Returnable Container Collection Process in Reverse Supply Chain Operations: A Case Study of an Indian Distillery Company

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Abstract

Reverse Logistics (RL) field is recognized as an imperative field of research across all industry domains. The contribution of the RL practices to the firm's supply chain performance is also well established through various researches. Corporates have started considering RL processes as an integrated strategy in their design and execution of the supply chains. Field research outputs are going in the various sectors in showing the reverse supply chain practices and their increased importance in the system. This research paper reflects a comprehensive analysis of the RL practices with respect to distillery industry in India. The field, distillery industry is highly an unexplored and a complex one. In this domain, the scope for controlled practices in Reverse logistics is having a direct impact on the performance of established supply chain. The paper has attempted a pioneer step to analyze the area of RL operations in distillery Industry by understanding their various factors and their mutual relationship with respect to distillery industry by using established modeling technique ISM (Interpretive Structural Modeling). It finally recommends factors to be focused in increasing the RL performance in the Distillery Industry.

Keywords: Reverse Logistics, Returnable Containers, Interpretive Structural Modeling, Distillery Industry

1. Introduction

Logistics has become a buzzword of today's business community. General notion prevails that the logistics is 'movement of goods'. But it is much wider concept. It is defined as "the art and science of obtaining, producing, and distributing material and product in the proper place and in proper quantities."(APICS, 2011).Logistics is the collection of activities associated with acquiring, moving, storing and delivering supply chain commodities (i.e., products in all stages of manufacture, service and information). It encompassesbusiness functions of transportation, distribution, warehousing, material handling and inventory management and interfaces closely with manufacturing (Ratliff and Nulty, 1996). Logistics is one of the major functions in the business as about 35% of the total cost is the logistics cost. Today, in the globalization era the field of logistics has gained everyone's attention. Logistics is considered as a value adding activity. It consists of following phases: transportation, storage, packaging and material handling.

Logistics systems are broadly divided into two categories: 1) Forward logistics systems 2) Reverse logistics systems. Forward logistics is defined as procurement, storage and movement of materials, parts or finished inventory from the supplier to the manufacturer to the customer. Reverse logistics is defined as a complete supply chain dedicated to the reverse flow of products and materials for the purpose of returns, repair, remanufacture, and/or recycling (APICS, 2011). Fundamentally forward logistics and reverse logistics differ in the start and end points. Forward logistics has a fixed originating point (i.e. the manufacturer) and the several end points (i.e. the customers) on the other hand reverse logistics has multiple originating points and a single end point (i.e. the recycler or the remanufacturer). Moreover in forward logistics product quality is uniform, inventory management is consistent and the price of the product is uniform whereas in reverse logistics, product quality is not uniform, inventory management is unorganized and the price of the product is not constant.

The concept of reverse logistics has been created to respond to the necessity of businesses to develop and/or restructure their material returns. But till now, reverse logistics activities were considered as an expense and also as a cost center for any business. The field is still considered to be an unexplored area in the various industry domains.

There are different reasons that motivated the development of this area such as strict environmental regulations, customer demand or economically driven opportunities to reuse products or recycling materials (Dekker et al. 2004). Reverse logistics costs are difficult to measure and less visible. And it is very difficult to forecast the reverse logistics activities. But the reverse logistics benefits the business in many ways. Nowadays many industries started paying attention to their reverse logistics practices as an integrated element leading to contribute in product life cycle management, service quality, customer satisfaction and loyalty.Strategic importance of effectively managing returns is becoming increasingly evident as firms seek to maximize the value they create for themselves and for customers. (Mollenkopf et al, 2007).

Indian distillery industry is growing in many folds in the recent years. India is the fourth largest producer of ethanol in the world and the second largest in Asia. According All India Distillery Association (AIDA), India will have business more than $39 billion by 2014, by showing a compounded annual growth of 12 % per annum. (AIDA Report, 2011). The distillery industry today consists broadly of two parts, potable liquor and the industrial alcohol. The potable distillery producing Indian Made Foreign Liquor and Country Liquor has a steady but limited demand with a growth rate of about 7-10 per cent per annum (Chauhan and Dikshit, 2012).Reverse logistics is a common practice in distillery industry in India. The study on reverse logistics process is also on nascent stage. Though reverse logistics practices exist in this sector, these practices are highly unorganized. This paper examines the existing reverse logistics practices and the challenges faced with Indian distillery industry. The parameters in the operations are analyzed with Interpretive Structural Modeling (ISM) technique, a tool to structure the collective knowledge on a sequence. It also identifies the areas of improvement for the reverse supply chain operations in the selected domain.

2. Literature Review

This section represents reviewed articles published in reputed journals like Supply Chain Management, Journal of Modeling in Management, International Journal of Physical distribution and Management, Benchmarking and many other reputed refereed publications. The Literature review covers the areas of application of reverse logistics in various industries, dimensions of reverse logistics, and its impact on firm performance and Application of ISM techniques in various industries. Nevertheless, the review exercise is identified the huge gap for the requirement of literature with respect to distillery supply chains. By analyzing the practices from the various industries, the concepts can be applied and assessed for the further performance.

2.1 Trends in Reverse Logistics

In the history of manufacturing, Reverse Logistics is identified as a tool to handle the waste. During that time, it was restricted to collect metallic parts due to high economic value. In 1980's and 1990's, Environment laws were enforced in various industries in Europe especially in waste treatment, packaging and product returns. In order to comply with these regulations and show their responsibility towards environment, Reverse Logistics took its genesis and is growing rapidly in direct proportional to the advancements in technology (Marta et al, 2010). Over the last 10 years, Product returns management field is being evolved as a challenging field for Business Engineers. Effective reverse logistics believed to result in direct benefits, including improved customer satisfaction, decreased resource

Reverse Logistics encompasses the logistics activities all the way from used products no longer required by the user to products again usable in a market. (Wassenhove et al, 1997). Fleischmann et al.(2000) base reverse procedures on the excess products and extended producer responsibilities. An environmental corporate dimension with a focus towards remanufacturing, recycling and reclamation have added vigor to these areas of study (Laura et al, 2002). Tibben-Lembke (1999) articulates the difference between Retailer handling reverse procedures and their vendors with analysis on disposition strategies. Further, the question for costs and benefits of RL processes was answered by MollenKopf et al (2011), saying that Reverse flows are often perceived purely as a cost item that should be minimized. On the other hand, De Koster et al (2002) discuss the benefits of RL processes. They are: income from re-sold products, reuse of recycled products, money saved on spare parts (while they are collected from the de-mantled products). However, managing the reverse supply chains are is more complex than traditional manufacturing supply chains. (Rogers et al, 1999; Amini et al, 2005; Mitra et al, 2008).

