PERFORMANCE MEASUREMENT AND EFFECTIVENESS OF SUPPLY CHAIN: A STUDY OF SELECT INDIAN COMPANIES

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By

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CANDIDATE'S DECLARATION

I, Gurmail Singh, hereby declare that the thesis entitled "PERFORMANCE MEASUREMENT AND EFFECTIVENESS OF SUPPLY CHAIN: A STUDY OF SELECT INDIAN COMPANIES," submitted to Lovely Professional University, Phagwara, in partial fulfillment of the requirement for the award of the degree of Doctor of Philosophy in Management is the original work carried out by me under the supervision of Dr. Amit Dutt. No part of the thesis has been formed the basis for the award of any degree or diploma at any other university or institute.

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Abstract

'Supply Chain Management' is an efficient means of addressing procurement problems, customer support, market flow, and delivery. The outcomes are decreases running costs, improved product volumes, creating win-win and sustainable ties with vendors.

One of the most significant paradigm changes in contemporary business strategy is that individual firms no longer compete as independent organizations, but rather as supply chains. Organizations worldwide have taken the idea of supply chain management as essential and even crucial to their enterprise. The concept of a collaborative supply chain is to achieve a comparative edge by enhancing total efficiency by measuring a comprehensive view of the supply chain. However, the philosophy of contemporary success assessment is somewhat fragmented and does not help this notion. This thesis therefore introduces and implements an integrated supply chain performance measurement system that offers a more comprehensive solution to the analysis of supply chain performance measurement by integrating both supply chain macro processes and decision-making layers. The suggested framework for assessing the efficiency and efficacy of the supply chain will also offer a good picture of the whole supply chain structure.

Next, the literature on success assessment systems and performance Metrics in supply chain management can build a conceptual model. The suggested approach will be discussed in the model and tested by 50 companies from 10 separate Indian manufacturing sectors. Different Performance Indicators are identified to measure the efficiency and effectiveness of the supply chain. The impact of transportation on performance indicators and relationships between net sales and performance indicators along with the relationship of Net sales and Transportation expenses are also measured .The Data Envelopment Analyses , Multiple Regression and Correlation is used as statistical tool in the study .In the present research proposed a DEA-based method to calculating the relative efficiency of supply chain networks using costs as input and key value indicators as output. Remembering that this technique is not meant to identify the optimal proportion of initial allocations. It depends on the option of the better percentage of alternatives. Our process may be expected to be easier to use. In other words, the theoretical benefits of pooling in order to minimise the disruption of supply chain processes have already been understood in most sectors. The

analysis of main performance metrics as inputs and outputs reinforces our basic high cash flow theories in terms of manufacturing costs, shipping costs, fuel costs, labour costs, raw materials and sale costs, which play a critical role in determining the productivity of supply chains. The analyses claimed that the DEA is a "rational benchmarking" tool that tests outcomes in a variety of ways and helps businesses to review their findings on performance, quality effectiveness and productivity. Finally, the results indicate that the cable manufacturing industry, the tyre manufacturing sector, has the most powerful and profitable supply chain. It can be shown that the organization is devoted to the aim of rising net income and allowing full use of funds. Expenditures are not overdrawn and the company's entire capability is planned to achieve peak efficiency.

Further Ten separate equations from ten different industries accurately explain the influence of Transportation costs on various efficiency indicators. The transport variable shows the important and non-significant influence on the constant, the interaction between the dependent variable and the independent variables is displayed, and the performance metrics are shown in the value. The equation definition suggests that the management of the enterprise should be mutually prepared with different variables that should affect or establish a coherent arrangement between dependent and independent variables. Using the equation, the transport variables that influence the (Dependent variable) accessible for study can conveniently reflect the supply chain output of the sector. While measuring the impact of the various key performance metrics on net income. Various variables also identified strong multi-collinearity values represented by the high VIF, the meaning is excluded from the study, and the ten different equations have not been impacted by the individual variables. The connection between the key success metrics is determined by net sales of operating output and the number of workers for total results, and firms who operate together typically prefer to perceive collective performance more strongly.

It can be Concluded that the philosophy and management of the supply chain is certainly an approach that can improve the market process in the industrial field. In particular, given that supply chain management must optimise the competitiveness and performance of the production industry, the elements of the chain and their role must be taken into consideration in the overall progress of the supply chain. It is also worth noting that the successful application of the Supply Chain Management concept is essentially dependent on a well-identified partnership between the business strategy and the value of the customer. The research model was developed to provide an

adequate demonstration of the possibilities for the usage of modelling and simulation processes in manufacturing companies. This study also leads to a modern paradigm of supply chain output assessment and awareness on the productivity of supply chains in various industries. Study often impacts businesses by training decision-makers to make political, tactical and financial choices on macro supply chain systems. The findings of the study often reveal parallels and disparities in the efficiency of the supply chain. Besides, the potential scope of the research is provided for both educational and realistic use.

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Gurmail Singh

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Introduction

1.1 Introduction

Globalisation had a tremendous impact on manufacturing sectors, both at the national and international level. Due to globalisation, the new markets have developed and increased competitiveness. Modernisation has also driven the consumers to expect more from suppliers with regard to improvement in efficiency, serviceability and flexibility while retaining competitive prices. As a result, companies are now trying to maintain costs, quality, technologies, productivity, efficiency and other strategic advantages as a tactic to be followed in a globally competitive environment.

Supply Chain Management is a significant multidisciplinary concept of modern business management and research. It increases corporate efficiency and sustainability through a new theory in the business management of the sustainable competition. Supply chain management has become crucial for companies that supply the products and services to end-customers. The emphasis is on the various stakeholder groups and their relationships, which is of enormous importance to all manufacturing sectors in terms of size or whether they supply goods and services.

Although, the concept of supply chain performance assessment, as an approach to evaluate all operation performance in the supply chain, may stimulate quality improvement. However connecting performance metrics did not only accomplish this quality enhancement of supply chain to particular improvement initiatives but also helped to accelerate efficiency against significant competitive results by win-win solutions for producing rewards and value-added across the chain. Performance assessment in supply chain management is a quickly increasing multi-criteria decision-making challenge due to the vast number of factors influencing decision-making. However, the correct choice of performance measurement factor is critical to companies' success and competitiveness in the age of globalisation. (Patel, 2005)

1.1.1 Concept of Supply Chain and Its Origin

Concept of Supply Chain

A supply chain concept is commonly considered the positioning of businesses that sell goods or services and bring the same to the local or global market(A, 2012). The supply chain consists of producers, vendors, carriers, storage facilities, distributors, dealers and end consumers. Any commodity exchanged to the market for consumer goods undergoes several consecutive transactions from the manufacturing industry to the consumer market in its progression from raw materials to finished items(Sambrani & Pol, 2017). For example, when the end customer orders a bottle of Soft Beverage, the consumer would not buy from the soft beverage manufacturer directly but through a middle man (distributor or retailer) and the commodity travelled through many stakeholders between manufacturing organisations and consumer markets on the circulation of soft beverage manufacturer –> wholesaler –> retailer –> end-user –> through a series of transactions(Tan, 2001)(Sharma, 2018).

Generally, an optimised model of the supply chain will include three intertwined flows: resource flows (purchase, processing and dispersion), digital information flows and fiscal flows (cash transactions to distributors and sub-distributors for the products and assistance and the payment by the customer to a retailer for the final product)(MEENAKUMARI, 2009)(Dey et al., 2019). Manual distribution was a crucial component of supply chains, knowledge and financial elements are almost as important as physical flow in specific supply chains. Besides, the role of information inputs in supply chain processes is also vital along with the supply chain mechanism for new goods (components, prototypes etc.)(Seiler, 2016). For example, the supply chain system for new goods involves robust synchronisation of conceptual inputs (design) with physical inputs (components, prototypes etc.)(Kumari, 2017).

The flow of commodity or service streams in the supply chain is not just forwarded from the first supplier to the final consumer; it may flow back through the supply chain for several purposes, such as servicing or maintenance, re-manufacturing, recycle or disposal. The backward chain will play a vital role in various fields such as consumer loyalty, recycling and environmental sustainability. Reverse logistics relates

to a typical structure or skill sets aimed at transporting goods in the backward direction in the supply chain (i.e. from customer to distributor or manufacturer), and associated tasks can involve managing inventory returns, recycle, reuse of resources, disposal of waste, renovation or reprocessing(Asare et al., 2016)(Pullinger, 1933).

Eventually, it should be remembered that the supply chain has an extensive network range of distributors(Petersen et al., 2005). There are a wide variety of related supply chain arrangements. Some supply chains are relatively quick and bare, like a small grocery store that buys vegetables straight from the producer, and some are complex and tedious like a fish cannery that comes from the fisherman and sells the goods across a distribution network. Many businesses and manufacturing sectors managed the inventory and communication movements throughout the production network, both upstream and downstream, between various vendors, producers and distributors(P, 2017).

There are four significant criteria's in Supply Chain Concepts:

Activity	**Definition**	**Concepts**
Management activity	Supply Chain Management prepared, executed, empowered and successfully regulated all operations engaged in delivering products and resources from the primary distributor to the ultimate consumer. The fundamental concepts of management are Scheduling, Organisation, execution, inspiration and power(Lambert & Enz, 2017)	Scheduling, organisation, execution, inspiration and power
Logistics activity	Supply Chain Management prepared, executed, empowered and successfully regulated all operations engaged in delivering products and resources from the first distributor to the ultimate consumer. (Thakkar et al., 2009)	Carriage, processing, storage
Objectives activity	Supply Chain Management involves various value-added processes designed to fulfil consumer needs, create long-term partnerships, develop loyalty between supply chain stakeholders and gain a sustainable competitive edge. (Muhammad Babar, 2012)	value, consumer demands, faith, connections

Components activity	Supply Chain Management includes vendors, producers, warehouses, warehouses and other intermediaries participating in the transportation of goods and services from production to the end of use. (Badiezadeh et al., 2018)	Providers, fabricators, storage facilities, shops

1.1.2 Origin and Evolution of Supply Chain Management

The distribution network has always been the backbone of companies, bringing innovative products and ensuring that manufactured commodities are shipped to consumers on schedule. The design of supply chains has developed over time, became a dynamic network of different stakeholders that need to work together successfully(Sahay & Mohan, 2003).

It is believed that supply chain management originated in 1911, firstly referred by Frederick Taylor in "The Principles of Scientific Management". The Supply Chain actual boost up during the time of World War II to address the problem of the complex requirement of army logistics(Patel, 2005). Later on, logistics analysis turned to organise to enhance labour-intensive procedures and allow full use of resources(Seth et al., 2006)(Tan, 2001).

However, the sharing of technology and expertise with customers or suppliers was deemed too risky and intolerable. The little emphasis seems to had been located on a collaborative and strategic buyer-supplier partnership. The procurement strategy was also usually thought to be a manufacturing facility, and supervisors paid restricted attention to issues related to purchases(Siddhey, 2015)(Chan, 2011).

In the 70s, 'Production Resource Planning was initiated, and administrators understood the effect of the massive work in progress on manufacturing expenses, efficiency, innovative product design and lead-time delivery. Manufacturers used modern materials control principles to boost efficiency within the company's premises. 'Just-in-Time Manufacturing Processes' was also initiated by Toyota manufacturing Organisation at the end of the 1970s, and developed a manufacturing ideology that was one of the critical elements of management solutions including the ideas of Complete Quality Assurance, Nil Inventory Production Services, Nick of

Moment, Equipment as required, differences of virtually the same core idea of Just in Time. The definition of Just In Time' was described comprehensively as the development and distribution of finished products in time for sale, of sub-assemblies just in time for assembly in finished goods, of parts made just in time for transformation into sub-assemblies and of material bought just in time for production(BALASUBRAMANIAM O A, 2016). The 'Just In Time' ideology was aimed at product or service elegance, system consistency and operational consistency, the simultaneity of production and consumption, rapid material flow, versatility of the workforce, and supply(Rajagopal et al., 2009)(Dani, 2011). The Manufacturing and Supply Chain process drew the attention of the whole developing nations at that time.

Intense market rivalry in the 1980s pressured the Supply Chain Network of global companies to deliver low cost, high quality, and more versatile design goods. Producers used manufacturing Units and other control initiatives to increase output performance, cycle time and consistency. The revolutionary management principle of 'Just in Time' was accompanied by another management theory of 'Total quality management' to enhance the supply chain performance(Rienkhemaniyom & Pazhani, 2015)(Gandhi, 2011). Total quality control approach to doing business aims to organise a company's productivity by continually enhancing the quality of its goods, facilities, people, processes and environments. In the late 80s, the consumer-oriented management framework was aimed to fulfil or surpass customer standards by delivering defect-free products or services for the first time, on schedule, all the time. While the primary aim was to please customer needs, TQM acknowledges that it was impossible to satisfy customer needs without meeting internal customers' criteria (R. Singh et al., 2014)(Choon Tan, Keah, Vijay R Kannan, 1998). It was also aimed to reach or surpass the needs of both internal and external consumers. Organisations had begun to organise consistency as a strategic tool. Improved efficiency contributes to improved production and performance and improves its strategic advantage in the sector(P, 2017).

The struggle for innovation in Total Quality Assurance was a never-ending task. Consequently, in the 90s, when the original expectations were reached, newer and stronger targets are set for the supply chain's performance. Consistently trying to

achieve gradual changes was the foundation of total quality management(Kumari, 2017). It was attempting the drive for changes involved in competing for cooperation and engagement of all leading distributors, including administrators, staff, vendors and consumers. Agreements with manufacturers were also be established. Total Quality Management's fundamental concepts extended to every entity, whether production or service, public or private. Total Quality Management promoted the teamwork by team action between staff and agencies, and quality assurance becomes everyone's obligation(Sahay & Mohan, 2003)(Galt & Dale, 1991).

At the end of the 90s Supply Chain Management was built from technologies such as Just In Time and Total Quality. It was used as an indicator of revolutionary and cumulative improvement, sometimes defined as originating from internal systems to increase overall performance(Song & Sun, 2016). The emphasis was not just on improving companies' internal productivity but has also been expanded to incorporate strategies of waste mitigation and value-added across the whole supply chain. Supply Chain Management had changed its attention from internal framework to external linkages and procedures and was based on the engagement with the manufacturers and the outer world, through economic growth and mutual learning. It was seen as a series of activities aimed at managing and organising the entire supply chain, from raw material manufacturers to end-users, which was established greater coordination by cooperation around the entire supply chain(Martha C.Cooper, 2010).

This systematic method of supply chain measurement was related to the efficient management of interfaces between all the organisations concerned and the convergence of both upwards and downwards processes. This robust method focuses on collaboration and integration, which was near related to establishing more productive and longer-term partnerships between consumers and sellers(Chopra & Meindl, 2007).

This modern form of partnerships was gradually used to allow the efficient use of resources across the whole supply chain. In particular, they may also contribute to greater accountability in transactions, improved loyalty and dedication. Supply Chain Management has been effective in providing substantial performance enhancements across the entire supply chain. Information may be more effectively exchanged and

information defined, collected and distributed through supply chain organisations (Ambe, 2014). This has led to a new acceptance of collaboration methods and inter-organisational partnerships to gain substantial mutual benefits, including the exchange of expertise, knowledge, learning and other vital assets(Baymout, 2015).

Hence, supply chain management can also be viewed as a revolutionary concept focused on Just in Time and Overall Quality Management principles. Moreover, inside the organisations, the cumulative growth had been traced back to sourcing specialists, shipping and logistics experts who have brought the idea of inventory handling a move further into integrating physical storage and transport functions(Felea & Albăstroiu, 2013).

It is worth noting that supply chain management was dynamic and had proven to be challenging to incorporate. It has been defined as a multi-factor mechanism that relies on close and long-term relationships between institutions. Its achievement was related to the demanding, and complex growth of a modern community focused on collaborative learning, increased openness and confidence. The biggest challenge for supply chain management was to preserve and continually enhance the alignment and compatibility of all communications and frameworks to improve the overall performance of the supply chain, with greater dependency on distributors and the growing emergence of outsourcing and fierce competition. (Lambert & Enz, 2017).

1.1.3 Definition of Supply Chain Management

Definitions

Listed below are specific and significant scholarly definitions of Supply Chain Management to enhance and improve the understanding of the concept :

"Supply Chain Management (SCM) is the practice of organising, executing and managing supply chain processes to fulfil consumer needs as effectively as possible. Supply chain management involves all movements and storage of raw materials, work-in-process inventory and finished goods from the point of origin to the point of consumption.." (Felea & Albăstroiu, 2013) (Seth et al., 2006)

"Supply chain management includes the management of products/supply from the supply of essential raw materials to the finished product (and possible recycling and reuse). Supply Chain Management reflects on how businesses leverage the systems, innovations and capabilities of their vendors to improve their strategic edge..". (Cho et al., 2012)(Lu. Dawei, 1998).

"Supply Chain as life-cycle processes requiring physical products, knowledge and financial flows, the purpose of which is to fulfil the demands of end-users for products and services from different integrated suppliers." (Ayers., 2001)(Turner et al., 2018)

"Supply Chain is a group comprising producers, vendors, dealers, retailers and shipping, knowledge and other wholesalers involved in the supply of products to customers. The Supply Chain involves both foreign and internal associates for the organisation." (Chow et al., 1999)(Beamon, 1999).

