Internet of Things with independently intellectual property, such as the software and hardware client technology of the Internet of Things orienting consumer market and enterprise-class.

C. Promote The Innovation of The New Business Model

about The Internet of Things On the basis of existing practice, this company should further push the large-scale applications of the Internet of Things technology in the various aspects of the supply chain. It also should strengthen the communication and cooperation with suppliers, enhance the awareness of the application of the Internet of Things, and explore a better business model.

D. Improving The Construction of Security and Privacy

System to strengthen the research about security technology to avoid the information contained in the RFID tag from accessing by the unauthorized, such as encryption algorithm technology.

Secondly, it should strengthen the construction of network protection system, to prevent the supply chain information management system from being invaded and the information from being leaked or tampered.

Jingdong Mall must make full use of the Internet of Things on the existing basis to rapidly make the distribution plan and distribution routes, and do well in the time docking with customer. It also should further strengthen the construction of urban distribution sites to improve the level of the Internet of Things and information technology and to enhance the capability of supply chain management

VII. CONCLUSION

With regard to the rising global awareness of environmental protection, businesses have employed their green supply chain management to improve their core competitive advantage. Green supply chain management is a progressively widely-diffused practice among companies that are seeking to improve their environmental performance. Also saving of paper and various resources. Will lead to fast processing with use of Internet of thing Supply chain management process will be more streamlined, and the customer's diversified needs will be better met. Now Companies must start to attach importance to the application of the Internet of Things technology, to provide consumers with more intelligent services. Companies should use this technology in the supply chain management, and create more economic and social benefits. Green supply chain management practices, which are viewed as cross-organizational and closed loop reduces the ecological impact of industrial activity without sacrificing quality, cost, reliability, performance or energy utilization efficiency. From the study it can be cleared that green supply chain management is a modern way of conventional supply chain management with use of IoT. The results of studies are states that to overcome through the constraints of supply chain management, implementation of green supply chain management is necessary tool.

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