For a company to have a successful reverse logistics process in place, management must first develop a sense of urgency of the importance of reverse logistics in strategic planning (Alan, 2005). Cespon et al (2009) puts forward

the reviewed objectives reverse logistics strategies as to maximize the value added to the returned products, minimize the return cost of the product and optimize the efficiency of reverse supply chain framework, to reduce the environmental impact, to increase the service to the client. Erol et al, (2010) has reviewed the reverse logistics procedures from various industries and further argues that market structures of re-manufactured versions of products and cannibalization effect of the secondary market on the new products determine the Reverse supply chain initiatives in the different industries. Research paper from Chad et al (2001) argues that, even those the companies who had ignored the reverse logistics process are working to develop the standardized reverse logistics processes. This is the triggering point for our research in this particular industrial domain. Skapa et al (2012) studied in detail about how RL process is creating the value and its importance in Planning and measurement of RL process.

The Research on reverse logistics Industry in India is still at beginning stage. Srivatsava et al, (2007) admit that the procedures of RL have not been given the great attention in the organizations. Most of the research papers exhibit the perspective of the reverse supply chain business with respect to the market dynamics and customer perspective. There were few reports from Indian context (Ravi et al, 2004; Norris, 2005; Srivastava et al, 2006; Nandita et al, 2011; Sharma et al, 2011).

Lau and Wamg (2009) advocates on the strategies for reverse logistics will help them to achieve more sustainable production and consumption.The importance of studying the reverse supply chains has been increased among the supply chain communities in India especially from the manufacturing side.The above area of review clearly identifies the scope for researching Reverse logistics area in Indian industry context and its evolving dimensions. It also supports to identify application of reverse logistics practice in the unexplored industry and to design innovative strategies to implement the same.

2.2 Dimensions of Reverse Logistics

Success of reverse logistics supply chain depends on various factors. These factors are critical issues that create barriers in implementation of reverse supply chain or contribute significantly in its success. These factors not only affect overall performance of reverse logistics but also significantly influence each other's performance. Understanding of interrelationship between these factors is crucial in determining organizational performance.

Author	***Objective***	***Major Findings***
Fleischmann et al. (1997)	To survey reverse logistics processes, dimensions, distribution and models.	• Transportation capacity utilization for returnable bottles, integration of forward and reverse distribution.
Mollenkopf et al.(2007)	Qualitative methodology to consider theory development related to returns management within supply chain.	• Cross functional integration within firms, external factors influencing returns supply chain process, supply chain orientation for effective returns management.
Jayant, A. et al.(2011)	To identify dimensions of Reverse Logistics.	• Review of various perspectives on design and development of reverse SC, planning and control issues, coordination issues, product remanufacturing and recovery strategies.
Sharma et al.(2011)	To identify barriers in reverse logistics and develop relationship among them.	• Key barriers: Personnel resource, Limited Forecasting, Lack of Information flow.
Rajesh K Singh (2011)	To develop a framework for improving the coordination in supply chain and development of an index for coordination.	• Enablers for supply chain: Information flow, Responsive.
Ho et al.(2012)	To identify factors that influence implementation of reverse logistics and provide suggestions to eliminate barriers in the process.	• Statistical analysis of survey conducted indicates that company's internal and external factors influence implementation of reverse logistics.

Jayant et al (2012) reviewed the reasons for returns in depth. They are: End life of returns, End of use returns, Commercial returns and Reusable components, which has a direct relationship with the selected field of research. It leaves a scope for classifying the modes of returns and area to be focused on the study for the particular industry.

Our research identifies these components in the specific domain of Industry and tries to explore their applications with respect to practicality and business performance. In distilleryfield, these returns are highly related to the consumption pattern and they have not been identified as the part of the product. The Product returns are identified as re-usable returns. The bottles in reverse chain process are collected, streamlined and send back to the mother plant for the refilling. Research gap is being identified on the dynamics of distillery industry reverse logistics process, since the operations identified in the domain is complex and not as a streamlined one.

2.3 Reverse Logistics and Its Impact on Firm Performance

Previously reverse logistics activities were not considered as important factors in the firms' supply chain. Over the years, the field started gaining the importance to the level of understanding its impact on the profitability of the organizations. (Andel, 1997;MollenKopf et al, 2007). Earlier companies perceived reverse logistics activities as an additional cost burden.The firm level study on the Revere logistics system profitability and their characters also attempted by many researchers.(Guide and Wassenhove 2003; Dychkoff et al, 2004).Efficient management of returns can reduce companies' annual logistics costs by as much as 10 per cent (Mianhan (1998). But over the years reverse logistics emerging as a profit center. Today many companies have modified their supply chain strategies to incorporate reverse logistics activities. The review on this area,vividly elucidates that study and aligning towards the right reverse logistics framework will lead to the

Author(s)	***Objective***	***Major Findings***
Ronald, T. et al. (2002)	To compare and contrast forward and reverse logistics in retail environment, with focus on reverse flow of product.	In Retail sector under "Zero Returns" policy, retailer is credited for customer returns but product is never physically returned to vendor.
Daugherty, P. et al. (2003)	Reverse logistics operations in paper industry: a case study.	Relationship and trust between suppliers and manufacturers is key factor.
Ravi, S. et al.(2006)	To report a case study that focuses on identifying what may be considered a typical or generic RL process flow as well asthe key strategic issues that a firm may use for competitive advantage.	It identifies the lack of reverse logistics in Indian Paper Industry. It identifies opportunities forimprovement in reverse logistics process.
Festus, O. et al.(2008)	To investigate feasibility of current reverse logistics theories and models in developing countries like China in electronic industry.	It explains the Reverse Logistics practices and key strategic issues that a firm may use for competitive advantage. It highlights type of technology innovation and IT a firm needs in order to operate an effective Reverse Logistics system, resource commitment that a company needs.
Lau and Wang (2009)	The aim of this paper is to analyze the pharmaceutical supply chain using the DMAIC process for improvement of the reverse logistics in a recall to avert the possibility of harm to a consumer.	There is little network set up cost and collection cost is relatively low. The company can therefore maintain its own self-support collection network and only uses 3PLs for recycling.
Kumar, S. et al. (2009)	Analysis of the reason and the problems in the development of reverse logistics in the field of E-commerce.	The majority of the reverse logistics for pharmaceuticals is handled through third-party providers, and therefore this specific knowledge is well guarded, being a core competency.
Xu, J. et al. (2010)	This paper discusses the role of E-commerce in reverse logistics	E-commerce and logistics are the complement to each other. With the further development of e-commerce, the reverse logistics will become a huge competitive advantage for e-commerce. Research on reverse logistics will benefit the healthy development of E-business.