"Supply chain (sometimes named supply chain or demand chain) management consists of businesses working together to maximise strategic positioning and boost operational performance. The supply chain partnership represents a strategic decision for each organisation concerned. Supply Chain Approach is a channel structure focused on known dependence and partnership management. Supply chain operations include management processes that include functional areas within individual companies and connect trading partners and consumers across organisational boundaries." (Cooper, 1998).

"Supply Chain Management is the systematic, strategic alignment of conventional business functions and tactics through these business functions within a single organisation and across the supply chain to maximise the long-term success of specific businesses and the overall supply chain ." (Bernard J. LaLonde, 1996).

Characteristics of Supply Chain Management

In accordance with definitions of supply chain management and prior discussion of the concept, the following six unique characteristics are discussed for effective supply chains(Gandhi, 2011)(Angappa Gunasekaran & Kobu, 2007):

1. Agility: Flexibility has always been essential to supply chains. This characteristic must be reduced to next-generation supply chains since they should react to unexpected operational climate shifts. Any sort of unforeseeable and catastrophic event, such as a natural catastrophe, medical crisis, political or economic turmoil, has the power to overturn supply chains(Tavassoli & Saen, 2019)(Zulqurnain Ali and Bi Gongbing, 2018). However, where organisation are versatile, have a robust risk management programme, have smart decision support structures and are powered by demand, the next generation supply chains will succeed in even the most demanding and competitive environments.

2. **Delivery**: Pace is the foundation of the new generation of supply chains. It would be essential for supply chains to adapt to requirements as soon as possible to ensure rapid distribution for consumers and other critical stakeholders of the supply chain(Wong et al., 2005). Companies would choose to supply goods as quickly as required and therefore want to transfer more stock in a shorter amount of time.

3.**Global adaptability**: Businesses might regulate the distribution of their goods locally. Thanks to the Internet, supply chains may be extended worldwide. At the same time, production processes will respond at the local level. Next-generation supply chains have to know how to build global centres that are not only successful but can also supply goods locally without having to ship them across the globe with only a few orders(C. S. Singh et al., 2019)(Bagchi et al., 2005).

4. **Inventory:** The key to effective inventory control is that you can have precisely the correct amount of stock in your warehouse. Keeping too many items can result in outdated and unsold stock, while too few will almost always ensure that you do not have enough stock when it is desperately required. This calls for inventories to be optimised such that the stock will still satisfy demand(Sambrani & Pol, 2017). The quantity of stock must be determined by existing market behaviour, purchasing patterns and local demand for the commodity. One approach to optimising inventory across any supply chain is integrating various equipment, such as commercial measuring scales and truck scales. Innovative shipping methods could also be utilised to speed up the delivery method(Quayle, 2003).

5 **Strategy:** Supply chains can be vigilant in the event of instability, unexpected shifts or future disasters. Using data modelling and research, an organisation obtained perspectives and information about how to plan for specific incidents. The strategy is the main component of the successful supply chain(Wong et al., 2005).

6. **Innovativeness:** Innovation is accepted across any supply chain, by integrating the new technologies into the supply chains, organisation guarantee that business remains successful and deliver outstanding services at all levels. Modifications can be minor or significant, but the organisation must continually strive to integrate new methods through multiple roles and supply chain processes(Yusuf et al., 2004).

1.1.4 Types of Supply Chain

The supply chain comprises multiple companies, downstream and upstream, as well as the potential customer. (Felea & Albăstroiu, 2013) described the supply chain as a set of three or more entities (organisations or individuals) directly involved in the upstream and downstream flow of goods, facilities, funds and information from origin to consumer(P, 2017). There are three forms of the supply chain which are discussed as under :

1 **) Direct distribution network:**

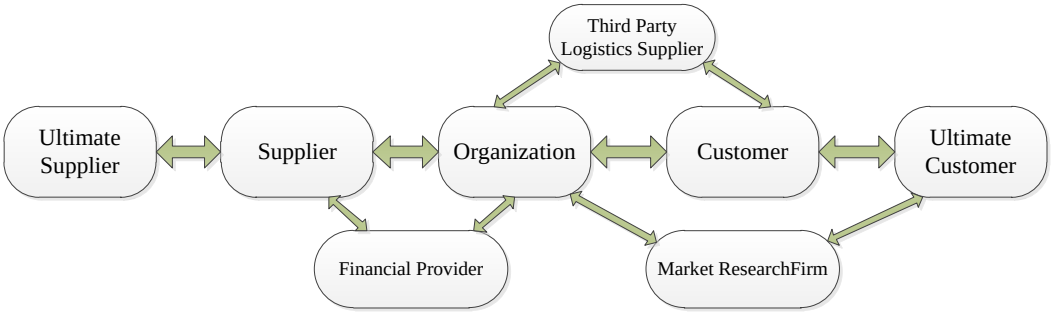
A supply chain is a group of 3 or more entities directly connected to the customer by another transmission and distribution flow.

2) **Expanded supply chain**

The expanded supply chain comprises the manufacturer of the actual manufacturer and the actual customer, connected to one or more goods, supplies, financial and knowledge upstream and downstream flows.

3) **The actual supply chain**

Both businesses participating in upstream and offshore inventory transfers, supplies, operations, and knowledge transfer from the original producers to the final users have an overall supply chain.



1.1.5 Importance of Supply Chain Management

Supply Chain Management helps companies reduce their intrinsic costs when purchasing raw materials and supplying goods or services. By introducing supply chain management strategies, organisations can reduce waste and operating expenses. some of the advantages of Supply Chain Management have been discussed below(Gandhi, 2011)(Cho et al., 2012)(Cho et al., 2012)(Álvarez-Rodríguez et al., 2020):

1. **Effective Working**: Starting a private company might just be a struggle, but if the company can implement product innovation tactics, advanced distribution and supply chain management, it would forecast demand and function accordingly. Supply chain management plays a significant role in boosting the business and responding more efficiently to the fluctuating economy(Quayle, 2003).

2. **Buffer Stock**: In every manufacturing business, there is almost always variability in consumer demand. That indicates that the companies must handle their stocks in a manner that minimises carrying expenses, while at the same time offering ample versatility to satisfy consumer demand. If a stock is too low, the organisation might have to work extra hours to produce more products(Asare et al., 2016). The organisation can even miss the revenue if consumers are eager to wait for goods to rolled out. As a consequence, the consumer might buy some other product. One

approach to fix this problem is to invest in a practical supply chain management framework. Some of these frameworks have product reserve levels to help the organisation remain within its budget and resources.

3. **Transportation Preferences:** When IT-based companies continue to expand, consumers have more ways to buy goods than ever before. If a business did not have a robust transportation schedule in action, the organisation would lose clients. Organisation's transportation solutions simply satisfy the needs of the market. Everyday items or huge segments shipped by the organisation and effective transporting of the goods quickly and efficiently is pivotal to business development (MR. Deepak Bhimrao Magar, 2016)(Ubale, 2011). Supply Chain Management solutions always helped the organisation to decide the right way of transporting the goods, and at the same time reducing the costs.

4. **Reducing Risk**: Risk assessment is a core feature for any market owner and various Supply Chain Management Systems. Regardless of the consistency of goods' enforcement, investing the resources into a supply chain management framework can help the manufacturing Sector reduce the risks(Arend & Wisner, 2005).

5. **Impact on Demand**: Owner of Organization can forecast demand for their manufactured goods using supply chain techniques, advanced transportation system and product innovation strategies. The supply chain in the present time must respond to shorter material life cycles, fluctuating fiscal policies and developing markets(Kurien & Qureshi, 2011). To ensure that the organisation reacts correctly to increases in demand, the supply chain management is the main element.

6. **The flexibility of Business**: Another significant advantage of centralised supply chain management is enhanced agility. Strong supply chain alignment allows management organisational stability to react quickly to various influential factors, such as competition and adoption in customer's demand(FELEA & ALBĂSTROIU, 2009). Due to an effective Supply Chain Management organisation, they may collect information across their supply chains, allowing them to be broadly informed of what their competitors were doing and planned according to months in advance.

7. **Reduction of Waste**: Organisations around the country are anxious about the amount of waste they generate. They are searching for innovative approaches to reduce or minimise the volume of waste that their organisation creates regularly. Once it relates to supply chain management, lean practices will help find waste improvement places (Dharmapala & Dept., 2008)(Masoumi et al., 2019).

8. **Reducing of Delays in Delivery**: Many supply chains are troubled with on-time delivery of goods that may eventually contribute to bad relation with customer and a loss of revenue. If business continually trying to contend with late orders from suppliers, hold-ups on manufacturing lines, or technical failures, the company have to introduce a supply chain management framework to prevent this away(Suresh, 2018)(Thakkar et al., 2009).

9. **Customer Satisfaction**: With the aid of the distribution network and supply chain technologies, it has become simpler than ever to get the goods in the hands of actual and loyal consumers. If the organisation engage in supply chain management, it can effectively monitor the orders, goods and supplies on the supply side and satisfy the customer with the on-time delivery of the goods(Pasutham, 2012)(Siddhey, 2015).

1.1.6 Supply Chain Practices

Supply Chain Management practises having been described as the collection of activities performed by a company to facilitate its supply chain(R. Singh et al., 2014). Best Supply Chain practises strategies that affect the whole supply chain, its components or main processes affected by contextual aspects such as the nature of the business, the scope of the organisation, its place in the supply chain, the type and duration of the supply chain. The literature witnessed the focus of the Supply Chain practice at the end of 95. Over the span 1995-2002, researchers and scholars concentrated on: segment management, logistics postponement, output postponement, optimisation and customisation of inventory turnaround, gross margin and benefit, average in-stock inventory, inventory calculation capacity, and collective activities to accomplish a shared objective(Rajagopal et al., 2009). During the supply chain evolution, the key emphasis was on inventory and its productive management about, logistics and manufacturing. Nowadays, four main supply chain dimensions have

been commonly followed throughout the Supply Chain Practices(Rajagopal et al., 2009):

1. **Strategy:** It can be described as a set of dynamic, interconnected decisions to be taken in reposition one's business in a complex environment. The strategy is thus defined as the ultimate action or solution to be adopted to accomplish its business goals and objectives. Today's market environment approaches were defined by independent companies who aim to conquer all rivals and focus exclusively on order-winning requirements that are product-based. Instead of its organisation required a focus on the coordinated control of the movement of physical commodities, relevant knowledge and allied resources from the production source. Supply Chain Management also encompasses the whole spectrum of the decision-making framework(Trkman et al., 2010). Consequently, by placing supply chain management at the centre of decision-making in the boardroom and uniting business and supply chain priorities, businesses improved sustainability, accelerated growth and significantly increased the shareholder value. The challenge was to put the supply chain to a more strategic stage in the organisation in order not just to be satisfied with management, but to mark a competitive market effect(Huan et al., 2004).

2. **Supply Chain Alignment:** The Supply Chain Strategy cannot be fully matched with the overall company strategy based on confidence and knowledge exchange to efficiently respond to consumer demand through exclusive and customised services(Sahay & Mohan, 2003). The secret to effective alignment to the customer's demand is that when the necessary supply chain services collapse, its performance will not match up to its consumers' standards or its competitors' quality of service. The supply chain aligned itself in both business units and supply chain associates and shared the same results, synchronised behaviour, and reduced demand management(Kohli & Jensen, 2010).

3. **Management of Stock:** Inventory control has gained substantial recognition over the years. Stock Handlers offer various explanations for keeping or not holding the product. Some of the critical factors for maintaining inventories by Indian organisations include: enhancing customer service; hedging against market increases and contingencies; pursuing economies of development, procurement and transit;

defending against demand and lead time uncertainties; and managing supply and demand(Martha C.Cooper, 2010).

4. **Information Technology in Supply Chain**: Information has always been considered a force whose value has increased as companies had utilised it to become both more effective and sensitive. The immense rise in the value of Information Technologies made a substantial impact on the supply chain process to Statical Data's effect on the enterprise's advancement (Banker et al., 1984). When the value of information increases, so does the importance of Information Technologies in the processing and interpreting statistics for decision-making.

1.1.7 Supply Chain Analytics

Performance Assessment is a stable and complex method that facilitates decision-making by capturing, creating and evaluating facts and figures. It was also clarified by concentrating on the idea of 'balancing' and 'dynamic nature.' 'Balance' relates to the ability to include various indicators and viewpoints connected to provide a balanced view of the enterprise(Pratiwi et al., 2019). The idea of 'dynamic nature' relates to the need to build a framework that continually tracks the internal and external environment and evaluates goals and targets(Trkman et al., 2010).

Performance Assessment was described as a monitoring mechanism that offered guidance to workers on the activities' results. It was suggested that success should be described as the efficiency and effectiveness of the operation. Efficient Supply Chain Management (SCM) has been correlated with several benefits, including improved consumer satisfaction, enhanced revenue, decreased turnaround times, normal inventory levels, and better product development. The Performance Measurement System's goal was to support and improve supply chain management's efficiency and effectiveness. The essential purpose of the Performance Models and systems is to assist management by supporting them, Evaluating market success, measuring and increasing distribution network quality by improved decision-making processes(Waller & Fawcett, 2013).

Efficient, synchronised and balanced Performance Measurement System should engage the organisation's performance management framework as a model for operational improvement. Performance Measurement System of Organization promoted their inter-comprehension and integration among other Distribution Network Stakeholders. It provides an indispensable contribution to decision-making in Supply Chain Management, particularly in re-designing company priorities and plans of the organisation (A. Gunasekaran et al., 2001).

1.1.7.1 Development and Evolution of Performance Measurement in Supply Chain.

Changing market dynamics demonstrates a trend away from firms as separate organisations to different businesses as part of a more massive supply chain. The organisation realised cost reductions both for their internal market operations and outside organisational limits for the whole supply chain. The performance measurement. Performance measurements have gone through the various developments in the current market scenario, which are discussed as under(Dharmapala & Dept., 2008)(Bai & Sarkis, 2014).

A systematic literature review was carried out on the subject of success assessment in 2004 by (Shaw et al., 2010)and reviewed the related papers written between 1988 and 2000 according to changing market conditions. It was stated that around 40% of the publications were written during that time (10 separate journals 1988-2000). (Purwaningsih et al., 2019)proposed a range of primary performance measurement measures, summarised as (i) cost accounting performance only, (ii) improving the financial viewpoint from a non-financial context, (iii) creating a holistic, comprehensive strategy, (iv) taking the concept of operational productivity as a whole(Gandhi, 2011).

In the starting of 1980s, output metrics were focused exclusively on Cost accounting. The retroactive view made it easier to equate the resulting expenses with the once-budgeted costs. Due to systemic broader companies' formation, it was essential to incorporate financial data such as return on expenditure and general benefit focus on success assessment. In comparison to the economic viewpoints, the calculation was

supplemented with a non-financial view. While various organisations used Supply chain performance metrics mainly to boost their internal productivity and increase capital attraction, the evaluation of success, enhanced with a non-financial viewpoint, enabled them to analyse their entire enterprise. This history of the success metric was disputed in arguments by (Baymout, 2015) that it was not possible to control what can not be measured (Ambe, 2014)(Thanassoulis et al., 1996). Nonetheless, the study might say that the subject has shifted from a retroactive to a constructive device.

During the 1990s, the assessment of success was much more positive. Automated processes and the goal of producing satisfactory outcomes to ensure improved operational responsiveness was in trend. This culminated in a holistic, comprehensive outlook that took care of all company stakeholders. At the end of 90s, it was said that after comparing two performance assessment methods in organisations that "both methods have been identified as indicators of potential success for non-financial metrics within their systems" They was one of a more comprehensive set of measures." One of the critical tools in this framework was the Balanced Scorecard formed by (A. Gunasekaran et al., 2004) the end of the 90s. Based primarily only on the financial point of view, the Balanced Scorecard marked a change in how it incorporated several aspects into measuring performance(C. S. Singh et al., 2019).

The need for more adaptation in performance assessment was acknowledged in 2000, and the vision of solutions was capable of measuring both, per individual resource. In the spirit of quality management, such success assessment solutions had to evaluate each human assets' efficacy through the use of very particular measures and assess the entire enterprise through the use of very well-founded standards (Taticchi et al., 2013).

Organisation had pursued interdisciplinary resources to include an early warning system to identify their organisation's current situation and designate appropriate steps to be performed based on information acquired. In this case, the key characteristics are 'inclusiveness, completeness, timeliness, universality, measurability, continuity, dignity and versatility was introduced at the time(Sahay & Mohan, 2003)(Bal & Satoglu, 2019).

The need for such factors in success assessment is rendered much more apparent when looking more closely at recent developments in market conditions. Through a single corporation's point of view, the development of supply chains and dyadic partnerships between firms underscores this turning point in the vision of overall corporate success in performance assessment(A. Gunasekaran et al., 2001). For reasons such as considering all applicable environmental performance considerations, the growing convergence of ties with consumers and suppliers needs an expanded performance assessment outside the company's organisational borders(Su et al., 2019).

