Application of Big Data Analytics to Small Scale Industry Reverse Logistics – A Case Study

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Abstract— **Data Analytics evolved recently and has gained importance in recent years. Reverse Logistics involves the steps in moving the products from the customers. Reverse logistics has gained attention with the recent closed loop supply chain concepts. The risk associated with Reverse Logistics is more compared to forward logistics. The key Data analytics concepts customized to Reverse logistics is studied in this paper. This paper aims at providing a solution for reverse logistics activities for a small-scale industry.**

Index Terms— **Supply Chain, Reverse Logistics (RL), Block Chain, Forward Logistics (FL), Closed Loop Supply Chain (CLSC), Big Data Analytics (BDA)**

I. INTRODUCTION

Reverse logistics (RL) involves the various steps/stages in sending the products back from customer to the suppliers. The complexity involved in Reverse logistics is more compared to forward logistics [1][2]. Proper planning of reverse logistics activities helps to improve overall supply chain efficiency. Reverse logistics is reactive in nature and it varies with different products. There is a need for organization to reduce the wastes and to recover the value from the used products, because of which RL is also a key area these days. RL can disturb the complete supply chain if it is not focused appropriately.

Cost is involved in each stage as the product must be shipped back from customer to supplier. The Information sharing is a key within various stages of the supply chain. Lack of information sharing between various stages of the supply chain will impact the RL effectiveness. Optimized RL activities helps in maximizing sales and minimizing costs. The

optimization is achieved by trying many permutations and combinations suited to the context. The key features of Big Data Visualisation are customized to a product small scale industry and solutions to the challenges faced are discussed.

II. LITERATURE SURVEY

Reverse logistics encompasses of the segment of supply chains that process anything returning inwards through the supply chain or traveling 'backward' through the supply chain. Over the last two decades, RL has presented major challenges and opportunities. Authors in [8] briefly discuss about what is Reverse logistics and its importance and the necessity in the recent years. A summary of forward and reverse logistics and how they are different in terms of uncertainty and operational difficulties. Case studies are analyzed in detail based on qualitative and quantitative methods. This also gives a possibility for further investigations on the subject. The differences between forward logistics and reverse logistics are summarized in a study [9]. The Authors have also categorized the various work that was carried out under FL and RL.

Reference [3] discussed about the optimization of RL activities. An exclusive literature survey is referenced namely on RL networking, outsourcing, adoption, and implementation. This provides a systematic overview of forecasting issues within timeframe of 1986 to 2018 in 70 papers. The research gaps were identified and suggestions for improvements are captured. Authors highlighted on the importance of almost all forecasting methods in this.
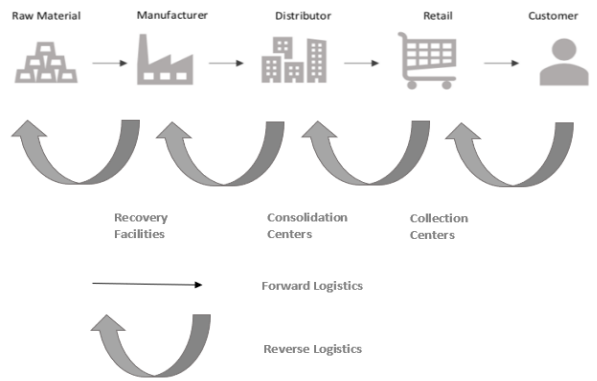
Fig 1 Reverse Logistics

Authors in [10] aimed to better understand to what extent reverse logistics affects the overall competitiveness of the company. With this, the reverse logistics subject and its relationship with company competitiveness is summarized. The first part of the paper presents the state of art on Reverse logistics, the various components, the importance in global supply chain, followed by RL implementation and relationship between Competitiveness on enterprise.

Authors in [11] came up with comprehensive bibliometric review of two decades, research on Closed Loop Supply Chain (CLSC). As CLSC has been evolving the need of literature became essential. A bibliometric analysis was performed based on 1,155 articles during the tenure from 2001 to 2020 with the help of visualization software VOSviewer and CiteSpace. The study had a descriptive analysis, thematic cluster analysis. Findings were ''game theory'', and ''remanufacturing'' are emerging research trends for CLSC and ''Dual channel'', ''quality'' and ''circular economy'' had become hot topics. The research gaps identified were used as a scope for future directions.

Authors in [12] discussed on application of the internet of things in Reverse Logistics Information Management. Internet of Things had gained a huge importance recently. A reverse logistics management information system (MIS) is developed based on the application of Internet of Things. This is limited to the analysis of constraints impeding the development of the reverse logistics MIS, which includes management constraints, economic constraints, hardware technology, data security and rights management constraints. Detailed solutions are mentioned as scope for future work.