Kokkinaki, A. et al. (2010)	Role of E-commerce in reverse logistics.	E-commerce for reverse logistics is an area of web applications that has been active and progressing aggressively. The e-commerce environment is more efficient tool and infrastructure for reverse logistics.

greater impact on the firm's performance. Literature gap identified to study the perception of the Indian companies on Reverse logistics with respect to their Industry in a structured framework. For that, the enablers or variables those affect the performance and their relationship also to be studied in detail. The paper tries a pioneer attempt in that direction. The establishment of the relationship can be established by various techniques Analytic Hierarchy Process (AHP), Analytic Network Process (ANP), Interpretive Structural modeling (ISM) etc. In the next section, Interpretive Structural Modeling (ISM) is widely reviewed for its application.

2.4 Reverse logistics practices in Industries:

Nandita (2011) reports that most research on reverse logistics is focused on automobiles, metal scraps, sales and packaging materials and waste paper cycling (Stock, 1992, Kopciki et al, 1993; Kumar and Putnam, 2008; Pilar et al, 2004). Within specific industries, reverse logistics activities can be critical for the firm. Arvind et al (2012) also reviewed on reverse logistics practices across various domains of Industry. Generally, in firms where the value of the product is largest, or where the return rate is greatest, much more effort has been spent in improving return processes.

2.5 Reverse Logistics in Reusable Packaging/ Containers:

Some research has been done on the part of returnable packaging. Kroon, L. et al. (1995) suggest different methods of designing a returns management system for packaging, Karkkainen,et al.(2004) has proposed use of RFID in transport packaging. Twede,D.et al.(2004) highlights supply chain issues and proposes use of reusable packaging. Monsreal,M.(2011) analyses the necessities of collecting nonreturnable packaging at the point of sale, as well as their processing and sell toRecyclingcompanies. This paper proposes the realigning the returns of beverage containers for a brewery in Mexico but doesn't propose anything about losses in the system.

The extensive literature review identifies the scope for research with respect to the Indian distillery industry. Till now, there is no formal research has been initiated on this selected domain of research. In the Global level also the focus is gaining on the research on distillery industry research. The literature review on this area gives the wider scope for the research in the selected domain i.e.distillery industry and also gap for research has been identified for the study on the collection mechanism of returnable containers.

The industry also uses the several techniques in maintaining the efficiency of the supply chain. In order to control the

Author(s)	***Objective***	***Major Findings***
Kroon, L. et al. (1995)	This paper presents a number of methods that may be used to create a return logisticssystem for returnable Containers.	Switch-pool system introduced where cleaning, control, maintenance and storage. A sender chooses a returns logistics system on the basis of the type, the weight and the structure of the goods, as well as on the quantities involved, and whether the sender has or does not have a return logistics system.
Karkkainen,M .et al.(2004)	To manage the rotation of reusable transport packaging – a multiple case study.	Individual package level tracking is suggested which would bring in sufficient efficiencies in managing return of packages in respective supply chain.
Twede,D.et al.(2004)	To highlight supply chain issues in reusable packaging.	Reusable packages save purchase and disposal costs across the supply chain. Use of 3PL (Third Party Logistics) for reusable packaging replenishment.
Monsreal,M.(2011)	This paper analyses the necessities of collecting nonreturnable packaging at the point of sale, as well as their processing and sale to recycling companies.	The paper gives a framework whose objective is to increase the quality and quantity of recycled material used in the production of new packaging.

environmental emissions they usereturnable containers. The next section will give an insight about the reusable containers and their relevance in the reverse logistics process of distillery industry. Research from Monsreal (2011) reveals the recycling framework incorporating the reusable containers. Following section reviews the ISM framework developed and applied for various industries.

2.6 Interpretive Structural Modeling (ISM)

Interpretative Structural Modeling (ISM) was first proposed by Warfield in 1976. This method aims at deciphering the complex relationships between factors/ variables identified and to establish the hierarchy amongst those variables to represent the system architecture.The method is interpretive in that the group's judgment decides whether and how items are related (Mandal et al. 1994). Thakkar et al, (2010) establish the characters of ISM technique. They are : the technique involves the set of interconnected data, establishes the leads to relationships s among the criteria, and captures the complexities of real life problems and higher ability for capturing dynamic complexity. Sharma et al (2011) clearly articulates on the use of ISM to decompose a complicated system into several subsystems using the "practical experts and their knowledge".

Research evidence has found the application of ISM technique in Reverse logistics areas too. Ravi et al (2005) concentrate on Computer hardware industry and Promod et al (2010) applies the same technique in telecom reverse supply chains. Both the works are bound with Indian environment and leaves the scope for this paper to apply the same technique towards Indian distillery industry. Some of the latest works with ISM has been identified in measuring performance measurement of supply chains (Charan et al, 2008), in assessing the variables in risk management in supply chains (Mohd. Naushatet al, 2006; Khurana et al, 2010), in supply chain integration

Article-Author	***Objective***	***Major Findings***
Deshmukh, A. et al.(1994)	Vendor Selection Using Interpretive Structural Modeling (ISM) keeping the Indian engineering industry scenario.	• It identifies 11 most important criteria for vendor selection from the 23 criteria identified by Dickson. • It finds price, delivery and after-sales service as thetop-level criteria followed by Quality and attitude and willingness to do business.
Ravi, P. et al.(2008)	To determine the key supply chain performance measurement system (SCPMS) implementation variables, to improve the effectiveness and efficiency of supply chain (SC).	• Highlights the variables associated with implementation of supply chain performance measurement system (SCPMS). • Awareness about performance measurement system (PMS) in SC isa very significant enabler.
Shankar, R. et al. (2010)	To identify the barriers of supply chain collaboration (SCC) in the Indian Apparel retail industry and their interaction with each other.	• There exists group of barriers having high-driving power and low dependence requiring maximum attention and of strategic importance. • Other group consists of those variables which have high dependence and are the resultant actions.
Singh, R.(2011)	To develop a framework for improving the coordination in supply chain of Small and medium enterprises (SMEs).	• 32 enablers for coordination in a supply chain have been identified based onliterature review. • Top managementcommitment, Organizational factors, mutual understanding, flow of information, relationship and decision makingand responsiveness have been identified as a major categories. • Top management commitment is a major driver for improving the coordination among these factors.
Rahman, Z. et al. (2011)	To understand the interaction among these barriers and to develop a hierarchy of TQM barriers model.	• 12 factors affecting TQM implementation in an organization have been identified through literature review and expert opinion.
Sushil (2012)	It is an attempt to interpret the links in the interpretive mode. Structural models using the tool of Interpretive Matrix.	• The tool of Interpretive Matrix leads to evolve the framework and methodology of Total Interpretive structural modeling (TISM). • It highlights the need of interpretation of interpretive structural models.

(Singh,R.K, et al, 2011). The review shows that the focus is moving towards the usage of the expert oriented technique like ISM. The interactive method is identified as the preferred method by a direct and indirect variables and their level of interactions with respect to hierarchy can also be established for the particular research objective. Since, distillery industry is least explored, this work on the reverse logistics characterization is a pioneer attempt in that field. The construction of the model will be explained in the further sections of the article and it identifies the process flow of the activities carried out in the reverse logistics process. It explains the major elements identified by the literature review and interviews involving the stakeholders affecting the Reverse Logistics process. ISM framework is adopted to determine the contextual relationship between elements and to determine the major element which leads to or results in all the other elements.

