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STUDY OF APPLICATION OF ARTIFICIAL INTELLIGENCE (AI) IN REVERSE LOGISTICS

Ms. Neha Patkar

Abstract:

Rapid technology transformation and legislation related to product return has driven the organizations to make endeavours for improving efficiency in reverse logistics. Now maintaining of efficient Reverse logistics (RL) system has come to the forefront and has become a key capability area for any logistics & manufacturing firm. This has helped the individual organisations in sustaining increased competitiveness and mitigating threat of losing market share due to increased competition created by globalization. Any firm's ability to handle reverse flow of products and its processing within the supply chain system has been constantly increasing so as environmental, legal & customer service related issues may be addresses satisfactorily. The product return policy of e-com portals are continuously gaining popularity in the market and compelling all market participants to come with the similar policies to match the competition. Reverse Logistics is process of returning product back through the supply chain, it involves disposition, recycling, remanufacturing, and disposal resale including warehousing & transportation that varies with type of returned product or material. In SCM, the concept of Artificial intelligence (AI) has gained a lot of applications. The faster intensification of e-commerce, persistent supply chain management, and worry for atmosphere, lead to advancement in reverse logistics. [20] The application of AI methods takes reverse logistics industry to next milestone & provides various benefits to each and everyone involve in SC. The application of AI in reverse logistics is also gaining popularity. This paper is prepared to emphasise the importance of Reverse Logistics system and its position in consumer centric industries. This also aims at highlighting diverse perspectives of Reverse Logistics and its influence on the market dynamics. Also explore the relevance of Artificial Intelligence approaches in Reverse Logistics system.

Keywords: Reverse logistics (RL), Artificial Intelligence (AI), Return Management, Genetic Algorithm.

1. INTRODUCTION

Product take back legislation forces companies to collect & control disposition of their product after consumption by customers. The company is using reuse & recycling as an alternative to reduce disposition costs. Reverse logistics system helps manufacturer in implementing these alternatives efficiently. Reverse logistics is process of supervision of the products return mechanism from consumer to the producer; this involves all actions that governs the providence of returned products. The ever rising global population and evolution of mechanization has resulted in mass production and supply glut in the market. Reverse logistics involves the movement of goods from customers, and retailer store to the manufacturing firms through one of many possible paths and the AI helps to make reverse logistics system at its optimum. Nevertheless, there are various challenges for the system to overcome. One of the biggest challenges is to make correct disposition decisions of returned product to minimize time & cost of processing for ensuring maximum rupees recovery and minimum bearing on environment without affecting the value of product. [5]

2. RESEARCH OBJECTIVES

RO 1 - To emphasise the importance of Reverse Logistics system and its position in consumer centric industries. RO 2 - To identify the application of Artificial Intelligent AI approaches in different aspects of Reverse Logistics. RO 3- To study the use of Genetic Algorithm (GA) in solving different aspects of Reverse Logistics.

3. RESEARCH METHODOLOGY

Data Collection Approach. The following data sources have been referred for concluding the research: Science Direct, Springer Link, Emerald, and Wiley Interscience. Moreover, help of keywords search like Reverse logistics (RL), Artificial Intelligence (AI), return management, Genetic algorithm (GA) has been taken to explore journal publications references in specific online databases. In depth analysis of the reverse logistics literature has been carried out to identify its relationship with Artificial Intelligence, further related literature has also been analyzed for supporting the future reverse logistics researches. The researcher has also browsed through the top journals in logistics, information system, operation management, environmental management and economics for being as thorough as possible. Archival research method is used for compiling data from presented resource of information. Archival research involves collection of data from sources that previously exist. Archival research is a type of research which includes finding out evidence from Archival existing source; it is commonly also undertaken in combination with related research methodologies. The type of research methodology used in archival research can be different based on its association and its applications [32].