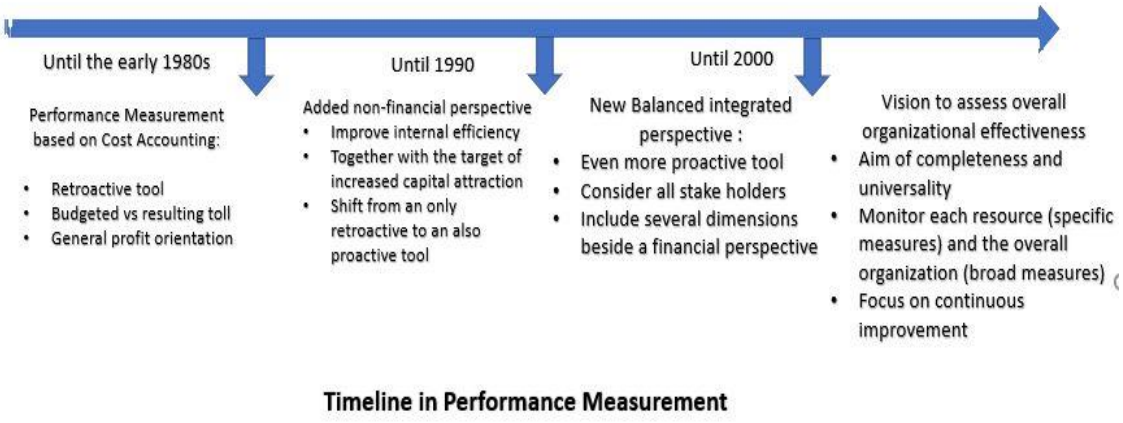


Figure1.1.7.1: Timeline in Performance Measurement

1.1.7.2 Efficiency and Effectiveness of Supply Chain

To protect the Supply Chain Management, the supply chain's performance must be calculated periodically to set the regulation system in operation. Supply Chain Efficiency and effectiveness makes it possible to calculate and measure the activity of the supply chain. The aim of estimating the supply chain's effectiveness is to achieve the best possible result for a specified quantity and raw material quality. Understanding the supply chain aimed to meet the goals, which contribute to an improvement in the performance of the current supply chain(Ibrahim et al., 2011)(Ming & Feng, 2019)(Sengupta, 1990).

The output assessment method involves defining steps, identifying goals, preparation, contact, control, recording and reviews. A performance indicator is a collection of

criteria used to quantify the quality and efficacy of an operation. The word 'metric 'applies the variable's interpretation, how it will be measured, who will be carrying out the measurement, and from where the results were derived (Meza & Lins, 2002)(Sarode et al., 2010)(Sarode et al., 2010). It was claimed that the output assessment method must be viewed as a variable management device locked. The measuring performance method involved a plan, tactic, and receives suggestions from different levels in terms of managing the organisation's performance. Quality assessment was essential practice for every enterprise to increase supply chain reliability and performance. The decision-makers must establish a device for measuring outcomes(Saudi et al., 2019). Supply Chain Effectiveness can be described as categorising acts were evaluating the procedure of quantification and response leads to results. There were many structures to assess supply chain efficiency and effectiveness. Such programs allow companies to provide a standard to measure their supply chain efficiency through various processes (Neeraj Anand, 2010).

Measurement of Supply Chain Effectiveness is viewed as a mechanism to maintain consistency in creating various companies in a competitive environment. Supply chain assessment milestones are regarded in line with the supply chain's general goals and steps. It should represent a holistic strategy and be categorised as political, logistical, institutional and financial and non-financial initiatives. Supply Chain Efficiency assessments boosted companies to build more efficient strategies. Comprehension of the supply chain accompanied by recognition of central aspects of the supply chain. Supply chain effectiveness indicators helped enhance the efficiency of the supply chain and the companies' financial performance (Ubale, 2011)(Waller & Fawcett, 2013).

The performance assessment method involves different measures, such as: analysing measures, establishing goals, organising, interaction, tracking, reporting and reviews. Performance assessment is a collection of measures used to determine the efficiency and effectiveness of an intervention. The word 'metric' refers to the measure's description, how it will be measured, who will carry out the measurement, and where the results will be collected. The performance assessment mechanism must be regarded as a closed-loop management device(Potter & O'Reilly, 2014). The

performance assessment method involves regulation, plan and input from multiple levels to monitor the enterprise's performance. Performance measurement was a key practise for every company to increase the supply chain's quality and efficacy. It was the decision-makers' duty to create a performance evaluation instrument(Amrina & Yusof, 2011).

Supply Chain Efficiency assessments can enable companies to build more efficient strategies. Comprehension of the supply chain accompanied by recognition of central aspects of the supply chain. Supply chain effectiveness interventions are beneficial in enhancing the supply chain's efficiency and the companies' overall effectiveness (Anderson & Dekker, 2009).

Recognition of main variables was also accompanied by developing a measurement tool to assess supply chain effectiveness. As the critical activity followed by the formulation and execution of strategies, it was essential to boost critical variables. It was challenging to assess many variables' interactions and prioritise them for ultimate target achievement(Jones & Clark, 1990). These variables were also regarded as Key performance Indicators of Supply Chain Effectiveness.

It was noted that companies started evaluating their performance on numerous Key performance measures in the last 20 years. Organisations had already started establishing understanding to react to current demanding and increasing market climate, which is required to track and recognise supply chain effectiveness(G. Singh & Dutt, 2020).

In typical supply chain management, the measures customarily utilised to evaluate supply chain performance include stock volumes, procurement costs and distribution times. At the same time, existing supply chain analysis techniques tend to research all the supply chain operations. A performance measure is the concept of the distance, content and components of a broad performance variable(Onsarigo Miencha et al., 2017). The productivity of the supply chain must be calculated in terms of both financial and non-financial criteria. Measuring the efficiency of the supply chain has been described as a critical factor in enhancing corporate success. There are many aspects of the supply chain, beginning from suppliers, transport, storage, distribution,

retail and end-customers. It was noted that in the sense of the supply chain, continuous improvement in efficiency had become a subject of significant concern for every supply chain participant. In reality, supply chain based businesses have used various success improvement techniques to help their supply chain initiatives(Nallusamy, 2016).

Researchers had proposed different metrics to measure the performance of the entire supply chain: distributor Performance, client satisfaction, stock, the supply of goods, customer reaction time, expense minimisation, selling maximisation, revenue maximisation, maximisation of investments, minimisation of investment, maximisation of return on investment, probability of stockouts, maximisation of buyer and supplier benefits, the flexibility of supplies chain(Sorak & Dragic, 2013) integration of information technology(Sorak & Dragic, 2013).

There were numerous methods to measure the supply chain's effectiveness; Equal scorecards; performance measurement questionnaires; performance measurement standards for system design; and IT-enabled supply chains for IT and computer-aided manufacturing methods. There were two wide-ranging reports. The first outlined the analysis and questions related to supply chain performance measures, whereas the second deals with queries related to supply chain performance measurement systems(Amrina & Yusof, 2011).

There were different ways to identify them as qualitative or Quantitative cost and non-cost performance measures. Other indicators include cost, quality, use of resources, agility, visibility, trust and innovation); assets, outputs, and flexibility; efficiency of the supply chain; efficient and configurable coordination, and input, output and composite measures, or strategy and flexibility(Angappa Gunasekaran & Kobu, 2007).

Several performance measurement discrepancies found over some time by multiple researchers are listed below.

a. Strategy-related deficiency.
b. Focus on costs at the expense of non-cost metrics.
c. Failure to maintain equilibrium.

d. Customer and opponent insufficient consideration.

i. Loss in the supply chain, thereby facilitating industrial optimisation.

f. Failure to think of a system.

Researchers responded to these constraints by structural design. The Supply Chain Operations Guide (SCOR) model was then created by the Supply Chain Council in 1997 and defined as a comprehensive approach to defining and assessing supply chain efficiency and monitoring. The idea was the crucial holistic approach; even individual metrics (for example, expense and time) can not be accurately calculated for the efficiency of the supply chain, assessed at several levels)(Masoumi et al., 2019)(Tavassoli et al., 2014).

Supply chains consist of four distinct performance measurement types:

a. Asset actions (e.g., output costs, sales costs, procurement costs, etc.)

b. Output actions (e.g., sales, profit, deliveries on time, etc.).

c. Versatility steps (versatility of length, the flexibility of distribution, etc.).

d. Every performance measuring system must ultimately be connected to customer satisfaction.

Almost every organisation has supply chains, but they are especially evident in industries with an apparent flow of goods from suppliers to production facilities to end-customers(A, 2012)(Ibrahim et al., 2011).

Recent studies and other researchers highlight. The usage of the Data Envelopment Study on the global forum notes that DEA was more than a productivity measure within the definition of a manufacturing process. DEA is a method of "balanced benchmarking" that tests success under several parameters. It allowed companies to test their results, competitiveness and efficiency assumptions(Neeraj Anand, 2010). DEA has been used as a form of "overall performance of an entity. For example, aggregate quality metrics enable executive leaders to compare their organisation's success against other high-performing organisations properly. It was anticipated that DEA literature would have expanded to at least twice its current level(P, 2017).

1.1.7.3 Organizational Effectiveness

Organisational effectiveness is an external standard of how often an organisation meets the needs of the various institutions and people associated with its activities. Different models emerge either from framework characteristics themselves or from the use of inappropriate performance measures and architecture(Petersen et al., 2005)(Dar, 2017).

The variety of current methods are trending in the Supply Chain to measure the effectiveness are discussed below:

Balanced model: The Balanced Scorecard was an example of a balanced model with its financial and non-financial outlook. The Balanced Scorecard covers internal business, creativity, and consumer viewpoints from the financial perspective. Balanced models typically display various category indicators. Companies can prevent one-sided optimisation by considering each classification for possible side-effects. Quality models primarily concentrate on constant improvement. The European Framework for Quality Management's model is an important method. The goal is to help businesses develop a business model that ties success to happy employees, happy consumers, and a positive effect on society(Manzoni & Islam, 2007)(Kaplan, 2009). Five enablers (leadership, strategy, staff, joint ventures, and procedures) and four outcomes (customers, staff, stakeholder, and marker outcomes) are analysed against both the eight principles shown in Figure.

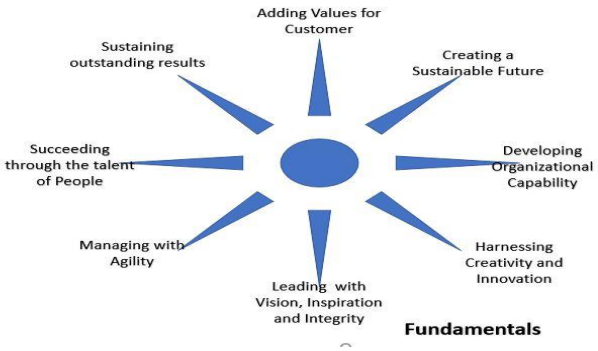


Figure 1.1.7.3: Fundamentals

Questionnaires Model: A practical example of a questionnaire model is the TOPP model, commonly produced by the Norwegian production industry. This model tried

to calculate a company's success using a series of questions. The questionnaire comprises three separate components (general summary, business activities, particular areas such as marketing, architecture, technical planning, etc.)(MR. Deepak Bhimrao Magar, 2016). The method compares three dimensions are:

- Effectiveness (customer satisfaction)
- Efficiency (economic and business resource optimisation)
- Shift capacity (strategic understanding of changes handling)

An independent appraiser assesses answers at three levels (top management, middle management, and production level) by qualitative assessment and their importance.

Hierarchical structures: Hierarchical structures were defined by a typical example of a hierarchical model—the performance pyramid known as the strategic measurement and reporting technique (SMART). The key features of the model were standardised goals with related metrics and behaviour. This structure is in keeping with the equal participation of consumers and creditors in all stakeholder categories. Although the left side of the pyramid reflects measures for external efficiency, the right side reflects internal efficiency, as shown in figure 1.1.7.3.1

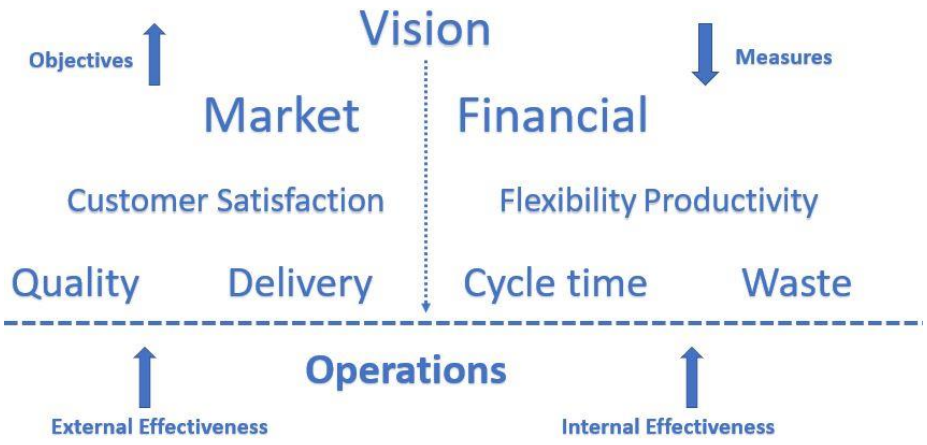


Figure1.1.7.3.1 Internal and External Efficiency

1.1.7.4 Organizational and Business Performance Indices

Any intervention in the supply chain that results in a change in any dimension of the supply chain's efficiency had eventually become successful business output.

Ultimately, each company was primarily interested in improving its asset return (ROA). The impact of various supply chain interventions can be calculated using the following specific categories as expense and profit(Shaw et al., 2010)(Bowersox et al., 2000).

Reduction of Costs is Achieved by

- Inventory reduction.
- Reduction of logistics costs.
- Reduction of direct material costs.
- Reduction of indirect material costs.

Improvement of Income and Profitability

- Products with a higher margin.
- Attaining more significant market share.
- Backorder reduction and loss of sales.
- Recovery of new markets.
- Reducing consumer delivery time.

Improvement of Organisational Effectiveness

- Reduction of production risks.
- Increased utilisation of properties.
- Capital investment gap.

Reduction of Operating Resources

- Inventory reduction.
- Accounts receivables reduction.

Ultimately, a standard system is required to combine different related costs and benefits.

1.2 Aim of the Study

The majority of the supply chain strategy work involves developing nations. Consequently, there is a shortage of a comprehensive analysis of the supply chain's output assessment and productivity in developed countries in general and India in particular. Although there are reports on general supply chain management in both types of nations, there is no work on supply chain management's output assessment. Supply chain management is becoming highly relevant in a variety of developed countries. Therefore, this work focuses on the methods for producing the supply chain and the measurement of productivity relevant to the manufacturing sector in the developing world, particularly India.

This study aims to establish and implement an integrated system for the output assessment of the supply chain. The system would be built across decision-making stages and across supply chain ecosystem structures that combine upstream producers and downstream consumers with businesses. The suggested methodology will also calculate the efficiency of the total supply chain. The system would enable companies to make better supply chain management decisions at political, organisational, and operational levels and to assess success against increasing performance assessment factors. The research would promote cross-organisational understanding. This research aims to establish a conceptual framework to understand the success of the supply chain of 50 specific companies by taking five companies from 10 separate sectors in the Indian context. Throughout this regard, the analysis intends to quantify such companies' supply chains' productivity by measuring their success based on defined metrics. Throughout the analysis's intent, seven indicators are used: Average Collection Time, Inventory Transfer Duration, Inventory Turnover Ratio, Inventory Ratio: Stock Ratio, Working Capital Capacity Ratio, Asset Profit, Debtors Turnover Level. On this basis, the research's further goal is to create clusters of companies to investigate the strong intraclass correlation between them. The research further seeks to assess the success metrics' effect perceived to be a benchmark for its overall results in the Net Sales report. The research also seeks to create a connection between the company's transport costs, a critical component of every supply chain, on the

performance metrics included in the report. Ultimately, the report establishes a connection between the company's net sales and transport costs.

1.3 Objectives of the Study

Based on the above-described aims, the below-stated objectives were established to provide direction to the study:

1. To evaluate the effectiveness of supply chain of different industries on the basis of established indicators.
2. To study the impact of the Transportation expenses on Performance indicators of Supply Chain.
3. To evaluate the relationship between the Net sales and the Transportation expenses for the considered companies.
4. To evaluate the relationship between the Net sales and the Transportation expenses for the considered companies.

1.4 Conclusion

Supply chain management is practised in various manufacturing organisations as a method to leverage their overall efficiency. It is also beneficial to raise revenues by lowering prices and pleasing end-customers. Supply chains exist in virtually all businesses but are highly evident in industrial sectors that involve a direct distribution of products from manufacturers to manufacturing facilities to end-users. Supply chain productivity and overall output must then be measured in detail to establish essential variables that need further effort. It is, therefore, essential to ensure that the supply chain is correctly applied.

The need to research the supply chain's effectiveness and assess the efficiency of India's manufacturing sectors' supply chain has been addressed. Supply Chain Management was implemented with the aid of concepts offered by scholars

accompanied by the adoption of Supply Chain Effectiveness. Further, the reason for the analysis and the goals have been set. The chapter laid out the context of the analysis and the relevance of supply chain management for industrial companies in developed and developing countries. It then clarified the ultimate purpose of the analysis and its particular goals as the study is based on the manufacturing industries in various sectors of India.

Chapter -2

Literature Review

2.1 Introduction

It is common for researchers to refer to the existing literature in the research area, primarily to assess the research work status. Specifically, the literature review is an evaluation summary of the literature's details applicable to the researcher's chosen analysis area. The analysis outlines summarise, examines and clarifies the existing literature. It offers a theoretical framework for research and allows the researcher to assess the essence of the analysis. The written works contained in the analysis chapter are reviewed and analysed.