3. RESEARCH METHODOLOGY

Research Methodology is a way to solve the research problem systematically. This section deals with the various steps that are adopted to perform this particular research. Most of the research work reported about Reverse Logistics in distillery Industry has been limited to packaging, facility location, and recycling. In addition to that, the country such as India has been ignored and no substantial research has been reported on reverse logistics in distillery Industry in India. As a result, it was decided to work on this relatively unexplored aspect and perform a descriptive research. It includes surveys and fact finding enquiries of different kinds. We attempt to highlight the description of state of affairs as it exists in present.

3.1 Research Objective

The main objective of this paper is to identify factors influencing the reverse logistics operations in distillery industry and illustrate the areas of improvement using Interpretive Structural Modeling (ISM).

3.2 Research Approach

Case Based: Nasik being the Wine capital of India and its proximity to the cluster of Liquor Companies and its suppliers, it was decided to adopt Case Based approach and study the existing practices revolving around the Case Company.

Framework

To identify the process flow of the activities carried out in the reverse logistics process. Identify the major elements affecting the Reverse Logistics process referring the literature and expert opinion. The framework adopts ISM approach to determine the contextual relationship between elements considering the expert opinion. To arrive at the major areas of improvement the relationship between elements obtained through ISM is further detailed down using expert interviews involving the stakeholders and supporting Data Analysis. This is the pioneer step in the reverse supply chain study on the distillery industries.

4. Case Company: ABC Ltd

ABC Ltd. is one of the largest spirits company in the world by volume, selling X million cases for the fiscal ending March 31st, 2012. ABC Ltd.has a global footprint

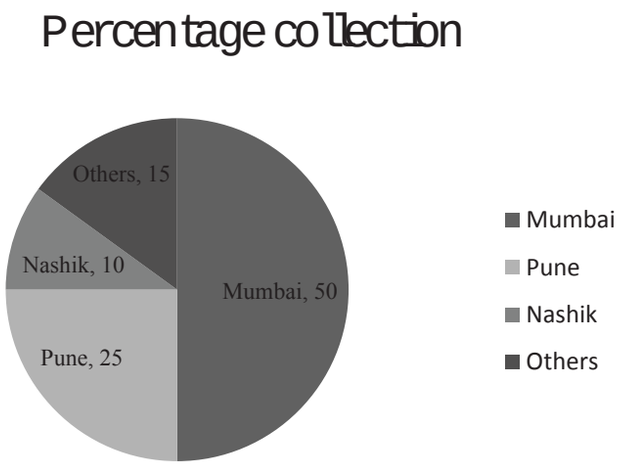

Figure 1: Percentage collections of old C49 bottles for ABC, Nashik -Area wise

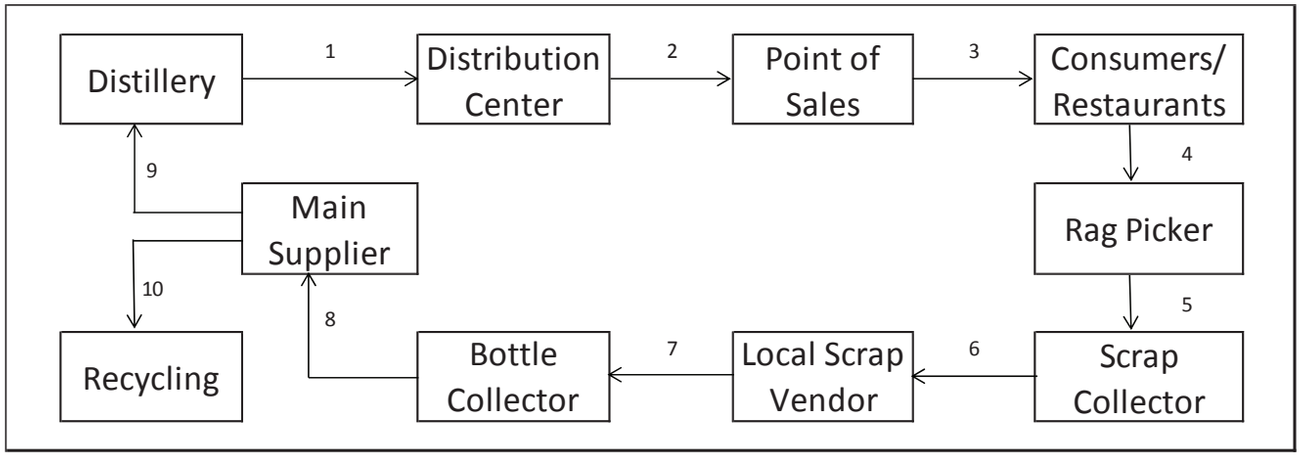

Figure 2: Complete process flow including both forward and reverse logistics of the Distillery Industry

with exports to over 30+ countries. It has very good presence in India with distilleries, manufacturing and bottling plants and sales offices all across the country. To achieve its purpose to deliver products to customers located anywhere in India, ABC Ltd.has established a robust supplier-distribution network covering the whole country. Ithas wide range of brands; major brands are C49, AB12.

C49isABC Ltd.'s legendary flagship brand.Over the decades C49has attained phenomenal success and is now being exported to 10+ countries across the globe. It retains the leadership position in the popular segment year on year, making it one of the most celebrated brands ever from the house of ABC Ltd.

C49 being very popular brand its consumers are prevalent throughout the country and in all segments of society. ABC Ltd. has got Distillery plant in Nashik, which forms the primary source of data for this research work. Due to these reasons C49 is apt brand to analyze reverse logistics practices.

ABC Ltd. has the collection for C49 from areas in and around Nasik. Following pie chart gives the percentage distribution of C49 bottles from the regions around it. Average collection of C49 bottles from these regions is 50 lac units per month (approx.).

4.1 Process Flow

While studying the reverse supply chain, other related parallel reverse supply chains are identified. The focus is on the reverse supply chain of the empty bottles. Main Supplier is the sole contractor to Case Company ABCLtd. for C49 bottles. Collection, Sorting, transportation, washing, crating are some of the processes which are carried out by the Main Supplier. Main Supplier collects bottles from Bottle Collector, who currently collects the entire quantity of C49 bottles from Nasik city and few surrounding villages. Bottle Collector gets the supply from Level 3. Bottle collector sorts the bottles and supply in a gunny bag (216 approx.). One of the bottle collectors is also identified collecting bottles directly from Level 4.The sub-suppliers collect the bottles from various scrap vendors and give the collection to their respective Bottle Collectors. Scrap vendors receive bottles from 'rag-pickers' from whom the sub-suppliers collect the bottles on 'milk-run basis'. Some of the bar-restaurant owners give their collection either to the scrap vendors or to the Sub-suppliers depending on the contract.