4. ARTIFICIAL INTELLIGENCE

Artificial intelligence (AI) sometimes also called machine intelligence refers to a system that is capable of observing its environment, learning from collected data and demonstrating reasoning abilities like humans. The primary objective of AI is

to facilitate person in a variety of requirements. AI is applicable for handling different situations like production and operation management, and supply chain and logistic management, inventory management. Application of AI helps to minimize the probability of human errors for the consumer centric industries, thereby brightening the chances of success. Summarily the AI (Artificial Intelligence) redefines human intellect by use of computational method with endless data handling capacity. AI is an efficient technology means for society to deal with various challenges [28]. Furthermore, AI can be utilizing to completely automate & improve returns & related decision in reverse logistics system.

4.1 Objectives of Artificial Intelligence: [28]

- Understanding neural network designing in a common way.
- Identify the components of a formal system.
- Understanding how execution of multi-dimensional searches.
- Use appraisal functions to accelerate the search method.

5. REVERSE LOGISTICS AND ARTIFICIAL INTELLIGENT

Retailer are maximizing their profit & reducing overhead with the effective utilization of innovative Reverse Supply Chain (RSC) technology. AI provides end to end tracking & control for every process from return to remarketing leads to a happy & satisfy customer with the increase in brand value. The scenario of the reverse logistics process has been mechanized & automated with augmented availability of computer hardware & required data. AI is exceptionally intelligent and, with evolving technology, it has attained the ability to become exponentially more intelligent with each bit of data it collected and stored. AI is not a new concept in the world of supply chain management, although it has not been in the forefront until now. There is increasing awareness of the interaction between the artificial intelligence topic and reverse logistics problems. [20]

Furthermore, the data related to reverse logistics can be used for taking right decision with the availability of refined AI techniques which ultimately, result in decrease in cost & more recovery, which enhance reusability help our environment & betterment of customer experience retail & vendors associate along the way. The effectiveness of AI method was improved with availability of more data, faster cheaper computer. Return product data is mandatory for taking correct decision for customer satisfaction the major challenge in application of AI in reverse logistics is to obtain the correct data to make the right decision. However, if correct & current data is provided to AI system, correct decision can be achieved & implemented in reverse logistics system. Intelligently products disposition throughout the Reverse Supply Chain add benefits and value to all involved parties in Supply Chain. With the advancement in reverse supply chain, disposition system is predefined decisions, which originate with initiation of agreement between merchant vendors & proceed accordingly with downstream logistics chain. In present scenario, as we all aware that online sales are in trend, customer "buy & return" practices are common, well according to statistics. Customers are now accustomed to buy try & often return the product. Experts say that, companies allow their buyer to do this, to promote customer satisfaction & increase brand loyalty. Retailer can maximize recovery on every returned product by utilizing innovative technologies for reverse logistics in Supply Chain. The new & fully automated platform, uses AI tools to make the highest margin decision in real time for reverse logistics.AI provides end to end tracking & control for every process from return to remarketing leads to happy & satisfy customer with the increase in brand value. The automation platform engineer manufacture & implement robotics & other deep learning AI tools across its facilities to the faster & correct decision. AI disposition tool automatically evaluates recent, price of product with similar condition across multiple channels. Then the price is compared against cost of repair, replacing & transport the return product back to the buyer. The AI tools helps to take optimal real time decision with greater efficiency & makes financial sense too.AI keep eye on entire process and the product is return, till the consumer get their return item with best possible resolution. AI frees up the retailer to focus on their daily sales while ensuring the company will receive highest price for their returned product.

6. RETURN MANAGEMENT FOR REVERSE LOGISTICS

A return request is an opportunity for the company to provide service to any customer; such requests may be perceived as a customer demand for better service as a refund or a repair. Better and deeper insight in reverse logistics system for return management helps to gain benefits in time, reliability & cost factors. Often, at occurrence of return request, customer service is considered at stake but here, AI methods use insights for improving customers service.

In reverse logistics system the return process is the customer service which can be influenced by three factors. [4]

a) Time – The duration of return process till completion and receipt of demanded or requested service by the customer.

b) Reliability – The extent to which the customer receives the desired service.

c) Cost – What does it cost to the customers for receiving the requested service.