III. LIMITATIONS AND CURRENT SCOPE

Journal papers related to Big data Analytics were reviewed. This helps us to understand the *As-Is* trends that is currently available. Big Data Analytics is an increasing trend in many of the organizations for the purpose of converting the data into meaningful information. The transformation of data to information is the key. After the conversion, this aids in strategic, tactical, and operational decision making. Author in [4] discuss about the recent status on Big Data Analytics (BDA) applied to Reverse supply chain Indian Industries with emphasis on understanding the BDA concepts and develop a structure to examine Industries reverse supply chain. A survey was conducted through questionnaires on reverse supply chain management levels of 500 industries. The hurdles faced by the Industries for big data analytics transition, connection with reverse supply chain levels and the learning were focused. With this study, there was a scope for further research.

Authors in [5] cover a brief literature review of vast study that was accomplished using applications big data analytics to supply chain management within the search period of 2012 to 2018. A total of 313 articles were considered. The number of big data analytics papers contributed according to country of origin was also analyzed; a summary of the top twenty most frequently cited articles were given.

Authors in [6] briefed up on the Critical analysis of Big Data challenges and analytical methods. The paper presents a holistic view of the Big data challenges and importance of organizations to understand the big data landscape before deploying any tools to make robust decision making. The questions considered were the challenges for big data theorized and the methods used to overcome the challenges. A systematic literature review was carried out for a tenure of 1996 to 2015 understanding the past trends, the patterns in big data research area, there implications, limitations. With this as well there was a scope for further research.

Authors in [7] aimed to summarize some of the different analytics methods and tools which can be applied to big data, the opportunities provided by the application of big data analytics in various decision domains. A brief discussion about what is Big data, the characteristics, Tools and methods, Data storage and management, processing, and analytics to make key decisions for supply chain.

With all the above said papers we learnt the importance of big data, data analytics and based on the various scenarios the tools are to be selected and deployed. To adapt with this rising trend there is always scope for future studies and this is taken as an opportunity and explored.

IV. PROBLEM

A small-scale product Industry is considered for this study. This industry manages data in a structured fashion, but they do not have enough historic data in place. Since the products were key and the schedule has to be managed stringently, the industry experience challenges in managing Product deliveries, product out of stock and Bottlenecks in transportation. This has become a huge concern and the management were exploring for insights for the same. There was also an observation that the returns from the customers are not managed and utilized appropriately. The products were accumulated without realizing the actual values. Small repairs can be done in many cases and put the product back to field.
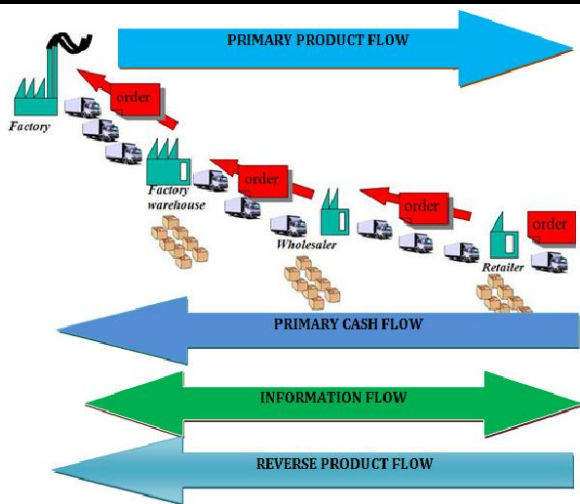
Fig 2 Supply Chain Flow

A. Analysis and Interpretation:

Products are produced at fixed quantities every month. Planning is in place for the production and shipment of the fixed quantity. The different data within the industry were managed in different forms/formats within various departments. The products fall under repairable system. The products that are shipped are put into field. Once the failures happen, the failed products are returned and after appropriate investigation, repair/replace or refurbish actions are planned.
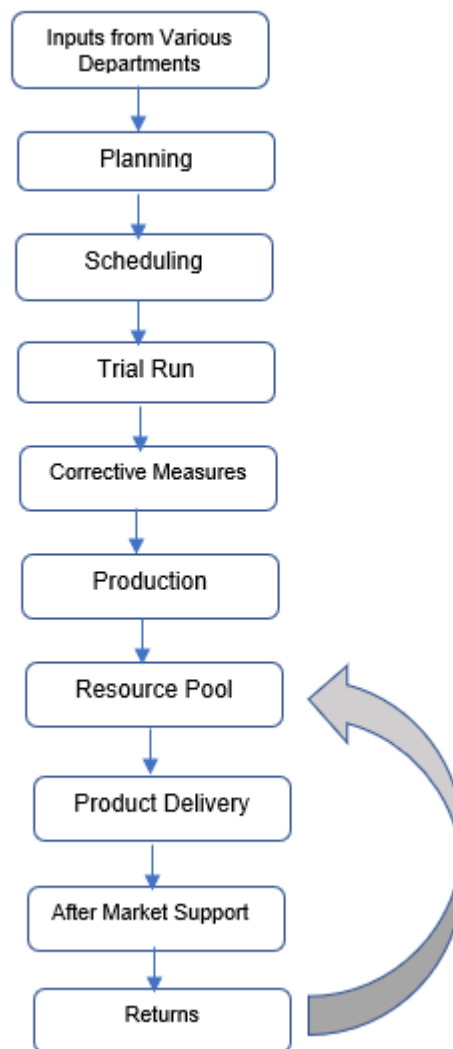