Processes	Description
1,2,3	Forward Supply Chain
4,5,6,7,8,9	Reverse Supply Chain
10	Recycling

One of the trends in the Industries is to use the returnable/ reusable containers, which is the widely practiced model in the beverages industry at the global level. Monsreal (2011) reports the analysis in detail with the collection of non –returnable material to the recycling companies

Recycling in this context means use of broken glasses in production of new bottles and other usable products. Broken glass waste is transported to Glass processing industry and then separated according their end use, processing capability and thereby into different colors.

The collection of empty bottles starts with the rag-pickers. They collect the bottles from the house-holds/

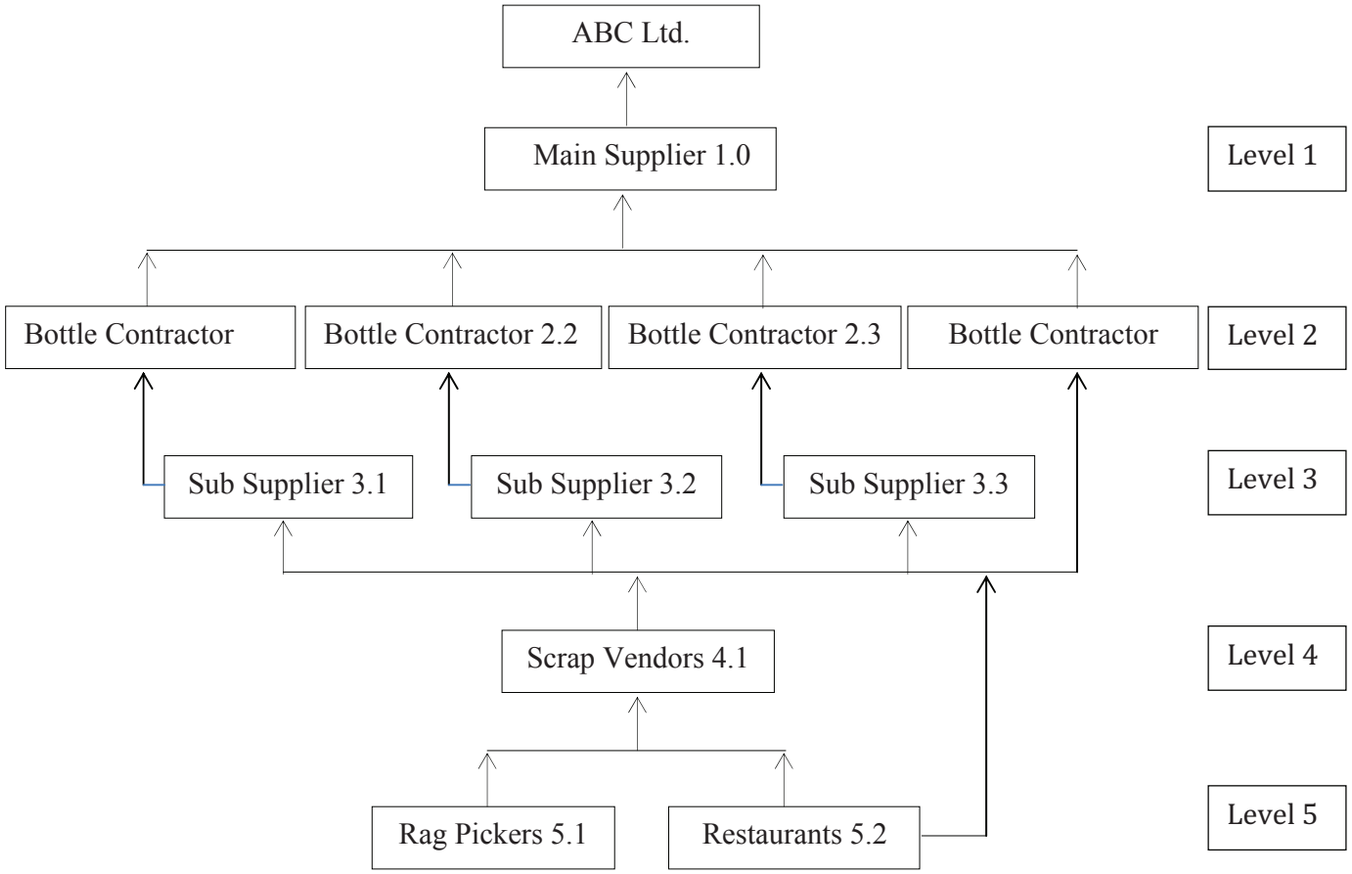

Figure 3: Stakeholders Involved in the Reverse Supply Chain of Empty Liquor Bottles

Figure 4: The existing process of collection of empty liquor bottles across the levels

garbage dumps and collect all kind of scrap which may contain plastics; bottles etc. and further gives their daily collections to the local scrap vendor. The local scrap vendor segregates this daily collection according to the item groups i.e., bottles, plastic, etc. They pack the bottles in a gunny bag and keep them ready for a sub-supplier who collects the bottles from various such scrap vendors allocated in his area through a milk-run approach. The sub-supplier also has a contract with local bars/restaurants for the collection of bottles. The sub-suppliers in turn give his daily collection to the bottle-contractor. Similar such sub-suppliers give their daily collection to each bottle-contractor who operates in his pre-defined area. The Bottles here are segregated brand-wise and packed into a quantity of 216 (approx.) bottles per gunny bag. The bottle contractors in turn supply these segregated bottles

to the main supplier 'M1'.Washing and cleaning of bottles is done at 'M1'. He in turn supplies the bottles in crates to ABC Ltd.

These bottles are used by ABC Ltd. in their regular production for production of'C49 brand bottles'. The reverse logistics process is explained in the above figure.

To identify the various issues in the reverse flow, literature reviews and some research work previously done by authors was studied. Since there does exist any previous research work in Indian Distillery industry, a small survey(appendix 2, questionnaire 1) was taken along with the help of group of experts and couple of academicians. This methodology helped in identifying some of the important issues in reverse logistics of Indian Distillery industry. Some issues like Personnel resource, Limited Forecasting, Lack of Information flow (Mahapatra, S. et al. (2011)) was identified among the twelve barriers of reverse logistics.

5. Interpretative Structural Modeling (ISM)

Interpretive structural modeling leads to structuring the collective knowledge. It applies the graph theory principles to construct a network or directed graph that establishes the complex relationships. Singh et al (2008) say that the technique is based on the Group's judgment and decision whether and how the system elements are linked. They further argue that it is controlled on the relationships foundation and final structure is exploited from the complex set of system variables. So the identification of the variables is the key step in implementing the ISM technique.