The literature review aims to explain what information and ideas have been formed on the topic, their strengths and limitations. In this portion, the researcher attempted to review and examine the existing literature, primarily to locate holes in the work and frame the study.

The current literature review analysis started with the current study and debate on supply chain management, covering concepts and trends, the advancement of supply chain management, the benefits of supply chain management for suppliers and supply chain management activities. The analysis then calls the assessment of results. This performance assessment viewpoint helps to explain the interaction between performance measurement and supply chain management. Finally, the literature review recommended that the scholar choose a methodological analysis for the thesis to bridge the difference in optimising the different supply chain management criteria.

2.2 Review of Literature

Objective 1

The first objective of the research work was to evaluate the effectiveness of supply chain of different industries on the basis of established indicators. For the same, the literature review carried out is detailed below. This helped in studying the parameters

and tools used in previous studies to examine the effectiveness of the supply chain of different industries and help in finalisation of tools for our study.

(Wang et al., 2020)Wang et al.(2020) undertaken the study to evaluate the Global Supply Chain's sustainability performance. In this study, the experimental research design used to measure the relative environmental performance of the Global Supply Chain. Data Envelopment Analysis is used to calculate the effectiveness of the survey of 16 industrial sectors. Data were extracted from the WIOD Socio-Economic Accounts between 2005 and 2014. The results recommend that Data Envelopment analysis plays a crucial role in monitoring and measuring the performance of Supply Chain. Our DEA input-output modelling framework's main advantage lies in its ability to identify the multidisciplinary effects of supply chain activities while computing for Global Supply Chain's complicated instincts. The empirical findings also showed that environmental ineffectiveness in the supply chains during the decade was not insignificant. The results recommended that Global Supply Chain would have been possible to reduce around 40% on average CO2, SO2 and NOx emissions if the most efficient accessible production facility was accepted.

Dey et al.(2019) investigated the Performance analysis of the supply chain's viability in small and medium-sized businesses using Combined Dynamic Equation Simulation and DEA. The questionnaire and interview methodology was developed and executed to obtain the understandings of Small Scale Enterprises organisers about continuous supply chain practises and performance of small and medium-sized enterprises in the UK and France. A sample of selected 30 and 54 SMEs from the UK and France selected for the study. The research specifically addressed all activities as inputs and all performances as outputs appropriately by integrating SEM and DEA analyses approaches. The current study highlighted that the small and medium-sized companies proposed the DEA based Performance Metrics modelling approach merged with other stand-alone performance measurement frameworks to contribute to a more sophisticated and stable approach.

Alvare-Rodrigues et al.(2020) had undertaken in their research an analysis of the output of retail supply chains in Spain as sample 30 large retail chains were chosen for the study. The mixture of Life Cycle Appraisal and Data Envelopment analysis

model was used to evaluate the quality and reliability of the complex network system of the Retail Supply Chain. The study indicated that only one out of thirty retail supply chains in Spain was reliable and successful. The Life Cycle Appraisal + DEA approach is enhanced by offering environmental, operational, and fiscal benchmarking to support the Retail Supply Chain's efficient management.

Su et al.(2019) discussed and analysed the agricultural commodity supply chain efficiency of agricultural science and technology. The sample was chosen from the Technology Parks of China. Data Envelopment Analysis (DEA) is used to determine the feasibility of this research. Data were derived from open statistical Source. The result Suggested that Industrial Supply and Retail Cooperatives completely optimise established operational networks and storage facilities for ultimate short finance, commodity price volatility and increasing transport costs, concentrate on the storage of agricultural goods, take numerous fund-raising steps and overcome the 'obstacle' of capital to have a simple purchasing source assurance. This study also incorporated the procurement process and distribution grants for cooperatives and a virtual development network to resolve the shortage of farm warehouse products. Based on the study, it can be said that the performance of the Data Envelopment Analysis is 0.9-1, and the supply chain efficiency can be improved more rapidly in the 21st century.

Ilham et al.(2019) Investigated the productivity of the supply chain in Indonesia. The research was performed in 7 different cities in Indonesia. 139 respondents were sampled. The data obtained were evaluated using the Data Envelopment Analysis(DEA). The study focused on direct selling to customers such as hotels, stores, restaurants, hospitals, and catering for big capital farmers. Besides the egg distribution network, the Agriculture Minister developed a new model to raise farmers' incomes and price stabilisation. In Conclusion, it was found that the price of eggs often depends on supply and demand and the presence of high-quality breeders in the production field and growth region. The study includes computerised cost information on the location of eggs produced in many areas, as per the study, to prevent egg prices by these groups. The higher the supplier's commitment and cost-to-benefit ratio, the fewer links in a supply chain, the better the supply chain. Big capital

farmers urged to break the distribution network straight to existing clients through marketing.

Huang et at. (2019) evaluated the supply chain in the fashion retail industry. The study was carried out in major Canadian fast-fashion company. Different manufacturers, Distributors, Suppliers, and retail stores as consumers weres selected for the study. A multi-stage output model (MEM) was built to evaluate the allocation output in the time-based Data Envelopment Analysis (DEA) model. The research analysed the allocation output in the fashion retail chain using a multi-stage DEA efficiency model. The result revealed that the MEM could play a complementary function in a traditional calculation in the retail sector. The shops near the headquarters are more effective than the stores further from the headquarters. The allocation efficiency relates to the store's size and the store's position, the authors add. Analysed results proposed that the organisation enhance the knowledge sharing between the headquarters and the distant shops and boost the local business research in those stores.

Purwaningsih et al.(2019) research aimed to calculate the productivity of the poultry distribution network. The sample was carried from various poultry farms in Indonesia. The Data Envelopment Analysis CCRO System was used for the research. Primary data was obtained by in-depth interviews with intermediary traders and close examination of their business unit position. Information processing of broiler marketing flows from live birds on the farm to the traditional sector to classify the commodity sold and the expense of the delivery process. The study calculated the relative productivity of the poultry commodity broker-dealer. Product creation research was used as a success assessment for the supply chain to calculate productivity and quality. The average value-added ratio of intermediaries (traders), which is approximately 1.24, is classified as adequate; three out of 11 intermediaries classified as inefficient. As a result, DMU 3,5 and 6 must reduce overhead, delivery costs, and DMU 1,2 and 3 must boost the influential input variables to become more productive. The study focused on the retail price of meat dictated by the purchasing and sale price of intermediate dealers and the decrease of body weight (30 per cent) and the amount of benefit decided by the vendor.

Zhai et al.(2019) carried out exploratory research to evaluate energy supply chains' efficiency with emission trading. The two-stage DEA model was used for measuring ecological efficiency. The model measured the possible productivity of growing community percentage change with little efforts. Results show that a city has, on average, 392.21 tones of emission, resulting in a 6.61 per cent improvement in efficiency, to trade to its competitors. The result helped corporations to make ecologically healthy choices; they say. In the study, a new two-stage DEA approach was formulated that used border-shift research methods to measure the environmental efficiencies of ESC under carbon credit buying and selling. It was suggested that emissions are inspired to reduce their carbon emissions in both stages and trade redundant loans to others with limited carbon credits. This carbon trading between cities leads to a shift from the traditional CCR to a new level, improving the DMUs' performance under assessment. All these findings could provide valuable insight into ESC efficiency and help companies to make better environmental decisions, the authors say. Experts believe that further work was required to analyse cross-border changes to investigate DEA's relative effectiveness and assess which DMUs are more likely to engage in carbon trading. The analyses helped to understand the inputs or outputs was considered in the study. Many problems were addressed more effectively by envelope template, and new envelopment-based models developed to overcome the different analytical concerns.

Rentizelas et al.(2019) The presented DEA methodology will assist the biomass procurement planning phase and facilitate decision-making under various decision conditions. There are numerous indicators from various biomass zones, transport types, export ports and processing technologies. The proposed DEA methodology will help prepare a biomass development process and enhance the decision-making process on various decision-making parameters. The research-based on how greenhouse gas can be reduced. The findings helped the decision-makers and policymakers in the short and long term. The DEA approach was used to help determine where to build the supply chain more effectively. It was extended to the case study on transport between Brazil and the United Kingdom. The Torrefaction of biomass at any point in the chain covers both possibilities.AQ2, a supply channel

route from San Francisco do Sul (SC) in rail transport, was the most effective DMU after splitting. The most effective rail transport scenarios, as well as the most productive road transport possibilities, were founded. The model indicates each alternate route's success and thus helps policymakers prioritise the sector's growth. It was the first study to explore the future supply chain of biomass between Brazil and Great Britain. It also led to the latest debate on the new exciting aspects of biomass supply chains, the study states. Several consequences were noticed for both scientists and academics as well.

Tavassoli et al.(2019) presented a modern paradigm to forecast sustainable supplier membership. Regular DEA models were taken, and research data were deterministic. This analysis indicated that the model suggested demonstrates excellent precision in prediction. A case study was presented to implement the proposed technique to a renewable supplier selection problem. Throughout the case of both null information and probabilistic data in the DEA process, no framework is accessible for rating DMUs. This DMU also suggests that zero data was a modern concept in DEA models. All vendors were categorised into two categories, namely productive and successful categories depending on their quality ratings. To anticipate each supplier's current membership, a current two-stage DEA-DA model was introduced. The theoretical model's estimation performance was 70% in the first and 90% in the second phase. This study' results indicated that the proposed model is quite reliable. The recommended solution has numerous opportunities for sustainable development and supply chain management practitioners.

Ming et al.(2019) Exploratory Research was carried out on Performance Evaluation on Supply Chain System of Manufacturing Enterprises. AHP DEA's performance assessment model was chosen for the study. This model differed from the other AHP and DEA hybrid model used to understand the mixture of subjective and objective, whereas the latter did not represent decision-makers choice. This research verified the protocol's logic and legitimacy with illustrations strengthens and tightens the decision-making cycle. Based on the performance evaluation ranking framework of industrial firms' supply chain network, AHP-DEA uses a rigorous performance assessment model. The model approach thoroughly considers the benefits of AHP and

DEA; it incorporates subjectivity and rationale, but still complies with the real supply chain structure and the evaluation findings are detailed, according to the report. This measures the overall output values of each supply chain of production firms. The result suggested the effectiveness of the—process by example test, which further suggested a more logical and systematic decision-making method.

Li et al.(2019) analysed the fuzzy network epsilon-based data envelopment analysis for supply chain performance evaluation. The automotive industry data were chosen for the exploratory analysis design review to assess the fuzzy supply chain's productivity. The research measured the efficiency of decision-making units in the automotive industry. Each company can use this appraisal tool to improve the output of alternative factors. It applied to the automobile industry as a case study to assess the efficiency of the supply chain. The non-parametric DEA is one of the most commonly used approaches. Using this approach, the analysis measured the relative effectiveness of a group of homogeneous decision-maker units. In this way, their success was contrasted with each other. Also, the factors of the deficiency have been established so that they may eliminate it. The findings evaluated the efficacy of the companies in evaluating the efficiency of their Supply Chain metrics. The total performance of the DMUs has also been determined. The outcome also indicated that this approach might be used in different assessments, for example, in the reverse supply chain. The blurry input and output are used to resolve the uncertainties. Fuzzy constraints can be extended to resolve uncertainties and other fuzzy approaches to fuzzy modelling and non-defined results. The results could be seen in multiple analyses of the supply chain and other sectors.

Jahani Sayyad Noveiri et al.(2019) measured supply chains' performance with undesirable factors and reversed flows with an approach to the Data Envelopment Analysis. The data set used for the study was taken from the open-source of the textile industries. Supplier, Manufacturer, Distributor and retailer are the factors used in the study. The result suggested that a DEA-based approach was introduced to measure the relative productivity of supply chain networks of unfavourable factors and reverse logistics weakly redundant equipment used to integrate unacceptable outputs. For two instances, initial and intermediate values, unfavourable variables were examined. The

study showed that our new DEA-based solution's punitive impact is comparatively more considerable than implementing the DEA model independently to every chain leader. The applicability of the proposed solution demonstrated by a specific implementation in the textile industry.

Bal et al.(2019) Investigated the evaluation process of multi-objective optimisation. Data Envelopment Analysis (DEA) approach used to get the optimal results of the model. The DEA optimised that the approach could easily analyse the findings for both scholars and practitioners. This study discussed the sustainability strategy using the DEA paradigm and examined Pareto's ideal strategies for a sustainable supply chain model. The DEA technique was seen as a valuable methodology for the analysis. The result also found that the DEA model described the production and economic, social and environmental goals as inputs. The findings obtained have shown that the 15th solution is the most effective. The study may be expanded by incorporating various MCO methods to evaluate the effects of the specialist's judgment. According to the report, the DEA strategy provides the least coveted social goal as an important one. It suggests a trade-off between ecological, legal and economic interests when agreeing on the right option

Badiezadeh et al.(2018) scrutinised the influence of the Data Envelopment Analysis (DEA) model for analysing the efficiency of supply chain management in the presence of Big Data related to the supply chain of tomato paste industries. This paper establishes an NDEA model for the estimation of positive and negative efficiencies. The paper concluded that Big Data is a global challenge because it was complicated to view or utilise it wisely. This paper evaluated the sustainability of tomato paste industry's supply chains by considering cultural, social, and environmental parameters. Additionally, Big Data's position in SCM addressed. Optimistic, cynical, and total supply quality. It was found that Big Data can significantly affect the environmental supply chain and require resources to do it. In the past decade, executives have paid attention to competitive supply chains, and Big Data may be a catalyst to their growth.

Suresh (2018) targeted to explain the fuzzy supplier selection.KANO model, VIKOR techniques and Data Envelopment Analysis were selected as a modelling technique

for the study Delivery, Consistency, Price, Material Processing, Customer Care, Technological Capacity and Process Enforcement were the performance parameters used in the study. The study suggested that due to the KANo and DEA model, it was straightforward to measure the raw material manufacturer's effect on the overall supply chain of the automotive industry is very strong. The output of the supply chain cannot be successful without the required supplier. The supplier with the high quality might not be adequate, and the supplier should be able to provide the raw material as required by the manufacturing companies with a long-term relationship and improved cooperation. Effective high-performance suppliers may only imply that a business achieves a competitive advantage on the market.

Zulqurnain Ali et al.(2018) Delivered a comprehensive study to analyze supply chain effectiveness in the supply chain of Small and Medium Enterprises (SMEs). The questionnaire method was selected to get the data for the analysis. The textile manufacturing sector of China was selected for the study. The present research filled the void linked to Supply Chain Finance and Supply Chain Efficacy by defining specific reasons for the implementation of Supply Chain Finance that had been overlooked in previous literature by using the Transaction Cost method. The result brought the light to understand the Successful implementation of SCF is focused not only on financial metrics but also on SC relationships (negotiation, trade digitization, coordination, and position of financial institutions) among customers, suppliers, and financial institutions fostering behavioural unity to advance SMEs. Therefore, SCF is SCE's significant indicator of textile SMEs.

Dar(2017) delivered a comprehensive study to explore the certain DEA theoretical advances and their implementation in real-life matters. The complex analysis conducted to change the comparison set for inefficient DMUs and rank DMUs using super performance. DEA was commonly implemented globally in the public and private sector contexts. Too many variables will lead the DEA models to under-discriminate output ratings. Setting the correct benchmarking goal was critical and applied to both the performance indicator and the benchmarking knowledge. The study brought light to the urgent need for management to establish targets for change.

DEA may obtain both productivity and benchmarking knowledge. It is a well-established linear measurement methodology focused on relative efficacy.

Elsayed et al.(2017) Investigated and furnished the study to prepare the most reliable trading tool for supply chain businesses in Safaga port. The tool makes it geographically positioned to accommodate goods transiting through one of the busiest ports worldwide. Assessing such performance is a challenge that will play an essential role in managing Egypt's Safaga port, the study states. The research assesses the Egyptian port's comparative performance during the 2004-2013 study period. Data were derived from input and output variables dependent on DEA-CCR, DEA-BCC, and SBM analysis. It measured the overall productivity of DEA ports. DP environment Sokhna has Safaga's maximum performance, so Sokhna port's output curves are Safaga's frontier curves. The result indicated that the Safaga port's efficiency score was less than 1 in DEA-SBM models, indicating port excesses and performance shortfalls in any optimized solution. The study process represented the technological and size inefficiencies representing low labour usage and wasteful activities.