Fig 3 Small Scale Industry Framework

Based on brainstorming, the industry as a team decided to understand the flaws in the system. The basic framework is mentioned in the above fig 3. The team decided to leverage data analytics advantages and try to resolve the problems faced. Data analytics is the science of analyzing raw data to make conclusions about information. Data analysts typically analyze raw data for insights and trends.

Supply chain analytics can identify known risks and help to predict future risks by spotting patterns and trends throughout the supply chain. Some of the advantages are:

- Increase accuracy in planning.
- By analyzing customer data, supply chain analytics can help a business better predict future demand.
- Supply chain analytics augment data-driven decisions to reduce costs and improve service levels.
- Gain a significant return on investment.
- Better understand risks.
- Achieve the lean supply chain

- It is also the foundation for applying cognitive technologies, such as artificial intelligence (AI), to the supply chain process.
- Cognitive technologies understand, reason, learn and interact like a human, but at enormous capacity and speed.
- This aids in proper data handling and store historic data in a structured manner.

The advanced form of supply chain analytics helps in supply chain optimization. It can automatically examine through large amounts of data to help an organization improve forecasting, identify inefficiencies, respond better to customer needs, drive innovation and pursue breakthrough ideas.

For this context, the data is analyzed in a very systematic way to drive meaningful conclusions. The various data steps are mentioned as below:
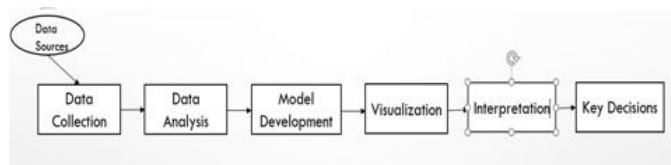

Fig 4 Data Flow

The data is collected from various data sources or departments and analyzed thoroughly. A combination of Historic as well as current data are consolidated and is used for the model development. Since the Industry is small and the investments allotted is not very high, after data analysis the team decided to use visualization techniques using a big data software. Data Visualisation can be called the graphical presentation of data and information by using visual elements like maps, charts, and graphs. Data visualization tools give a convenient way to view and understand patterns, outliers, and trends in data. It helps to analyze large quantities of data and create data-driven course of actions.

An empirical approach is used to solve the problem customized to the context with the highest priority given to returns management as per the Team brainstorming. A high level snapshot of the empirical model/approach considering the various factors are mentioned in Fig 5.
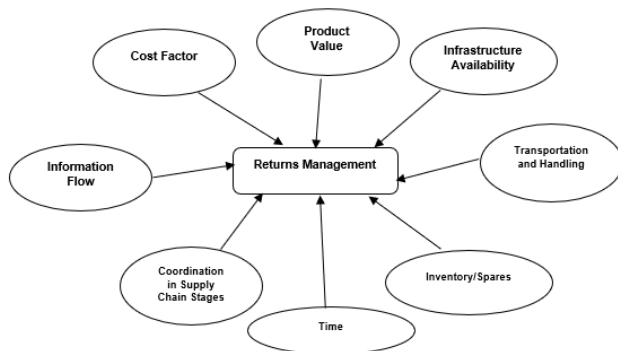

Fig 5 An Empirical Model

The data Visualisation solution is developed as live dashboards within the industry to have a visual impact for the team. This is deployed in a web server. This creates easy notifications or triggers between various departments and actions are taken at right time. It is an efficient way of

communicating time series data. Proper information sharing is established between various stages and systematic data handling is made with the limited resources available. This improved RL effectiveness as well. It aids proper planning between collection, consolidation, and recovery phases of reverse logistics. A sample of data Visualisation dashboard is given in Fig 6.

Fig 6 Data Visualisation Sample

V. CONCLUSION

The solution is customized and well suited for the selected context. This can be given as a usage-based service to the customers/clients that the industry offers service to, in order to enable right and fast decision making. Various Data analytics and Visualization techniques can be applied to optimize the scheduling and planning activities. This method can be extended to large scale industries handling multiple product lines. This can help plan business operations, anticipate bottlenecks, and prepare for any contingencies. The proposed solution has the following advantages such as Improved RL Efficiency, reduced lead time, Improved Productivity, Optimized production runs.

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