5.1 Parameters for ISM

The parameters identified for the present study for the analysis for ISM. These parameters selected through literature review (Sharma et al, 2011, Jayant et al, 2012). They are further authenticated by the expert feedback for the fitment into the supply chain operations of distillery industry.

1. Limited Forecasting:

   In a case company, it has been observed and supported by expert opinions that reverse supply chain flow has a critical challenge of forecasting. Company experiences difficulties in forecasting and planning for reverse supply chain due to the degree of diversity in amount of used bottles collected and processed per month. This directly affects the strategic and operational planning of company.

2. Breakage Losses:

   In reverse supply chain of used bottles, breakage losses are prevalent at each and every stage of operations. Major losses occur at loading-unloading and in house activities at main supplier. Breakage losses are outcome of improper material handling practices and result in significant amount of losses in overall supply chain.

3. Lack of Information flow:

   In the current scenario there is limited information flow between reverse supply chain of a case company, which causes obstacles in planning activities. This also sometimes leads to loss of opportunity due to limited visibility of untapped areas. In addition to that there is no information sharing between forward and reverse supply chain.

4. Transportation Capacity Utilization:

   In a case company, transportation capacity utilization is highly unexplored area. There is lack of standard space utilization model as well as transportation routes. Most of the times transportation vehicles operate on half capacity load and this results in higher expenses on transportation.

5. Unskilled Labor:

   A significant barrier to commercialization of reverse supply chain in distillery industry is use of unskilled labour. Lack of proper training and skill sets lead adoption of improper practices and result in losses at each stage. This hampers the efficiency of each operation and ultimately results in significant lower overall efficiency of reverse supply chain.

6. Responsiveness:

   Responsive supply chain describes how quickly it responds to changes in input data. Due to extreme fluctuations in amount of collection of used bottles, responsiveness is very important in case of reverse supply chain in distillery industry. Responsive supply chain ensures minimal delivery time, cost reduction and accurate forecasting of data.

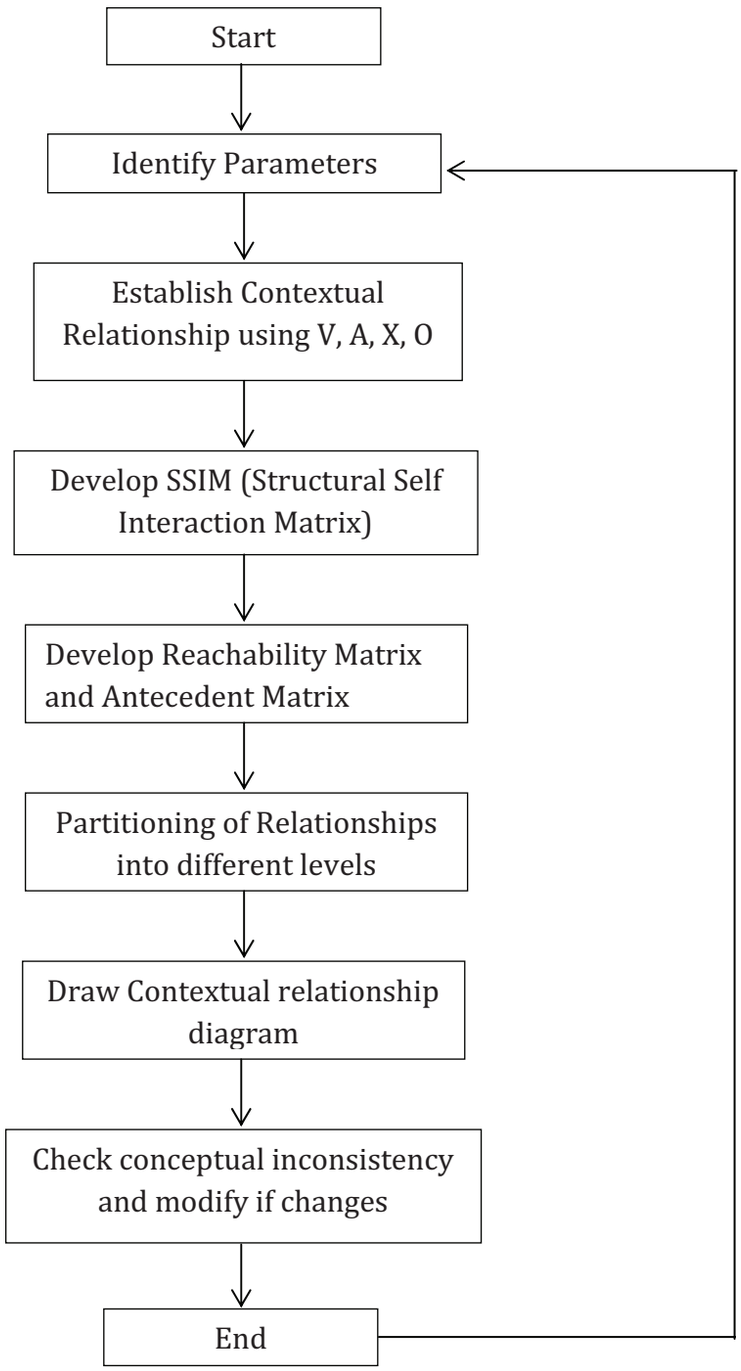

Figure 5: ISM Process flow

Responsiveness is identified out of six variables which are top management commitment, organizational factors, mutual understanding, and flow of information, relationship and decision making (Singh, R. (2011). Similarly transportation Capacity utilization has been identified from the literature. (Fleischmann, M (1997)). Survey and interaction with consultants helped us to identify breakage losses also as one of the major issue in reverse logistics in Indian distillery Industry. It also helped to develop the relationship matrix and construct ISM model.The various steps involved in the ISM technique are (Jyoti et al. (2010):

(1) Identification of elements, which are relevant to the problem or issues, thiscould be done by literature review and through discussions with the experts inthe area of problem being taken.

(2) Establishing a contextual relationship between elements with respect to whichpairs of elements will be examined.

(3) Developing a structural self-interaction matrix (SSIM) of elements, that indicates pairwise relationship between elements of the system

(4) Developing a reachability matrix from the SSIM, and checking the matrix fortransitivity. Transitivity of the contextual relation is a basic assumption in theISM which states that if element A is related to B and B is related to C, then Awill be necessarily related to C.

(5) Partitioning of reachability matrix into different levels.

(6) Based on the relationships given above in the reachability matrix, draw adirected graph (diagraph) and remove transitive links.

(7) Convert the resultant diagraph into an ISM, by replacing element nodes withstatements.

(8) Review the ISM model to check for conceptual inconsistency, and make the necessary modifications.

The above-described steps for the present issue are discussed below:

(a) Structural self-interaction matrix: In order to decide on the contextual relationship, X "leads to" Y relationship is chosen.The symbols used to describe the relationships are as follows:

(1) V: parameter i will lead to parameter j and parameter j will not lead to parameter i.