Onsarigo et al.(2017) presented an outline study to analyze the technical Efficiency for Strategic Change and Global Competitiveness in Supply chain in Commercial banks. As a sample, 45 banks, five public sector banks, 28 private sector banks, and 12 foreign banks of Kenya were selected for the study. The DEA model was used as a statistical tool for the analyses of the data. In research, it had been found that some banks are inefficient, and others are not running at the optimal standard, noting that the technical performance ranged considerably from bank to bank in Australia Many Kenyan banks are also inefficient. Others are not running at the optimal stage, study reveals. Government policies had promoted innovation, more extensive industrial usage, sector diversification, and bank consolidation. Banks in developed countries like Kenya will need to be well-equipped to enforce change management strategies, concentrating on technological quality and profitability. The study further revealed that bank managers often expected to implement the new banking technologies to increase bank efficiency and find a spot on the productive frontier,

Chern et al.(2016) aimed to examine the efficiency of supply chain scheduling algorithms. The sample was selected from Taiwan's leading international semiconductor production and manufacturing business houses. The DEA model was selected for the analysis of the study. Results demonstrate the model presented in this analysis can be used to test a real-world process with unfavourable outputs/inputs, to show this DEA model's efficacy, eighteen situations with specific needs, capabilities, and multiple times contrasted. The report concluded that DEA models helped to assess the performance of wafer-testing procedures in the US and Taiwanese super-conductor business. A supply chain network's efficiency measured as a whole method, and then the actual efficiency of each internal mechanism is determined depending on the weights applied to the associated inputs and outputs. The relation between the products utilized by different supply chain actors defined by adding the same weights to the same items, irrespective of their use as inputs or outputs. As a result, a certain number of DMUs were needed, and potential research concentrates on deciding the optimum size for the virtual parameters to render output disparity more discriminatory. The study brought light to all standard commodity inputs and outputs inside a supply chain model, including stocks, stocks, and supply chain network delays. It uses the principle of DEA to measure supply chain performance, which in its current form has a negative output value, breaking the presumption that performance would be between 0 and 1. The result suggested that the model mainly used to determine the performance of preparation output. Future studies can apply DEA models by awarding scales or using a fuzzy set theory to unknown variables.

Hishan et al.(2016) examined the Effectiveness of supply chain in the Apparel Industries. The questionnaire was used to collect the respondents from the 15 different industries. The DEA model was used in the research to measure the effectiveness of Data. The research examined the advantages and challenges of its implementation, evaluating SCM's efficacy in the fashion industry. Concerning efficiency and sensitivity in providing the products or services to consumers, the clothing firms received a range of advantages from SCM implementation. Small businesses impacted by development and cost factors. That, in effect, has influenced their ability to gain larger market shares and consumer loyalty and resolve healthy rivalry levels.

Those significant advances, in effect, helped businesses as revenues grew, and consumer loyalty increased. If the chosen organizations face specific problems with SCM, numerous solutions are accessible to improve their processes. The result suggested that businesses should be resourceful about seeking opportunities to develop their processes; foreign businesses use SCM to seek opportunities to develop their processes. Nevertheless, the research also suggested that popular SCM technology software has downsides.

Mahdiloo et al.(2015) focused and examined the technical, environmental and eco-efficiency measurement for supplier selection: The data envelopment analysis was used as the primary tool for the analysis. This paper offered a modern paradigm for choosing renewable suppliers. The study proved that the models are computationally intensive, and models required the linear programming for the analysis. The study addressed the complexity of DMU's so-called three-step approach in calculating eco-efficiency ratings. The model is updated to classify DMUs as eco-friendly if they are both physically and environmentally effective. This paper refers to DEA, renewable product collection, and competitive supply chain management literature. The analyzed model in the study offered a more credible eco-efficiency metric of decision-making units (DMUs). The result indicated that Hyundai Steel Company's real-world market case and its vendors to demonstrate the feasibility and applicability of the revised model.

Tavassoli et al.(2014) presented the outline report to measure supply chain management's effectiveness and efficiency. Data envelopment analysis was incorporated into the study. The study explored the concept for product performance, productivity, and total quality of supply chain management. A theoretical description discusses the applicability of the current supplier classification model. Assessing SC's overall performance is a significant challenge for management. Measuring productivity and profitability is essential. In this article, the study suggested a model for calculating performance, efficiency, and total SCM suppliers' total output. The study proposed a SIDEA model to rate all suppliers individually. The effects by utilizing the new model demonstrate the applicability and different capacity by supplier selection.

Talebi Zarinkamar et al.(2014) delivered a comprehensive study to measure banks' supply chain efficiency. The research recognizes four inputs, including operating costs, the interest charged, capital spending and fixed assets. Besides, the study used bank deposits, fees and loans paid out as performance parameters. Three separate data envelopment analyses models used to analysis tests the relative productivity of both units. The research was carried out in 30 branches of Bank Mellat, an Iranian bank. Preliminary findings suggest that most banks operated under favourable conditions. The research identified four factors, including running costs, the interest charged, capital expenditures, liquid assets, bank balance, fees, and loans charged as performance parameters along with four inputs, including running costs, the interest charged, cash and liquid assets, bank balance, fees, and loans received as production parameters for consumers. The report looks at selected bank results in Tehran, Iran. It was found that the relative productivity of different 30 divisions analyzed different DEA methods. Results showed that most banks performed well above average. Implementing the minimax procedure has seen improved results in terms of super performance, the paper states.

Khodakarami et al.(2014) investigated and developed the model to measure the supply chain's sustainability by using two different DEA models. This paper attempted to establish a set of linear DEA methods to concurrently estimate performance, efficacy, and return to the decision-making unit (DMU) size. The article ends with a case analysis demonstrating concept deployment to DMUs. This paper established frameworks for measuring over-all output by simultaneous measurement evaluation. The study specified a range of properties for such a model, including the availability of in-process solutions, system consistency, one-step procedure, comprehensiveness of outcomes, interpretability of scale returns, model linearity, and formulation simplicity. Between the resources, only the availability of BCC-type enhancement solutions was explored. Ultimately, the study implemented a novel optimized two-stage additive process, satisfying both properties. However, the paper presented a detailed review to determine a DMU's organizational size shifts.

Cook et al.(2014) outlined research to prioritize the step before choosing the Data Envelopment Analysis Model, to address the several issues related to the use of Data

Envelopment Analysis (DEA). Research interpret the researchers, practitioners, and reviewers within the DEA community may have concerns and, in many cases, incorrect views on these issues. DEA was interpreted as a multi-criteria assessment framework where DMUs are alternatives. In every operational productivity analysis, the "method" being measured must be established. One pitfall was that the performance score might be misjudged as input and output factors take the form of percentiles and ratios concurrently. The study should find out that in DEA implementations, a combination of ratios/percentiles and raw data is acceptable. It is too conservative to say that these two data sources cannot coexist in a layout. Aviles-Sacoto's review of business schools stressed the data collection process aimed at learning. DEA is built and implemented in different fields. DEA also offers details on the relative gap of best practices. Identification, size performance, Malmquist productivity index, and others ought to provide an output sense as a prerequisite, authors add. Under general benchmarking, DEA performance can no longer be considered "output quality." The study revealed the organization's "overall efficiency." DEA literature was projected to expand to at least twice its current level. The Conclusion comes that the DEA group will be transparent on these problems and informed of the numerous DEA applications.

Sorak et al.(2013) focused on and examined the supply chain management of small and medium scale industries. The various business ethics as a research area raw material, final products, delivery of products, exchange of information were used in this study. The delivery performance, Stock, transport, Working capital, Supply chain flexibility were used as performance indicators in the research. The result indicated that the model was developed to illustrate the possibilities of using the simulation process. Versatility can be a powerful means of gaining competitive advantage, reducing costs, and improving emergency response. Overall, information sharing was considered one of the most critical factors contributing to unforeseen system performanceThe supply chain formed by multiple companies (manufacturing, trade and finance organizations, retail sector, and various positions or activities within the company) and supply chain participants may improve mutual profit by exchanging knowledge and collaborating, i.e., engaging with each individual.

Leal et al.(2012) scrutinized the research to find the best transport mode, which also helpful in eco-efficiency with the data envelopment analysis. The bioethanol industry of Brazil has selected the study for analysis. The service value and environmental condition are the core area of research. The solution suggested will allow the Brazilian government to establish a transport network development program. DEA may also facilitate short-term developments in bioethanol road transport, which can be useful in the sense of Brazilian transport, authors add. The usage of DEA established the standards for developing transport methods not known to be 100% eco-efficient. This study's findings indicate that eco-efficiency interventions and metrics will help decisions on the modal selection of bioethanol transportation in Brazil. Between the transportation alternatives, a priority list developed to illustrate milestones and recommend suggestions for others. The study helped provide the solution that allowed the Brazilian government to establish a strategy to boost biomethane transportation infrastructure, which was used to increase bioethanol in the country's road transport short-term.

Cho et al.(2012) explored and discussed the measure the performance of service supply chain management. The paper introduced a service supply chain efficiency assessment system. Measures and metrics were considered based on political, tactical and organizational success in the service supply chain. The success metrics for service supply chain activities such as distributed generation, consumer experience management, supplier relationship management, capability and capital management, service performance, information and technology management and service supply chain financing were also discussed. The dimensions like Finance, Competitions, Service quality, flexibility, resources and innovation were analyzed in the study. The findings of this research were beneficial for all professionals. The distribution network and analysts undertaking additional field studies. The hotel industry was characterized by continuous growth due to globalization and technological progress. In this sense, assessment of the business supply chain efficiency was considered undoubtedly crucial for the industry. The research helped to conclude that study was supposed to inspire researchers further to work in this area. Researchers and

practitioners were benefited from identifying opportunities for improvements in the hotel industry.

Balal Ibrahim et al.(2012) aimed to examine the effectiveness of supply chain practices. A resource-based view theory was used to describe the impact of various aspects of supply chain management activities on the productivity of supply chain processing firms in Sudan. The quantitative approach was used, where convenience sampling and self-governing survey questionnaires filled from 110 manufacturing firms in Sudan. The study stated several empirical findings that suggested that supplier management activities have a significant positive impact on the supply chain's productivity. The analysis found various observational findings suggesting that procurement management strategies greatly impacted the supply chain's efficiency. This research's useful contribution can describe the significance of supply chain management practices to decision-makers and managers in increasing supply chain performance effectiveness. The statistics were only obtained from specific interviews in an organization and focused on the industrial sector. Quality and efficiency are seen as primary metrics to assess the success of the supply chain. The management of suppliers was seen as one of the factors influencing the overall cost of managing the supply chain, so suppliers can help reduce costs. Studies on supply chain activities in the retail and automobile industries define critical business goals and strategies between vendors and producers. The analysis showed that the marketing strategies of the vendors affect the efficiency of the supply chain. This research carried more weight, particularly for generalization, focused on survey results from 110 manufacturing firms. Sudanese manufacturing firms' effectiveness can be highly reliant on their supply chain activities. This analysis provides SCM executives with the correct methodology to determine the supply chain's quality. A new aspect of the management of the supply chain has also established. The study revealed and suggested that supply chain management activities directly influenced the performance of the supply chain.

Akcayaa et al.(2011) focused and analyzed the DEA information solutions and data mining techniques in the DEA framework. Paper systematically explained to organize solutions for DEA models so that researchers can analyze and view these solutions

through the analysis of information or data mining techniques. The developed methodology was checked and applied to compare vendors of a leading Turkish carmaker in a modern world project. The research also suggested a technological system to reflect the findings of every DEA analysis systematically. The model permits observers to evaluate the leasing of DMUs. An advanced DEA solver, Smart DEA, has been developed and tested for benchmarking of Turkish car suppliers in a real-life project. It was concluded that useful software was developed to enhanced incorporating assistance, knowledge, or tips for non-DEA concepts.

C.Chen et al.(2011) scrutinized the Supply chain performance evaluation. Data Envelopment Analysis was used as a statistical tool for the study. Three separate DEA network structures were implemented under the principle of clustered, autonomous and mixed hierarchical frameworks. Performance research, the interaction between the manufacturing chain and the departments, and the relationship between the three different organisational structures were addressed in the study. The analyses helped to conclude that the concept of DEA generalized into a more dynamic and general context. The study also explained that the two divisions belong to a single decider for the intermediate product connected to two divisions.

Kurien et al.(2011) focused and examined the Supply chain management performance practices. Due to the sophistication of such processes, it was difficult to choose appropriate supply chain efficiency indicators. The study found that Companies required a formal process or methodology for auditing current performance assessment processes. A study suggested a need to restrict the number of success metrics to prevent knowledge overflow. Further research in the field of SCPMS was also recommended.

Yang et al.(2011) delivered a comprehensive study on the role of Data envelopment analysis in Supply Chain management. This study defined two forms of supply chain processing options that are similar to each other. The CRS DEA supply chain model was developed based on the development capacity range to determine the supply chains' overall technical performance. The key benefit of the model resides in the way that it helped to identify the most effective manufacturing capacities in the supply chains by eliminating or upgrading inefficient subsystems (supply chain members).

The proposed model often explicitly defines the benchmarking units for dysfunctional supply chains to boost their efficiency. A particular case validates the reasonableness and acceptability of this method. The paper provided the two interpretations of the probability of the CRS supply chain manufacturing. Based on concepts, a DEA model was developed to improve the network technological efficiency of supply chains. The analyses helped to evaluate the Supply chain comprises 17 branches in the Anhui Province, China Building Bank. This paper also explained the various supply chains, furthermore, the intrinsic features of production. Further consideration was also recommended to the supply chain performance evaluation.

Aoki et al.(2010) presented the outline approach of Data Envelopment Analysis to Supply chain management. The paper suggested the DEA model for supply chain management. The research focused on partner selection and supply chain development. This study explored how the supply chain itself can be structured to maximize DEA's benefit. Numeric tests illustrate the feasibility and efficacy of the new system. In conclusion, The DEA model has incorporated the adaptive variables to enhance the supply chain's overall performance.

Sarode et al.(2010) focused and examined the supply chain's effectiveness by selecting an appropriate supplier. This paper aims to show the application to solve the Analytical Hierarchical Mechanism (AHP) issue. Delivery performance, Flexibility, cost and asset were selected as the criteria for the analysis. The choice of a suitable vendor will naturally improve the productivity of the production process. AHP's use of a multi-attribute decision-making model to choose a reliable solution is the business's strategic choice to increase the supply chain's quality. A research project by the Indian industry was explained to confirm the essential characteristics of this concept. In this volatile time of growth, the goal was not to be just a competitor but to remain competitive in the future. It was concluded from the study that the impact on the Malaysian industrial sector of external factors and found that AHP was useful for the company's production. It was also noticed that AHP was a smart way of choosing a supplier for the product.

Rajagopal et al.(2009) carried out the study to analyze the significant determinant of the supply chain relationships that businesses explore to render the supply chain

partners more successful. Survey method and a hierarchical model was used to test the hypothesised and validated by the SPSS framework. Data were obtained from a field study in a survey of 584 companies in Malaysia. Work reveals that the exchange of capital has beneficial consequences in the relationship of the supply chain. Increasing flexible relationships will also result in expanded productive collaborations across the supply chain. The study helped to conclude that the SCP model would be more efficient. Identifying the variables that suit their chain is critical for effective execution. The evaluation of the bullwhip effect in SCP was recognized, innovations and approaches for handling the Bullwhip effect Malaysia's potential future opportunities, which were stated especially suitable for the industries.

Xu et al.(2009) aimed to examine the Data Envelopment Analysis and its applications to supply chain performance evaluation. Six largest furniture manufacturers in the western region of China were selected for the research. Direct cost, Operation cost, Transportation cost and order lead time were selected as leading key performance indicators for the study. Cost, Time and Hr as input, Flexibility, Financial, and service are considered output in Data Envelopment Analysis. This research discussed the quality appraisal of a furniture company's supply chain in southwestern China. We identify and evaluate our RDEA Structure, which are the main difficulty variables influencing the assessment stage and system. The study provides a realistic description of how the rugged DEA model operates and how well it functions. It was found that the model used for the measurement of network efficiency. To define the output score of each DMU, we employ an output interval. In the end, it defines the output difference and finds that the most effective DMU with the lowest average performance loss is. Such assessment findings can assist decisionmakers in optimizing the network's operational performance.

Dharampal (2008) researched to develop an insight into how to generate cost reductions in a supply chain by project inefficiencies in procurement units to an active boundary. The DEA-CCR model measure the Performance of Supply Chain Production calculated using data creation analysis (DEA). The paper focused on saving costs in a supply chain by predicting inefficient supply units at an active boundary, utilizing the CCR-Model with Intrinsic Security Regions (IAR). The

research demonstrated how to add value in the supply chain by review of supplier details. The study further revealed that an organization would improve its profit and be successful by increasing operating performance in the CCR / IAR model and allowing cost savings. Additionally, the added benefit was provided by manufacturers who, in part or entirely, move it on to the customers on a demand basis.

Celebi et al.(2008) investigated and focused the data envelopment analysis for supplier evaluation of Turkey's various banks. Delivery, Price, Quality and service are the major key performance indicators used in the study. Empirical results show that the total technical efficiency of PSBs is 88.5%. The analyst argues that the banks' overall operational performance foremost influenced by their vulnerability with off-balance-sheet operations (i.e., non-traditional activities). The lowest banks in the study were found as India's bank, followed by UCO's bank. In contrast to best-practice technology, Indian PSBs are useful in selecting optimum rates of performance. To achieve productivity improvements, 52 per cent of banks work in decrease returns and thus require a reduction in their operations. This study revealed that selecting a precise input-output mix and appropriate scale for improving inefficient PSB performance showed then impact on the sales with data envelopment analysis.

(Liang et al., 2006) demonstrated the distribution system deemed to be efficient while its members are unable to meet DEA requirements. The study developed a series of DEA approaches to characterize and measure supply chain efficiency. A schematic diagram of a vendor-buyer supply chain demonstrates the methods. These nonlinear pro-gram DEA-based grams viewed as multivariate conjugate gradient problems or resulting outcomes can be found via an algorithm technique. The current document was elaborated on several DEA models to assess the effectiveness and members of a supply chain. The models were nonlinear programming problems overcome as a model that enables programming issues. The study helped to introduce the new DEA models for the analysis of the multi-stakeholder supply chain industry and the measurement of the supply chain performance. The paper also discussed models which can significantly improve the efficiency of supply chains.