The quality of return process & cost factor is driven by company's return policy.AI in reverse logistics helps to get better insight into return processing, & can be helpful for improving the service delivery in the return settlement process. Time is considered as an important factor in reverse logistics system. The time taken in return to settlement cycle can be shortened by gaining the following insight.

a) To allocate the right return process sufficient customer information should be available who the customer is.
   - Why the returns are being made?
   - Where does the return originate from.
   - Right product info for allocating right return process
   - What is being returned?
   - What condition is return item in?

b) Adequate information of return for planning and optimizing the process of receiving at return center.

c) Adequate information on return status so as to trigger quick service delivery.

For e.g.: Amazon uses tracking information received from their carriers on real time basis for initiating refund to their customers, the moment the parcel is received by the carrier, even sometimes prior to checking of the returned product. The companies believe that the customers should receive the refund as early so as to give them confidence to buy from Amazon again [12]. In return process, most important benefit gained by better insights is to improve customer journey & their experience in return process. This has a direct impact on customer loyalty & customer retention.

Good insight should improve other dimension of reverse logistics system & can lead to improve oriented phase as: [3]

A better product catalogue (photos & description)

Better customer Service (Return practices)

Better expectation (use return reason for predicting right fit)

This will help in process improvement & value creation.

6.1 Types of Return [16]

Reverse logistics prospect to expand uses of product, preserve material and capital, preventing misuse, and generate derived market & opportunities in re-manufacturing & recycle. Usually actions of Reverse Supply Chain differ in involvedness & consequence of the complexed situation by different types of return which are as follows:

1. Product Lifecycle return: -Such return are associated with sale procedure, reason of return includes problem with product in service contract or guarantee, damages at some stage in transportation.
2. Re-useable component:
3. Such returns are linked to distribution or final consumption of the primary manufactured goods.
4. Disposing of used return: - This includes the use product and component those were return following consumer usage, those products are usually traded in an aftermarket or remanufactured with the useful components.
5. End of life for return: - This includes the products have been brought out from the marketplace in order to evade environment or business loss._

To, optimize value recovery of the returned product an efficient system of reverse logistic is required. The objective of reverse logistics system is to reduce the total of throw away in landfill on the road to recovery material & components of returned product.

7. ARTIFICIAL INTELLEGENCE FOR REVERSE LOGISTICS NETWORK DESIGN

In order to maximize the performance of Reverse Logistics, there is a need for establishing a resourceful and competent system through most favorable Network Design. Reverse logistics Network Design establish a system to handle the reverse process which involves users and reproducers. In literature various techniques have been applied to solve reverse logistics problems and try to create value and other profit making opportunity. Our review is dedicated to commonly used AI techniques in reverse logistics system.

Application of AI approaches in different aspects of Reverse Logistics (RL). [2]

1. Artificial Intelligence in RL network design.
2. Artificial Intelligence in the EoU and EoL products acquisition and assessment.
3. Artificial Intelligence in the EoU and EoL product transportation.
4. Artificial Intelligence in evaluation and selection of logistics suppliers.

Table 1: Application of AI approaches in different aspects of RL

S. No.	RL Aspect AI techniques	Network design	Product acquisition and assessment	Product transportation	Selection and evaluation of logistics suppliers
1.	Ant Colony optimization (ACO)			☺	
2	Artificial Immune System (AIS)	☺			
3	Artificial Neural Network (ANN)				☺
4	Case Based Reasoning (CBR)		☺		
5	Differential Evolution (DE)	☺		☺	
6	Evolutionary Algorithm (EA)		☺		
7	Fuzzy Logic (FS)	☺		☺	☺
8	Genetic Algorithm (GA)	☺	☺		☺
9	Greedy Randomized Adaptive Search Procedure (GRASP)	☺			
10	Multi Agent System (MAS)	☺			
11	Neighborhood Search (NS)	☺		☺	
12	Particle Swarm Optimization (PSO)	☺			
13	Simulated Annealing (SA)	☺			
14	Tabu Search (TS)	☺		☺	