(2) A: parameter i will not lead to parameter j and parameter j will lead to parameter i.

(3) X: parameters i and j will lead to each other.

(4) O: parameters i and j are unrelated.

The experts involved to decide the type of relationship involve stakeholders in the reverse supply chain in Nasik, two professors from academia. Based on contextual relationships the SSIM is developed in Table 1.

Table 1: Elements/Determinants Considered for ISM Contextual Relationships

Processes	Referred By
Limited forecasting	1
Breakage Losses	2
Lack of Information flow	3
Transportation Capacity Utilization	4
Personnel Resource	5
Responsiveness	6

Table 2: Structured Self Interaction Matrix (SSIM)

	6	5	4	3	2	1
1	V	A	V	A	A	
2	V	A	X	O		
3	V	A	V			
4	X	A				
5	V					
6						

(b) Initial Reachability matrix/ Binary Matrix. The SSIM has been converted into a binary matrix, called theinitial reachability matrix by substituting V, A, X and O by 1 and 0. The substitution of1s and 0s are as per the following rules:(Jyoti et al. (2010)

(1) If the (i, j) entry in the SSIM is V, the (i, j) entry in the reachability matrixbecomes 1 and the (j, i) entry becomes 0.

(2) If the (i, j) entry in the SSIM is A, the (i, j) entry in the reachability matrixbecomes 0 and the (j, i) entry becomes 1.

(3) If the (i, j) entry in the SSIM is X, the (i, j) entry in the reachability matrixbecomes 1 and the (j, i) entry also becomes 1.

(4) If the (i, j) entry in the SSIM is O, the (i, j) entry in the reachability matrixbecomes 0 and the (j, i) entry also becomes 0.

(c) The initial reachability matrix for success factors is shown in Table 3, developed byusing the above rules.

(d) Iteration Table: Here, the reachability and antecedent sets for each factor are found from the reachability matrix. The elements for which the reachability and intersectionsets are same, is the top-level element in the ISM hierarchy. The top-level element of thehierarchy would not help achieve any other element above their own. Once the top-levelelement of the hierarchy is identified, it is separated out from other elements. Then byfollowing the same process, the next level of elements is found.

This iteration is repeated till the levels ofeach factor are found out as shown in below table.

Table 3: Alphanumeric Matrix – Binary Matrix which is called Initial Reachability Matrix

	6	*5*	*4*	*3*	*2*	*1*
1	1	0	1	0	0	1
2	1	0	1	0	1	1
3	1	0	1	1	0	1
4	1	0	1	0	1	0
5	1	1	1	1	1	1
6	1	0	1	0	0	0

Iteration Table

Table 4: 1st Iteration Table to develop ISM hierarchy

Reachability Matrix	*Antecedent Set*	*Intersection Set*	*Level*
6,4,1	1,2,3,5	1	
6,4,2,1	2,4,5	2,4	
6,4,3,1	3,5	3	
6,4,2	1,2,3,4,5,6	2,4,6	
6,5,4,3,2,1	5	5	
6,4	1,2,3,4,5,6	4,6	

Reachability Matrix Ω Antecedent Set = Reachability Matrix -> Level 1

Table 5: Identification of Level 1 elements in 1st Iteration Table

Reachability Matrix	*Antecedent Set*	*Intersection Set*	*Level*
6,4,1	1,2,3,5	1	
6,4,2,1	2,4,5	2,4	
6,4,3,1	3,5	3	
6,4,2	1,2,3,4,5,6	2,4,6	Level 1
6,5,4,3,2,1	5	5	
6,4	1,2,3,4,5,6	4,6	Level 1

2nd Iteration:

Table 6: 2nd Iteration Table to develop ISM hierarchy

Reachability Matrix	*Antecedent Set*	*Intersection Set*	*Level*
1	1,2,3,5	1	
2,1	2,5	2,4	
3,1	3,5	3	
5,4,2,1	5	5	

Reachability Matrix Ω Antecedent Set = Reachability Matrix -> Level 2

Table 7: Identification of Level 2 elements in 2nd Iteration Table

Reachability Matrix	*Antecedent Set*	*Intersection Set*	*Level*
1	1,2,3,5	1	Level 2
2,1	2,5	2,4	
3,1	3,5	3	
5,4,2,1	5	5	

3rd Iteration:

Table 8: 3rd Iteration Table to develop ISM hierarchy

Reachability Matrix	*Antecedent Set*	*Intersection Set*	*Level*
2	2,4,5	2	
3	3,5	3	
5,3,2	5	5	

Reachability Matrix Ω Antecedent Set = Reachability Matrix -> Level 3

Table 9: Identification of Level 3 elements in 3rd Iteration Table

Reachability Matrix	*Antecedent Set*	*Intersection Set*	*Level*
2	2,4,5	2	Level 3
3	3,5	3	Level 3
5,3,2	5	5	

4th Iteration:

Table 10: 4th Iteration Table to Identify Level 3 Elements

Reachability Matrix	*Antecedent Set*	*Intersection Set*	*Level*
5	5	5	Level 4

5.2 Summary

ISM depicts the factors affecting reverse logistics process, their priority and inter-relationship between them. The relationship among the variables shows unskilled labor as a major problem area in distillery industry. This was also identified during survey with stakeholders involved in the reverse flow. Interviews using questionnaires were conducted with the stakeholders across the levels in the reverse supply chain. Unskilled labor drives other factors such as breakage losses, lack of information flow. It is identified that collaboration among the suppliers is missing. Each supplier works independently and followsits own process. This lack of information leads to limited forecasting. The bottle collector does not have proper information about the touch points available for collection. Since the operation is completely independent, proper forecasting of old bottles is very poor. This increases the responsiveness of the reverse supply and transportation capacity utilization. It directly affects the case company to properly analyze and forecast the exact return from the reverse chain. In addition to this, experts were also consulted for their opinion which helped us to identify that unskilled labor is major driver andfurther drill down to various processes where labors were involved.