(Adler et al., 2002) presented analytical research to use the fuzzy logic, guaranty areas, and Discrimination severity functions that provide extra details in or in comparison to standard DEA tests. All policy and business in the analysis were widely relevant to these methodologies. It needs to be seen if the last DEA model will be built to address all the problems. The Study recommended that the Data envelopment analysis required room for trading, with inaccurate results, and area assurance, and cone ratio description. The usage of many such alternative techniques may be another effective technique by using the cross-efficiency theory, which tests all units with the same weight. Another theoretically valuable tool in the analysis might be to invoke and commonly included in the compilation of programs and research and development portfolios.

(J. Zhu, 1998) research to distinguished the two different approaches for combining different outputs and output stage in the measurement of DEA decision-making systems. A non-statistical efficiency methodology using linear inputs/output programming to weigh the performance of DMUs. The PCA integrated several measurements into new measures specified into measures as a multi-variable statistical tool. All approaches were applied to three data sets in the real world, characterizing the Chinese cities' economic success and generating comparable outcomes. The study clearly suggested that DEA considered many inputs and several outputs concurrently without the need for a previous weight assignment. Further skilled work expected on the reliability of the DEA test. The data matrix D for PCA is a stochastic matrix, and continuity between DEA and PCA means that further analysis of the quality and accuracy of the calculation is needed in the study

(Thanassoulis et al., 1996) scrutinized the descriptive study to analyse the data envelopment analysis (DEA) and ratio analysis as complementary methods to measure the efficiency of organizational entities, including bank branches and colleges. Research showed that the output metrics represented all factors included in the DEA test all approaches match reasonably. All approaches of DEA can vary considerably on the relative output of individual units. The study suggested that unlike DEA, ratio analysis was not considered ideal for establishing goals so that units may become more active. This study helped to conclude that DEA and ratio analysis

compared as alternate approaches for determining organizational units' comparative efficiency. The study of the DEA where total performance calculation has significance in terms of input-output rates that will render a device valid and effective.

Objective 2

The second objective of the research work was to ascertain the relationship of the considered Performance Indicators of Supply chain with Net Sales. For the same, the literature review carried out is detailed below. This helped in identifying the key performance indicators required for the study of the relation between Performance Indicators of Supply chain and Net Sales.

Gelsomino et al.(2019) performed analytical research on the optimization technique for supply chain financing schemes. This review was based on a summary of the other literature. An empirical description of the significant results resulting from incorporating the retailer into three supply chain financial schemes was created in the study. This research addressed the analytical gain formulation and conclusions of the different financial schemes and the statistical formulation. It also sheds light on creating a more comprehensive collection of hypotheses that might formulate empirical expressions for its significant results.

Saudi et al.(2019) analyzed the Impact of Working Capital Management on Supply Chain Performance and Market Development of the Malaysian Manufacturing Industry. Numerous Key Performance Metrics Working Capital, Cash Conversion Time, Receivable Conversion Duration, Inventory Conversion Period, Payable Conversion were chosen for the analysis. The exploratory approach was used to examine the function of Working Capital Management. The cross-sectional research design was chosen using a quantitative testing method. The sample size of 300 is chosen for the analysis. The questionnaire was used to compile the answers. Structured Equation Simulation was used for research. In the study, It was found that Working Capital management has been seen to play a significant role in the supply chain performance of industrial firms. dIn addition, the beneficial impact of working capital on the efficiency of the supply chain improves the business's growth which was also discussed. Components of working capital used in the study are namely;

CCC, RCP, ICP and CFP positively impact the supply chain's output in Malaysian manufacturing firms. Thus, improved control of working capital improves the supply chain's efficiency, which eventually increases the business's growth. Malaysian firms will then address deteriorating profitability by improved control of working capital and the supply chain. It was also recommended that managers follow useful methods for handling working capital resources to increase efficiency. The future study was also Suggested to incorporate other aspects of working capital to the existing model.

C.S.Singh et al.(2019) accomplished the study to review the different performance indicators in the current competitive and dynamic market. This research sought to unravel metrics that aimed to keep the supply chain resilient.130 studies were analysed in this study The principle of resilience is more comprehensive than centralised supply chain management, congruity preparation, risk management, or a mixture of these controls. The outcome of this study showed that there was a large number of fragmented supply chains worldwide, and there was a need to learn about SCR. The future on-site study has also been proposed to concentrate on the methodological investigation of indicators. Generalization of metrics that render the supply chain resilient After classification and review of the collected literature, seventeen success indicators for supply chain resilience were identified. Using these metrics, a sustainability framework for the supply chain was created to help analyse supply chain management and support volatility valuable to a supply chain and its participants.

Turner et al.(2018) focused and examined the framework for understanding managerial responses to supply chain complexity to understand the concept of project complexity, leading to further cross-fertilization of literature. The descriptive approach was used to recognize the possibilities for reacting to the dynamics of the framework, coupled with the personal experiences that have taken place in six institutions to analyze the functional implementation of the framework. The research demonstrated that the first administrators confronted with economic, sociopolitical or evolving supply chain complexities use various responses. Second, more than a third of the complications coded were accommodated rather than minimized by the research companies, indicating that adaptation to the dynamics of the supply chain

may, in some instances, be strategically acceptable. Third, the ambidexterity framework allows for a more detailed evaluation of whether current PM strategies should be considered or whether new approaches are essential to resolve supply chain complexities.

Sharma (2018) delivered a comprehensive study to understand the Indian Aviation Market's performance, which is among the world's most dynamic, fastest-growing markets. This research was undertaken to assess airlines' financial success in India. Jet Airways and Go Airlines' underwent the study as a sample.Net profit ratio, Quick ratio, and current ratio were considered the study's performance indicators. The Structure Equation Modeling and Data Envelopment Analysis models were used in the study. The result suggested that operating costs are lowest in the event of Go Airlines and Spice Jet. Including all selected scheduled airlines, Indigo Airlines' liquidity role in terms of quick ratio was top. The current ratio declined during the study span for all these chosen airlines, an indicator of low liquidity status. The total volume of liquid assets is smaller than average. Present company obligations were culminating in low liquidity—airlines' location. The mean return value of the total shareholder ratio for all selected airlines except Indigo Airlines was negative during the study era. Air India is the bottom producer, and Air India is in the centre in exchange for shareholders' fund ratio. Go Airlines' natural ratio was lowest.

Lambert et al.(2017) scrutinized the Supply chain Management System (SCM) issues and concerns relating to how it could be applied and guidance for the potential study. In study eight cross-functional, cross-firm company structures are used as a modern means of handling partnerships with vendors and consumers. The study focused on collaboration with a community of non-competing executives who have been meeting periodically since 1992 to develop SCM theory and practise. The study provided information about how the SCM framework was improved and extended. Work may help marketing and sales managers remain active inside the company. The study supported the cross-functional teams to incorporate the eight SCM processes through their specialised experience and skills. The SCM system offered the expertise and resources to navigate a dynamic business partnership network.

Sambrani et al. (2017) focus and examined the Impact of Distributor ROI Towards Sales Enhancement in the FMCG sector. Data were collected from 10 respondents each from the 40 FMCG.T test, and the ANOVA test was considered for the study. The study stated that Distributors' ROI (Return on Investment) reflects on market income and how inspiring it is to optimize distributor distribution. Analysis of Supply chain management utilized the empirical evidence gathered from various stakeholders and undertaking a cross-country empirical review The technically and pragmatically substantiated research aspects will serve as an enabler in improving distributor's and companies' emphasis on ROI. The study found that Performance Indicator ROI also provides room for more work in the field of rationalizing the definition of supply chain management method such as-Designing a detailed SCM model for ROI,

Balasubeamaniam et al.(2016) investigated and furnished the study to establish complexities and challenges to managing supply chains of auto components in Coimbatore. The questionnaire method was used to collect the primary data, and the secondary data was selected from the various journals and open data sources. Structure equation modelling, Descriptive analysis, correlation analysis, are used as a tool for the analysis. The study recommended approaches to address obstacles for successful supply chain management. Supply chain management has been a successful technique for addressing consumer demand and supply problems. The benefits of implementing SCM are evident in the context of stronger manufacturer client partnership, accelerated supply movement, decreased delivery times, lowered running costs, and higher consumer service. The supply chain was efficiently handled to make the distribution process more effective and increase its earnings. The analysis explicitly demonstrates that, when a firm's SCM activities change, supply chain efficiency often increases. Adopting supply chain management strategies for sustainability and efficiency is utterly necessary. Alone, productive, and reliable supply chain operations can help the company achieve a competitive edge and sustain long-term success. The research analysis offers practical inferences and conclusions that are very useful in Coimbatore for small and medium-sized auto-component industries

Y.Zhu et al.(2016) Scrutinized the influence of methods to predict the Supply chain finances in Small scale industries. The research area was China's small scale industries. The Annova and the T-test were used to analyze the data. Throughout this article, the study concentrated on that credit risk estimation accuracy for SMEs due to a fraction of improvement throughout accuracy could further ensure SMEs' regular activity, CEs, and SCF financial institutions. IEML methods work better than IML and EML methods. The result suggested that the RS – bolstering is the best way to forecast SME financial risk among six approaches. The Conclusion also showed that a small increase in accuracy might imply substantial potential savings. Conventional statistical approaches have advantages, including active and stable.

Song et al. (2016) delivered a comprehensive study to evaluate the factor affecting the Strategic Supply chain network design this study assessed the significance of individual variables of impact, including political and social characteristics, production characteristics, commodity characteristics, market characteristics and service requirements, in determining strategic position options in the supply chain structure. A structural equation simulation methodology was used to evaluate the impact of these variables. Results showed that supply characteristics, commodity characteristics, target markets, and service specifications positively affected the strategic nature of the supply chain network. This result indicates that network planners would regard demand predictive power and variability, item fill pace, and distribution reliability equally. When developing competitive supply chain networks, the international and social aspect is not a critical problem. The impact of 15 variables on the position issue remains unknown until The result also suggested that more work required to establish the relationships between the calculated variable and the influence of each component on supply chain architecture. A theoretical model for understanding a five-factor supply chain system's impact on position issue was the study's actual outcome.

Nallusamy(2016) aimed to understand the overall performance of the supply chain of small scale industries. For the analysis, 150 objects from 10 main categories were gathered via the Kolkata organization's information system. The ABC analysis was used for the analysis using critical key performance indicators. Complete annual sales,

total inventory loading costs, average protection stock, remaining days payable, prediction accuracy, inventories turnarounds, delivery days, goods are chosen as primary performance metrics for the analysis. Tests showed that introducing a new procurement program helped save the chosen company about Rs. 2.25 lakhs a month in terms of gross product carrying costs. In Conclusion, Study-based analyses such as Market modelling, ABC analysis, KPI estimates, and inventory management decisions were performed. Picked products from the three-year selling details were rendered for a market prediction. Simple moving average, weighted moving average, and exponential smoothing approaches were used to assess market forecasting. The outcome was then linked to real selling results, and a graph was plotted for each of the several products. It was found from the study that ERP offers greater information clarity to minimize mistakes related to a lack of information awareness. The monthly inventory volume was lowered from Rs . 2 Crores to Rs. 1.2 Crores and monthly sales improved from Rs. 71.85 lakhs to Rs. 94.55 lakhs by the current inventory strategy.

Baymout (2015) delivered a comprehensive study to analyze supply chain management in small and medium-sized businesses. The research addresses expanded supply chain operations for SMEs. This analysis also offers three case studies from advanced to underdeveloped. As a result, SCM analyses in SMEs are classified into various categories such as supply chain integration, implementation and strategy, and planning. SMEs see SCM as a customer control exercise and as a one-way operation. The data analysis helped to conclude the complexities in implementing SCM activities in SMEs and was focused on whether such companies were somewhat opportunistic and in touch with very few rivals. SCM may help SMEs develop stronger partnerships with their clients or LEs and thereby have incentives to boost their learning curve. Cloud infrastructure will eliminate the need for substantial expenditure & other criteria, allowing ERP, MRP, and other technologies to be implemented. The study also concluded that SCM was a valuable resource for SMEs to boost their e-business efficiency. This measurement system helped simplify their customers' component-level demands, which, in effect, help raise their own and total supply chain benefit.

Bai et al.(2014) examined and focused on determining the Performance indicators in Supply Chain management. The sustainable supply chain efficiency metrics were

initially addressed. A two-stage approach was used to define KPI and Data Envelopment Analysis (DEA) to benchmark and assess relative efficiency. .Additional research was conducted to assess the sensitivity and efficiency of the KPI collection. The data used in this analysis was illustrative and simulated. Just one model was used for the rough community collection and the DEA. Additional inquiries using a combination of rough collection and DEA models may be made. The two-stage approach uses a rough set neighbourhood, and then DEA supports us in accomplishing this aim. Reduced data sets require fewer administrative data collection. DEA requires a mutual assessment of many success metrics. Too close a rough set, "neighbourhood space" will cause severe knowledge loss. DEA's synergistic efforts are necessary for executives and researchers. The study revealed that the first phase in incorporating such methods and assessing efficient supply chains. The study also concludes that the method can be more effective in evaluating suppliers and other organizational entities' sustainability performance.

Waller et al.(2013) scrutinized the data set and big data to transform supply chain management. That study explored the convergence of supply chain management (SCM) with computer analysis, statistical ana-politics, and Big Data, collectively known as DPB. Data science needs domain awareness and a broad range of quantitative abilities, but current literature is missing. Various fields Statistics, forecasting, finance, economics, marketing and accounting were included in the study. The study described how people could build knowledge on the crossroads of SCM and DPB in the journal of business logistics and take concrete measures to respond to calls for more Big Data and SCM research. DPB reflects the middle stage of our five-year partnership as co-editors. The study further revealed that the connections between our profession and computer technology, predictive analytics, and Big Data are critical obstacles for educating potential supply chain leaders.

Felea et al.(2015) investigated and furnished the concept of supply chain management with the relevance of researchers from Romania. Concept, Definitions, Types od the supply were discussed in this paper. A supply chain involved operations such as purchasing components, output management, and physical delivery infrastructure, assisted by the required knowledge flows. It highlights problems in the

supply chain, such as establishing trust, sharing consumer requirements knowledge, designing innovative goods, and serving consumers. This work analyzed some of the more common supply chain management concepts, applications, and nomenclature. The research concentrated on understanding the most common and popular definitions. These also based on Romanian literature as a guide to introducing and converting the term "supply chain management "into Romanian. The result indicated that the goal was to establish the criteria/attributes based on what university and business members identified over the years. Procurement chain control includes activities including inventory procurement, production planning, and physical distribution network. Supply chain entails challenges such as trust-building, consumer demand knowledge exchange, innovative product creation, and customer loyalty. The study helped to describe the conceptual framework by identifying principles with which supply chain management functions in both analysis and practice.

Taticchi et al.(2013) presented an outline view of the various performance measurements of the Sustainable supply chain. Various literature was reviewed to analyze the results. Research results recognized the growing number of articles, leading writers, leading research papers, researchers' geography, most cited papers, and quote trends. The SCPM system is controversial, with just a limited number assimilating the TBL approach. The corporate sector was responsible for the development of conservation metric structures while academia steps back. The report also indicated that companies would: shift their supply chains to support global growth and leverage the increasing number of mid-size buyers in developing markets. Drive production rates and increase competitiveness in mature industries. Indeed, the company plan includes sustainability. Companies had the potential to develop a comprehensive strategy on issues ranging from supplying ethics to reducing carbon. A strong sustainability campaign includes a systematic approach covering the company's product life cycles. Experts say that conventional life cycle assessment and business operations need to be revised considering all sustainable development. Such companies are usually tall, but SME sustainability development is also out of reach. The study revealed that organizations could ignore unhealthy labour practices or manufacturing, production, or travel events that can damage their brand profile.

Inbound and outbound logistics impacts were also assessed. The first push to put recycling into the supply chain is challenging policies. Effective and equal monitoring/measuring is crucial to communicating optimal success to the primary consumers and industry.

Muhammad Babar (2012) focused and examined the effectiveness of supply chain in Pakistan's fashion industry. Quantitative analysis was carried out and stated a clear relationship between efficiency and procurement and a mild relationship between delivery and distribution network time. Multiple regression and the Annova was used as a statistical tool for the analysis. All independent variables show maximum reliability, i.e., 0.706. Even consistency as a 0.691 score element, showing strong reliability. The other two dimensions are planning and timely delivery showing their respective reliability of 0.547 and 0.519. The result indicated that the fashion industry in Pakistan has developed at a relatively good pace over the past six years. The supply chain played a significant role in fashion industry development was concluded in the study. Result Strongly recommends that the supply chain be given primary importance to keep growing fast.

Choi et al.(2012) addressed simple DEA templates and extensions. DEA was commonly applied to different types of organizations. Many output factors also discussed with DEA. Allocative value and size production returns were obtained before reaching industrial productivity. The principle of technological inefficiency offered a start for any other efficiency forms that the study may consider fascinating. The Analyst concludes that the consideration of distribution and total results when costs or advantages are of interest and information is available. However, this study does not restrict choices for future study.