☺Indicate application of AI approach in RL aspect

8. LOGISTICS NETWORK DESIGN

Logistics network design is amongst foremost significant tactical decision of reverse logistics problem. Decision of quantities of amenities, their location and capacity, also their movement which have an effect on both overheads and consumer's level of service. The problems of network design in reverse logistics vary from the linear to the complex non-linear solutions also reduce cost of deliverance of products to the complex multi-objective optimization problem. The considered issue of reverse logistic network design might have an effect on each a company income & therefore the consumer's level of service. The consideration of lead time of delivery and total cost is mandatory for achieving customer satisfaction and for these two factors multi-objective reverse logistics network design problem shall be used. The Reverse Logistics problems can be solved effectively by the application of Genetic Algorithm. [18]

To improve the reliability of the given AI methods for solving different RL aspects, they may be analysed by employing combination of suggested tools includes AHP, ANP, Interpretive Ranking Process (IRP), DEMATEL, SEM etc.[9]. It is important to acquire understanding of related techniques & capability to interpret given data related with RL for application of AI techniques. **[28]**

9. GENETIC ALGORITHM

Reverse logistics network problem is characterized by uncertainty which adds to complexity of the problem. As we can see from Table 1, GA is the most popular AI approach used in reverse logistics aspects Network design, Product acquisition and assessment and Selection and evaluation of logistics suppliers also.

A priority based Genetic Algorithm can be used for reverse logistics network for satisfying customer requirements with minimum cost, even in condition of uncertainty. Genetic algorithm (GA) is stochastic search techniques based on natural selection and natural genetics mechanism [23]. The GA has been achieving great attention as an Evolutionary Computation (EC) technique, which can be applied for problem solving and its optimization [24]. Genetic Algorithm is also applicable for variety of problems and also provide solution of different and complicated problems [25]. Generally individual problems have varied genetic representation and this is significant issue influence the performance of Genetic Algorithms. The mo-RLN model can be designed and is balanced by mo-hGA proposed plan with reusable configuration [9].Genetic algorithm effectively resolve problems related with Reverse Logistics and find optimal solutions with minimum total cost [26].

10. DISCUSSION AND CONCLUSION

This paper attempts to highlight the importance of Reverse Logistics system and its position in consumer centric industries and also study application of Artificial Intelligent AI approaches in different aspects of Reverse Logistics.Although it has been a wearisome process; to collect data crucial for completing this paper, ranging from aggregation of information for theoretical sets, going through varied articles to search out the correct and related information, comprehending the idea. It is observed that reverse logistics plays a significant role for the manufacturing sector to remain competitive in the market. Furthermore, having an effective reverse logistics process results into reduced cost, effective utilisation of available resources, higher degree of customer satisfaction, and reduction in amount of return. [6]

It is further advisable for those companies to think about having the reverse logistics processes because the cost of having reverse logistics may be limited to approximately 5 to 10% of the overall logistics costs. Be that as it may, it gives an open door for development. In this manner, it is imperative for any organization to ceaselessly attempt to improving their process if they desire to continue to exist in the market. [13]

The awareness about recuperation of used items and material, have been increased. Reverse logistics network problem will be a powerful tool & have a great potential for winning consumer in competition content. As we are able to see from Table VI, GA and FS are amongst the foremost AI approaches utilised in reverse logistics problems. Based on the review, it is clear that the complex nature of issues are experienced in RSCM consistently need multi objective optimisation. In light of the literature study, we can see the perplexing idea of issues ein RSCM require multi target advancement. AI is a potential technique to resolve reverse logistics issues. The main problem is not attaining adoptability with the modern advancements. However, in future there will be advancement in Artificial Intelligence which can't be resisting by companies. So every company shall organize to manage potential of Artificial Intelligence [28]. This can be a future trend for research fraternity AI and reverse logistics both.

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AUTHOR

Ms. Neha Patkar, Assistant Professor, Department of Industrial & Production Engineering, Shri GS Institute of Technology and Science, (SGSITS), 23, Sir M. Visvesvaraya Marg, Vallabh Nagar, Indore – 452 003, (Madhya Pradesh) Email: indore.neha@gmail.com