Table 11: Table showing the Levels and interrelationships between elements

Process	*Reachability Matrix*	*Antecedent Set*	*Intersection Set*	*Level*
Limited forecasting	6,4,1	1,2,3,5	1	Level 2
Breakage Losses	6,4,2,1	2,4,5	2,4	Level 3
Lack of Information flow	6,4,3,1	3,5	3	Level 3
Transportation Capacity Utilization	6,4,2	1,2,3,4,5,6	2,4,6	Level 1
Personnel Resource	6,5,4,3,2,1	5	5	Level 4
Responsiveness	6,4	1,2,3,4,5,6	4,6	Level 1

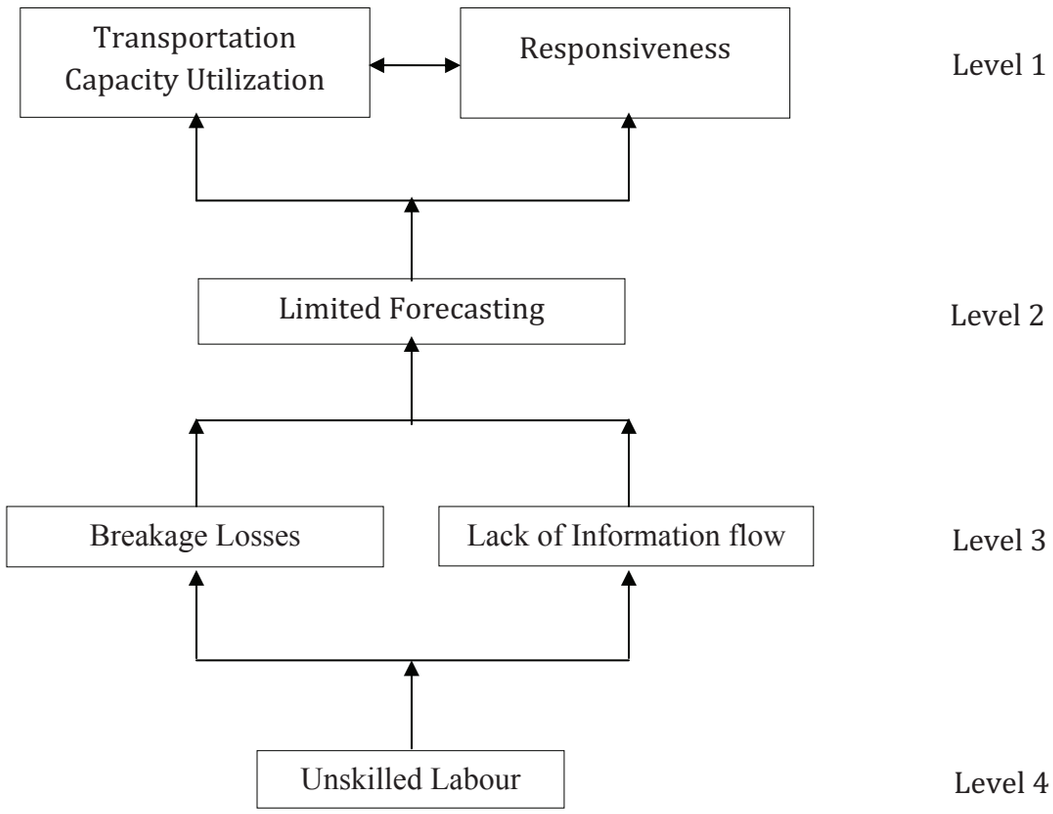

Figure 6: Inter Relationships Between Elements Considered for ISM

6. Conclusion and Discussion

The research work reported in reverse logistics in distillery industry has been limited to packaging, facility location, and recycling. In addition to that, in India no substantial research has been carried out on reverse logistics practices in this industry. This paper is one of the first efforts to report the practices through a structured approach of analysis, though the industry is completely fragmented. The paper discusses a real life case study of Indian distillery firm dealing with reverse logistics practices and concentrated on key strategic issues that a firm may need to consider to be successful in its reverse logistics. It is evident from the case study that, reverse logistics practices in this industry are in nascent stage and companies are not fully availing the benefits of reverse logistics. The segment of the analysis has been restricted to track the returnable container movements in the reverse supply chains.

One of the major shortfalls of reverse logistics practices in this industry is breakage loss at various stages of reverse supply chain. In distillery industry the whole supply chain being unorganized, recovery of bottles is decentralized in the sense that each supply chain member is self-serving. A better supply chain can be constructed with centralized supply chain, in which the objective is to maximize the business value using some supply chain management initiatives such as collaborative planning, forecasting, and transportation. After the system performance is improved, supply chain partners can share enhanced profits.The major contribution of this research paper lies in identifying dimensions of reverse logistics in distillery industry in Indian context and developing a relationship among them with the help of Interpretive Structural Modeling(ISM). The output states that unskilled labor is the root cause of losses in reverse logistics practices in distillery industry. Using the output from ISM and based on the Questionnaire, we have narrowed down to the processes where major losses occur.

7. Synthesis of case Findings and ISM

Case findings and ISM output appended by questionnaire based data collection resulted in proving that breakage losses can be classified as loading-unloading, segregating, washing, crating and transportation losses, out of which sorting and washing are major contributors. Our findings demonstrate that operational parameters tend to support each other – an improvement in one parameter at one stage of reverse supply chain leads to improvements in overall supply chain. Thus our study suggests that if a company concentrates on washing and segregating processes overall recovery of bottles will increase significantly.

8. Managerial Implications

In addition to the literature contribution, this study has provided new insights to unexplored field of reverse logistics in distillery industry. An important area of managerial practices to which this study has also contributed in addition to reverse supply chain is recommendation on integration of forward and reverse supply chain. Managers can derive cost benefit analysis based on identified parameters and then go ahead with investments in any of the suggested areas of improvement. Profitability can be achieved by proper management of identified critical operations in reverse supply chain.

9. Limitations

The limitation of our paper lies on the fact of representation comes from a single company and its supply chain; there is a fear of generalization on extending the findings to whole distillery industry Nevertheless, the selected company is the major manufacturer in the field occupying significant proportion of market share in India. Compared to other smaller manufacturers, they are more capable in implementing reverse logistics with the right resources. Although some of our observations may be specific to the operations of the surveyed case company, it is assumed that their current practices are to a certain extent representative of the trend of reverse logistics implementation in the distillery industry.

Major limitation of this case study is that, case company has some reservations in revealing some of the technical details and information of entities involved, which restricted data access. Linking this study with other approaches especially those that exclusively consider economical and financial factors is scope for further study.

10. Further Scope

The present study is restricted toa single company and its reverse supply chain; there is an acute need for more analysis of the other players in distillery industry. A good future research can be carried out involving large-scale field study or survey across many companies in distillery industries. The limited extent of market research till date and its incomplete understanding have in variety of unexplored profitability opportunities inherent in it. The research also has some important extensions, such as :

identify future trends and key factors in reverse logistics, such as collaboration between suppliers at various stages, consolidation, and elimination of intermediaries, build theoretical frameworks in reverse logistics, and provide coherent guidelines and recommendations to industry. In the current scenario, there is lack of information sharing between forward and reverse supply chains. This puts restriction on the visibility for recovery of bottles/ containers which otherwise would have happened based on sales in particular area. A model can be developed collaborating forward and reverse supply chains in distillery industry. This case study concentrates on only breakage losses; further scope consists of detailed study of other outcomes of Interpretative Structural Modeling (ISM). Another area of work can be on transportation model for bottle suppliers and bottle collectors to minimize cost.

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