Pasutham(2012) described a study to examine three companies' supply chain performance in the Thai manufacturing industry. Facility, Inventory, transportation, Internal integration, Human resource and operations are the performance indicators used in the study. This research stated that the measurement industry's supply chain performance has minimal experience utilizing this hybrid process. The study provided a structure with balanced horizontal (cross-process) and vertical (hierarchical) view of developing supply chain in Thailand. The study helped to conclude the study to

identify performance measurement considerations for internal supply and supplier relationship management: maintenance and customer interaction. In-depth interviews were used to understand manufacturers' views on performance measurement factors in the supply chain.

Jalalvand et al.(2011) delivered a comprehensive study to compare the different supply chain in different industries. The system was developed based on five processes presented in the SCOR model with success metrics such as plan, source, produce, supply and return, and the industry's critical business phases. Data Envelopment Analysis (DEA), a multi-criteria decision-making method, compares supply chains at the process stage, market level and supply chain stage. The system was synthesised of current frameworks and techniques to use the SCOR and the DEA model and demonstrated its applicability and power when contrasting to the Supply Chain. The study concluded that the approach created a fresh perspective in the subject-matter of the SCs rankings and offered the possibility to analyze and evaluate the whole SC elements for suppliers to consumers. By implementing the approach's step-by-step steps, many companies also determined their SCs based on their procedures, their market steps, and the whole SCs. Despite the high capacity and applicability of the method proposed, this method has certain constraints and implications. The study helped to conclude data collection from industry experts and practitioners and SCs through interviews and questionnaires. This approach contrasts SCs at a specific time, and referred resulted in different segments was analyzed dynamically.

C. Chen et al.(2011) aimed to examine the supply chain performance with the DEA network model's help. The exploratory research related to the cash flow efficiency of Supply-chain (SC) was an integral component of revenue management was carried out in the study. Data from 42 Taiwanese building companies were collected to quantifies the impact of Cash flow. SC's cash flow contribution contributes 2.73 per cent of financial result variation. The study further analyzed the attitudes of project managers regarding payment terms. This paper also analysed the methodology and provide management with realistic means to assess effects, the study says. This analysis contributes to a broader understanding of behavioural trends. In conclusion, a

more comprehensive assessment of SC payment terms that involve vendors and subcontractors would give management a better view of how the entire SC operates under varying circumstances.

Banomyong et al.(2011) delivered a comprehensive study to develop the performance tool of Supply Chain Management for Small scale industries in Thailand. The performance tool was built based on a systematic literature review. The analyses were piloted on 44 local small and medium-sized businesses. Efficient Information System, Employee Engagement, Complex, Interconnectable, Cross-Functional, Collaboration with Dealers, Manufacturers, Acceptable Performance Measures, Overcome Distrust, Introduction of Performance Measurement System Funds, Top Management Commitment, Supply Chain Performance Measurement System Understanding was chosen as significant criteria for the analysis. It also was found that many SMEs did not know their supply chain costs. The tool further streamlined to make data gathering easier. Although the containment tool was limited, even more research is needed to enhance the tool's explanatory power. In this paper, the author developed a model on the clearly defined theoretical foundation of Nine primary Supply Chain operations, i.e. Customer Care and Assistance, Prediction and Preparation, Ordering and Sourcing., Resource Control., Order Processing and Logistical Correspondence, Material Handling and Packing, Shipping, Site Selection of Warehouses, Storage of Materials, Goods Return and Reverse Delivery. It was found that the performance metrics used in the analysis were Average order cycle time, Average forecast period, Average inventory days, Average inventory cycle time. The study also helped prove that the developed model based on a composite metric can assess firms' overall supply chain performance level.

Longinidis et al.(2011) carried out the research related to the Optimized supply chain network design and introduced a statistical model integrating market volatility and supply chain preparation decisions. The studied models aimed to improve supply chain networks that were the mainstream of supply chain literature. This paper aims to fill the literature void by incorporating a mathematical model that incorporates financial factors into supply chain design decisions under demand uncertainty. The suggested Mixed-Integer Linear Programming (MILP) dilemma included reviewing

financial ratios and market ambiguity by scenario analysis. According to writers, incorporating comprehensive modelling aspects could extend the established system. Work focuses on the following topics: product line philosophy, cognitive science, potential contracts, selling and leaseback approaches, and risk hedging, The study proposed a successful approach to optimizes the design and services of the supply chain.

Amrina et al.(2011) targeted to explain the key performance indicators of sustainable manufacturing evaluation in automotive industries. Quality, Cost, Delivery, Flexibility were the leading indicators used in the study. This paper provided a new compilation of Sustainable Production Evaluation Primary Success Metrics. Potential work will concentrate on creating a viable vehicle manufacturing evaluation method by Confirming the adaptability of initial KPIs for business experience. The initial KPIs focused on combining performance metrics and sustainable development metrics. Original consistency, expense, distribution, and reliability metrics are KPIs used as productivity indicators. Car companies, particularly Malaysia, must pay careful attention to sustainable development. A questionnaire was developed to investigate KPIs in industry. It was concluded that crucial performance indicators analysed the Sustainable Production Evaluation work and provided the framework for sustainable product development. The research also aimed to combine efficiency and success in sustainable development metrics, and runs using skilled engineering experts and vehicles.

H.L.Chen(2011) delivered a comprehensive study to explain the supply chain's cash flow and the Suppliers' payment patterns. Information was gathered from 42 Taiwanese construction project contractors. The paper extensively quantifies the influence of SC cash flow results on construction project contractors' financial performance. Data of 118 functional surveys show significant behavioural trends of project owners about payment arrangements with project contractors during the building contract process. These behavioural trends provide project contractors with a foundation for promoting implementation initiatives to increase SC cash flow efficiency. Within this analysis, the activity patterns of payment terms of project owners analyzed. The work aimed to provide management with a quantitative means

of calculating the impact on the SC cashflow change's financial results. The Study Concluded that a more comprehensive overview of the SC payment terms, which involves vendors and subcontractors, gives management a full picture of how the whole SC works under various circumstances. The study revealed that it would be beneficial to integrate the annual sales and habits of project owners as the project owner's actions could alter significantly.

Shaw et al.(2010) focus and examined the performance measures of developing the environmental supply chain. The paper is focused on a systematic literature review of four main areas: process improvement, supply chain management practices, environment protection and benchmarking. Satisfaction with the participants, Methods, Systems, Power and Contribution of participants were the performance metrics used in the study. This study proposed a structure and measure that allows organizations to effectively track and evaluate environmental supply chain efficiency internally and externally. It was concluded that the paper aimed to demonstrate the current mechanism that introduced an ESCP program. Specific strategic behaviour and methodologies for measuring ESCP also expected to be established. Incorporating the ESCP in the ESCP process would make the natural environment an essential aspect of the policy available to organizations, to measure and equate their ESC with others, the scientific community must build on this structure.

Kaplan(2009) aimed to examine the conceptual foundation of the Balanced scorecard. This paper explores the origins and inspiration of the initial Balanced Scorecard article and the corresponding developments to broader management literature. Profitability, Market share, productivity, Public responsibility, personal development and employee attitude were the performance indicators selected for the study. The study helped to conclude that each of these developments was a logical extension of previous research, each of them introduced themselves incrementally and opportunistically, not as part of the concept's anticipated development over 15 years.

Chae(2009) delivered a comprehensive study to develop Key Performance Indicators of supply chain management and the manufacturing industry's perspective. The study gave the market perspective into supply chain efficiency assessment and realistic approach to the production of performance indicators. The study revealed the gap

between plan and execution and identified and corrected potential problems and issues. To business control, consumer satisfaction, and financial stability, key performance measures (KPIs) are essential. It also recommended that businesses focus only on a limited number of KPIs.The four phases of the SCOR model are preparation, source, processing, assembly, and distribution. The study concluded that the KPIs show the difference between strategy and execution and detect future challenges and issues and fix them. Companies must support organizational architecture, particularly Roles and Responsibilities (R&R) for the effectiveness of performance measures.

Roab (2009) described the study to analyses the Inventory turnover ratio as a supply chain performance. The study was carried out in Indian battery manufacturing companies. The findings demonstrated that businesses increased domestic production to attain high inventory turnover by reducing the non-value, adding behaviour and over-production. The number of occasions a company markets a commodity over a year can be accomplished by successfully integrating IT in all operating activities. A healthy turnover level suggests the company enhancing the industrial distribution of its products. It was concluded that companies would concentrate on the product turning ratio to improve their supply chain performance. ERP programs inform the procurement and supply of products to and within the store, the transfer, disposal or removal, and the appropriate examination, price, and inventory of the goods. In this context, the purpose of the current study was to quantify the effect of inventory shift on supply chain efficiency in India's leading battery production business.

Meenakumari (2009) carried out empirical research to analyse the power supply chain and distributors' liberalisation, often accompanied by the legislative overhaul. Data envelopment analysis was used to analyse the data. In the study, it has been found that administrative amendments designed to offer opportunities to businesses to improve production and organizational performance. The integration of the various steps in the final stage remains a challenging task. Models of benchmarking which can tackle many measurements of success are required. It was concluded that the benchmark share measure specified a rating according to the factor-specific metric.

Shankar(2009) scrutinises the supply chain's performance and the optimal scheduling of supplying the goods. Algorithm of Supply chain finance and logistics were considered to analyze the data. This research summarized research on objective optimization of multi-echelon SCN for advanced architecture, sourcing, development, manufacturing, and delivery decisions. Furthermore, evaluating and comparing various vital parameters helped gain essential management insights about different sell-off situations regarding the total cost involved and the satisfied supply fraction. The study helped to consider minimising the overall cost of making the drug, mainly when demand is lower by closing a few factories, which would improve monetary savings. The thesis also illustrated particle swarm intelligence algorithm implementation for output assessment and multi-objective optimization.

Anderson et al.(2009) focused and examined the strategic cost management in the supply chain. In the Study, Structural cost control utilised operational planning, commodity design and process design techniques to establish a supply chain cost system aligned with a firm approach. Variation analysis, cost driver analysis, dealer scorecards were used as a performance indicator in the analysis. The research discussed cost accounting, which utilizes calculating and measurement methods to determine the supply chain's efficiency. A vast array of recent studies exploring competitive cost control in the supply chain was analyzed within this two-part sequence. New management responsibility analysis has established a tendency to pay accountants a disproportionate commitment to reducing costs. It was also found that the system brings up the tracking and output improvement practices of the supply chain. The advances through two operational cost control fields were discussed through the sequence by collected papers in the accounting, procedures, and policy literature.

Thakkar et al.(2009) focus and reviewed the supply chain management in Small scale enterprises. The study helped SMEs to recognize their structural vulnerabilities, which have been treated as usual thus far. This study also found the increased reactivity of the supply chain with reduced prices and better product consistency. The research findings helped to find that the collections from the single production cluster with 10 SME case organisations. The findings also extended to other situations for

purposes such as globalization forces, evolving circumstances for improved productivity,

Bozarth et al.(2007) delivered a comprehensive study on the implications for the future supply chain related to England's cotton textile industries. The cluster's principle in the manufacturing sector illustrates the overt and implied advantages of spatial proximity for different economic actors. It contrasts with the current pressure on supply companies to search for the 'best' partners, regardless of where they were located. The use of these principles in future work helped to learn how assumptions regarding the supply chain position and product choices were made. Buyers and sellers profit from the impact of awareness spillover. Socialization helps establish interpersonal connections and trust within them. The study brought a new light on the new product growth activities, the enhanced contact of teams with businesses, consumers and vendors were shown to be significant precursors for improved product quality. Such benefits include better consumer management and reduced operating costs.

Angappa Gunasekran et al.(2007) described a review study to measure the performance and metrics in logistics and supply chain management. A report seeks to define the primary success indicators and measurements in the logistics and supply chains. The authors say some of the conventional measures adapted a new environment in which many activities were identified. The research focused on an analysis of literature and the findings of an inquiry. For effective management of SC operations, PMs and indicators are essential, particularly in e-commerce and online business environments. For assessing success in an SC or simulated company setting, typical performance metrics employed. The study further brought light to the performance measures used in a supply chain network identified with the recognition of non-financial measures and intangibles and developed appropriate models for measuring SC systems' performance, including e-commerce and virtual companies. By advancing modern IT systems, vast quantities of data are managed more efficiently, and essential knowledge is produced to make more precise and timely decisions. The paper finished with a suggestion for potential work in Performance Metrics and performance indicators in the Supply Chain market.

Ruth Banomyong (2005) delivered a comprehensive study to measure the cash conversion cycle in an international supply chain. The study was carried out in the shrimp industry of Thailand. The research paper used the sales on the day, inventory sales, and payable sales on the day as performance measures in the study. The study concluded that a thorough evaluation of the factor influencing the supply chain in the measurement analysis and the debtor turnover ratio is the critical factor affecting the supply chain. The C2C was an essential indicator of performance to assess how well a company handles currency. A high C2C is more effective as it turns out its working capital more often a year. This study aimed to evaluate and quantify a global supply chain, namely the export of frozen shrimp from Thai retailers to a leading US retailer. According to scientists, a holistic supply chain strategy is the real secret to success in the C2C. The also revealed that the producer of Thai shrimps and the exporter of Thailand with the help of C2C metric assist the liquidity evaluation and corporate valuation.

A Gunasekran et al.(2004) presented an outline study related to the framework for supply chain performance measurement**.** Order entry method, order lead time, customer order, the capacity of order and total distribution cost were considered as a key performance indicator in the study. In the survey, 66 % of the respondents reported the positive impact of SCM on the market share. For organizations that aim at increasing productivity, the meaningful framework to SCM advocated. The role of these indicators and measurements in the success of an employee not overestimated. A successful SCM system will improve cross-functional and inter-organizational process planning and management. All representatives of the supply chain are involved and dedicated to accepted goals. A robust control system was needed to ensure efficient and cautious measurement of performance throughout the supply chain. A study revealed that the supply chain's performance measures program would seem better suited to a performance measurement initiative across the supply chain. The vision was to enhance interaction between participants so that connections can last a time. New assessments and novel methods were prepared to determine the supply chain's performance as a whole provided through imaginative efforts.

Farris et al.(2002) carried out analytical research to discuss the Cash to Cash cycle metrics to measure supply chain management's performance. The study discussed the Cash-to - Cash (C2C) measure was a crucial phase in bridging inbound supply operation with the manufacturers, production, and consumer outbound transactions. Logistics and supply chain management stress the synergistic cooperation between all supply chain elements results in the lowest net expense. The study helped to conclude that C2C can be measured and discusses the crucial points of leverage. The C2C index is a significant metric for linking inbound supply operations with suppliers, output and outbound delivery, and customer transactions. The study also focused on educating the supply managers to evaluate C2C from both accounting and supply chain management backgrounds involved tests should be highly accurate.

A.Gunasekran et al.(2001) aimed to examine the performance measures and metrics in a supply chain environment. The analysis was carried out in four sections plan, source, Assemble and delivery. Total order cyle, capacity utilization, Just in time and scheduling techniques was used in the study. The study suggested that producers were no longer required to conform rigidly to the specifications but could incorporate a higher premium into the provided products/goods. The analysis was the requirement of the time to streamline information, data, and cash flow. The research revealed a change of focus from traditional cost accounting strategy to a technique that considers running expenses and their impact on specific functions. IT role moves from a passive investment enabler to a super-sophisticated conversion mechanism through repositories. The future holds for a small international supply chain when trade barriers continue to erode.

Beamon(1999) investigated and explored the performance measurement of the supply chain. The Study was divided into the four component supply, manufacturing distribution and consumer. Cost, Activities, customer response, inventory, transport and flexibility are the key performance indicators used in the study. Three evaluation measures were specified as essential components in each supply chain measurement framework. Most current models incorporate ineffective or counterproductive, limited output controls. The performance metrics were selected to boost and enable more comprehensive and accurate research. The research revealed that the groundwork

created a standard system for performance metrics capturing supply chain processes. Supply chain models utilizing this method define the supply chain more extensively. The paper further described the supply chain stability in terms of volume and supply with presents and current flexibility. The supply chain model had fully defined the supply chain system that effects and allowed more total, accurate and thus more efficient model creation.

Objective 3

The third objective of the research work was to study the impact of the Transportation expenses on Performance indicators of Supply Chain. For the same, the literature review carried out is detailed below. This helped in considering the various key performance indicators and tools to be used for the third objective on the basis of previous studies available

Ullah (2019) researched to analyze the leading performance indicators in the supply chain. The Electrical and Electronics Companies were picked, and Exploratory research Methodology was used for the study. Quality, Customer Service, Flexibility, Innovation, Supply Variability, Operational cost, Product variety, Was used as the leading performance indicators. Multiple Regression, Annova and Structured Equation Modeling were used to measure the performance of the Supply Chain. In the study, it was found that the method for selecting the correct KPIs for Seica cannot be overlooked, but data must be not only accurate but also useful, to encourage progress across the organization. It was essential to identify objectives and then develop performance indicators to track the progress towards the objectives. It was also found that companies' workflow and different priorities considerably based on the sector they serve in KPIs. We may also differ widely within the organization itself. Selecting a correct KPI is a process that allows businesses to explicitly define priorities and then create success metrics to monitor their progress against their target.

Masoumi et al.(2019) systematically reviewed and analyzed the different literature papers related to the automotive industry. This article explored renewable production literature written between 1995 and 2017. This study offered concrete guidelines for developing a competitive supply chain for automotive and culminates with identified

knowledge limitations and potential study suggestions. The research provided a process-oriented analysis of auto-SSCM studies. Based on the findings, a five-stage process proposed can be used as a model for an automotive SSC. The product evaluation culminated throughout discovering some fascinating study chances needing even more examination. The study also focused on vehicle industry processes and not reliant on any sample characteristics. The author claimed the work is a convincing possibility for further research. The study was restricted to the quest method, lacking other testing instruments.

Partiwi et al. (2019) aimed to measure the supply chain of Indonesia's strategic and highly regarded commodity ' shallot'. The method (SCOR) and (AHP) were used to calculate each model predictor's weight. The data used in this analysis was obtained from all shallot supply chain operators in East Java Province who were decided through multi-stage sampling from October to December 2016. The study further found that the government will boost farmers' exposure to shallot farming knowledge and creativity, authors add. Price had shown as a quality that must be valued most to preserve supply chain efficiency. Findings indicate that manufacturing and marketing cost management can improve supply chain profitability, they add. This finding's consequences were linked to chain-wide process coordination, cost savings, openness, and accountability among shallot supply chain stakeholders to enhance their efficiency.

Peng et al.(2019) Scrutinized the influence of the working capital management in Supply Chain from a single company viewpoint. Cash to Cash model was used for the analysis of the study. The NPV value and the company's working capital were used as a performance indicator in the study. The equilibrium approaches were demonstrated that the payout cycle would maximize if the retailer's discount rate is higher than the supplier's and vice versa, irrespective of the degree of cooperation. The study incorporated payment cycle optimization into the newsvendor model to optimize total supply chain benefit, taking into account chain members' engagement. Research also suggested three models representing various participant collaboration levels: non-cooperative, bargaining, and organized. Transfer payment systems are structured to ensure each participant served in cooperative co-operation. In this study, the Nash

negotiating formula and the Stackelberg test were used to determine each chain leader's best payout time in increasing income. The study helped to conclude that holding cash in the pockets of big discount rate firms may be more

Chuda Dhakal(2018) Presented an outline to understand the interpretation of the SPSS example of evaluating multiple regression performance is concise and intuitive. The study demonstrated that the understanding of multiple regression output obtained via SPSS is informative and intuitive from now on and can be used as a template by academics, students, and related faculties. In contrast, each of the related faculties can use real data for problem-solving analysis and studies.

Parsun(2018) focused and examined the relationship between supply chain performance, management factors, and manufacturing industries' organizational performance, which has been influential in growing its success over a few years. Another well-structured supply chain network will dramatically increase profitability, promote new business growth, enhance consumer service, and reduce operational costs. However, in global markets, growth is growing, contributing to more intense production of modern supply chain technologies and complex network architecture, the study says. The study states that supply chain networks also need to be re-evaluated to satisfy consumer demands, increasing prices, and complex, competitive pressures. Which claims it is trivial to undervalue global supply chains' sophistication. This study's fundamental goal was to determine the significant driver to enhance supply chain and organizational effectiveness. The result of the study provided the tools to use them to improve decision-making in supply chain efficiency. The results illustrated the primary variable that influences supply chain companies' success in Tamilnadu-based supply chain management firms. Organizations' effectiveness relies heavily on their ability to plan and develop their supply chain network to optimize customer benefits. The world's supply era. Chain management, where companies and firms do not live isolated in isolation. Adjust to ever-changing global demands via a supply chain process generating interest distribution network. The research presents SCM administrators with a valuable method to assess their existing SCM performance's comprehensiveness. It requires skills that enable a

company to separate itself from its rivals and benefit from essential management decisions.

Ambe(2014) Scrutinized the different strategies of a supply chain in vehicle manufacturing industries in South Africa. The SCOR method was in the study to analyze the strategies. The four areas were analyzed in the research, i.e. performance of delivery, Cost of transportation, flexibilities in actons, and Assets management. The results showed high quality, the efficiency of final product distribution, and expense. Innovation (radical and gradual changes) was the least of the metrics analyzed. The study revealed that competitiveness in cost, quality, and product offerings is paramount in today's turbulent environment for automotive manufacturers. The finding also indicates that in the automobile sector, the price was not negotiable. There was not any significant price disparity between Japanese, American, and European cars. European producers had many essential characteristics of flexible supply chain (such as agility) requirements utilized by European and Asian producers.

Potter et al.(2014) presented an outline report related to the implication in Supply Chain Management. The literature review was done in the five areas of information, IT, Automation, advanced analysis and integration. The literature survey analysis showed that the effect of smart supply chain systems could be innovative and impressive, authors add. Authors claim the identified potential research problems are fascinating due to the unfilled value-creating possibilities mentioned in the review. Increased this use smart features and functionality in different distribution networks also creates more opportunities for empirical studies, which they say can be extremely useful in providing more relevant insight yet. It is the writers' confidence in potential studies. The analysis revealed that the study was fascinating as they offer more opportunities in the field of the Supply Chain.

Sambasivan et al.(2013) delivered a comprehensive study to explore the factors influencing the supply chain alliance, motives and assets specifications. Structure Equation Modeling was used to analyze the data. 2156 samples were collected from the different manufacturing industries form Malaysia. The research explored strategic motivations, environment, transaction costs, understanding of immoral conduct, and

equity on strategic relationship performance. Work contributes significantly to recognizing strategic alliances and may help managers identify variables that impact strategic alliances efficiency, scientists say. The research establishes comprehensive and efficient supply chain collaborations—Earlier theories proposed to explore how these inter-company relationships were created. This research takes theories, resources, contingency, group dynamics, and personal relationships from transaction costs. This study hits the role of earnings management in handling opportunism and volatility in relationships. This research could be because asset-specific investments not shared with Malaysian producers. Around 70% of industry monitored the They concluded that brand coalitions in their industry were not successful. The result indicated that the need for a paradigm of expertise in creating and maintaining a collaborative relationship is evident.

Ibrahim et al.(2011) scrutinized the influence of supply chain management practice in Firm performance. This paper examined SCM activities by electronic manufacturing organisations in Malaysia and described the connection between SCM practices and firm results. A self-governing questionnaire-based survey methodology was used to assess SCM acceptance and SCM activities important for Malaysian electronics manufacturers. Data processing was carried out by managers of industrial companies and marketers of consumer goods. The chosen managers came from diverse industries and played a leading role in the administration of operations and supply chain management. This analyses helped to conclude the paper that addresses SCM activities carried out in Malaysia by electronic fabricators. In Malaysia's production industry, the adoption of SCM is not very significant. The companies that have progressed in SCM have benefited from SCM's success, particularly concerning revenue growth.

Neeraj Anand (2010) described the theoretical study of the retail supply chain's key performance indicators. Data selected from public sector interventions in Indonesia since the 1990s to 2015. Return on investment was considered as leading key performance indicators in the study. This study showed that greater validity, a holistic design, and a better classification of indicators had boost organizational project efficiency. The un-organized retail model tested in various geographical regions. It

was found that the impact on the financial results of companies in the identified categories of KPIs in other developed and developing countries can be repeatedly assessed. The conceptual model was also proposed to measure the connection between recognized performance measures and asset returns.

R.Singh (2010) described the concept to analyse and confirmed performance metrics of non-livestock retailers in India. The researchers defined the knowledge sources, analysis techniques, testing methods and research schedules. The terms, approaches and procedures used for accurate and productive research are selected for the study. The study concluded that Indian retailers realize the battle between supply chain operations and competitive edge. Inventory-focused companies have a high degree of learning and development. It was found from the empirical analysis that that higher-level respondent was unwilling to spare time filling the questionnaire. Very few CEO / President / Vice President / GM / AGM replied. As many as 100 management-level respondents engaged in the analysis. They provided useful answers and were instrumental in advancing this work. Many of the lower-level employees, i.e., department store managers, ignored complete awareness.

Trkman et al.(2010) specified the impact of Business strategies on supply chain performance .the Study carried out the empirical research to measure the analytical capability of the supply chain, source, production, and service region and its efficiency by using knowledge process support systems as moderators. 310 businesses samples were selected from the various markets of the USA, Australia, Canada, Brazil, and China have been interested in Structural Equation Modeling. The SCOR model was selected for the analysis. The findings showed that the association between research capacities and output is statistically significant. The modification of IT service has a far greater impact than the influence of business processes' alignment. The research offered a clearer picture of the areas in which market research may have the most effect. The study indicated that regions could influence the actual application of Business analytics SC's output. Such findings were replicated in a vast number of companies from different sectors and nations. Throughout the business point, the report assessed the business processes orientation.

Felea et al.(2009) scrutinize the supply chain strategies as concerned to supply chain management. The evolution of Supply chain strategy, Warehouse, transportation, total cost management and logistics management were also discussed in the study. The strategic design specified the chain's structure, the distribution of resources, and each stage's procedures. Supply chains were a core part of the global economy today. It was concluded from the study that each technique of the supply chain extends to all forms of goods. Designing and operating a supply chain was difficult to reduce overall systemwide expenses and sustain system-wide quality rates. Current market developments, including the externalization of materials, offshoring, and lean manufacturing, which rely on rising supply chain costs, significantly raise the supply chain's risk level. It was also concluded from research that supply chains must be structured and controlled to remove as much complexity and danger as practicable and efficiently tackle the residual complexities and risks.

Armyan et al.(2007) aimed to examine the performance measurement in the agro-food supply chain. The conceptual paradigm for integrated supply chain efficiency assessment was tested in the Dutch-German tomato supply chain through an approach as a case study. Service effectiveness, operational efficiency, responsiveness, costs, assets, and resources were used as a primary key performance indicator in the study. The case study concluded that the vegetable supply chain measurement system's critical performance components had been identified as four key categories of performance measures-efficiency, flexibility, responsiveness, and food quality. The research included the income, returns on expenditure, inventory, manufacturing expenses, lack of revenue, backscreens, storage conditions, and transportation for the analysis. The study revealed that the supply chain members understand the entire supply chain's achievement and the different aspects of their organizational success.

Y. Chen et al.(2006) described a study to define Data Envelopment approach to Supply Chain Efficiency. The study was done form the supplier and consumer point of view. the research to discuss the central management and dispersed management situations, the DEA productivity for supply chain operations was also examined. With the help of the numerical example logic was explained in the research. The research includes the two productivity roles of the supplier and the dealer. The retailer and

distributor games seemed to have many Nash balance sheets. The results suggested that the increased number impacted the results and examined the technical and effectiveness in nonlinear returns to scale.

Seth et al.(2006) Investigate and furnished the framework to measure the quality of supply chain management. A literature analysis of core service quality models and evaluation problems was undertaken. Various dimensions relevant to the standard of service have been discussed. In-depth exploratory interviews accompanied this at multiple stages. The methodological method for assessing the standard of service in the supply chain was selected for the study. There were significant similarities or differences between the specific transactions/procedures. This concept meant to be very helpful for the manufacturing efficiency in supply chain management. The efficiency of the supply chain depends on varying degrees of two-way deficiency. The study suggested significant customer repercussions. The first insights derived from this study indicated a model of the compositional quality of supply service. The chain was valuable both for academicians and policymakers.

Walter (2006) aimed to examine the role of efficiency and effectiveness in Supply chain management. The paper employs a desk-based approach to data collection, which offers an overview and review of the problems. Revenues, Working capital, and fixed asset are selected for the study. The study discussed the management of supplies which was cost-friendly and tried to offer adequate service levels. By comparison, a broader viewpoint on partnership management was the demand chain strategy, assuming that two intersect and productive management combines them. The management of supply is cost-effective and aims at an adequate service level. The study helped to consider integrating the two models, which played a role in an effective management process. The work also recommended how the methods should be adopted and Incorporate the strategy, which stated the impact the cash flow.

Reiner et al.(2006) outlined a view on the efficiency analysis of the supply chain process. An empiric benchmarking analysis was carried out in study with a sample of 65 European and North American corporations. The data envelopment analysis was also used for measuring the efficiency of the supply chain. The work utilized the SCOR model's findings, an industry practice widely recognized. In assessing DMUs

with a production strategy, methods used the variable scale DEA model (BCC). The study showed that how effective practice approaches suggested from DEA research as goals for improvement. Efficient DMUs have provided instances of best practices. The study concluded that the findings reinforce our key conclusions that affect the supply chains to guide the steady financial output. The recommendation to supply chain administrators was to focus mainly on client classes, postponement, and distribution processes. The study of the correlation coefficients underpins simple expectations that effective supply chains achieve enormously financially. The logistics cost generators are crucial to the profitability assessment. The findings also suggested that the decentralization of the mixture phase improves output.j

Wang et al.(2006) delivered a comprehensive study to measure the efficiency and implications for supply chain management in European container terminals. The performance and size properties of 104 European container terminals with an annual throughput of more than 10,000 TEUs in 2003, spread through 29 European countries, was obtained from data envelopment research. Compared with their counterparts in Scandinavia and Eastern Europe, terminals in the united kingdom and Europe found to be the most powerful. New container ports claimed to face much more fierce competition than before, and modern container ports need to think at all the factors affecting port performance, both externally and internally. The analysis was conducted to build correct metrics and gather data on these more ephemeral port-efficiency determinants. Communicating DEA findings to the port area and its clients, the liner shipping sector was required to extend this research corps. It was important to remember that while the DEA-derived results provide valuable information on optimum output 'theoretically,' these results should always be viewed with precaution in practice.

Peterson et al.(2005) scrutinized the factor influencing the strategic alliance in supply chain manufacturing Industries. A sample of 2156 companies representing different manufacturing industries in Malaysia was selected through a questionnaire survey model. Structure equation modelling was used as a research model in the study. The research helped to conclude the impact on the product and indirect means on the financial performance by the appropriate management with providers. If planning

would be to be successful, companies continued to communicate both through classical communication channels or linked information technology, authors say. In five of the eight joint preparation processes, they claim that purchasers and supplier companies' confidence rates have positively linked performance. Research sends a clear message that innovation could not be the total solution, while IT was critical to interprofessional management planning.

Borgstrom (2005) presented an outline view on exploring effectiveness and efficiency in the supply chain. A conceptual text explains and evaluates results and productivity as behavioural buildings. Supply chains are reliable and competitive because the operation plan's market value matches the consumption demand requirements. The method of measuring value development consists of procurement/sale, teamwork, and networking. The results rely on reciprocal and shared interdependencies and can exploit operation. Integrated tasks balance ordinary capital, and available resources accomplished. The efficacy is constrained by how the mechanism for a particular exchange between two parties is contextualized (consumer and supplier coalition). As a result, the study value of usage was combined for the network requirements, internalized and resolved as profitability goals in concurrent partnerships. Supply chains depicted to be successful but not efficient from the perspective of particular players.

Patel (2005) described a study to discuss India's businesses to follow modern approaches, including the supply chain's operation. ICAS framework, Brown's Framework, was used for the analysis. JIT, TQM, and SCM models were also used to analyze the study. This work intends to resolve the estimation deficit in developed countries. It explores SCM and its efficiency significance and comprehension. The results found assessing what to assess in the Indian automotive supply chain and its applicability. The technique used for this study primarily built upon the analysis of literature on questionnaires and primary data, which was collected in semi-structured and exploratory SCM interviews. The study highlighted the research's primary factors: cost competitiveness, cash cycle, cycle time reduction, and inventory management. Manufacturing and inventory, Transportation, financial efficiency, customer satisfaction, time, supplier relation management, information management

were the 7 measurement sets were widely based classes that integrate an Indian market and organisational environment.

(Arend & Wisner, 2005) carried out the research related to the Supply chain management, which provided quality, cost, customer support, influence, and risk reduction economic advantages. Inventory turnover ratio, Stock management, Return on investment, and working capital are considered as the main key performance indicators in the study. Multiple regression and SEM is used as the main statical tool for the analysis. From the study, it was found that Supply chain management is more likely than others that small and medium-sized companies that did not give considerable importance to strategic areas, including product development, product, or service quality. The more substantial Supply chain management companies, the higher the negative causal relationship between Supply chain management's performance and small and medium-sized enterprises. The study also showed that Supply chain management is poorly adapted to supply chain business practices.

Bagchi et al.(2005) carried out the survey in Europe regarding supply chain integration. A mail survey was carried out to explore the scale and essence of the convergence of the supply chains in 149 firms to summarise the present status of the supply chain of European companies. Using mathematical analysis, the research aimed to explain whether an improvement in supply chain integration's intensity shows a concomitant increase in operating efficiency. The majority of companies are pretty cautious about data sharing. It could be concluded that a negative relation was found between supplier length and system performance, like total transportation cost and distribution and return rates. In most industries in Europe, supply chain management is more a concept than fact. Most organizations were concerned about critical data sharing. Benefit reduction might be a valuable idea.

Wong et al.(2005) presented an outline study of Supply Chain Management practices in toy supply chains. In research, a comprehensive and comprehensive case analysis was analysed. The surveys of 11 European leading toy retailers contained quality semi-structured interviews and a questionnaire. This result indicated that theoretical limitations in the present SCM theories could be one of the main reasons for these observed functional gaps in the dynamic toy supply chain. The thesis centred on the

advancement of analytical and technical solutions to the competitive and uncertain business climate. The study described the philosophy and the hypotheses of the supply chain preparation and supply chain execution.

Vincova (2005) targeted to explain the use of DEA model to measure efficiency. In conclusion, it was said that there are several methods in our modern society, either based on the traditional approach or based on IT. The calculation technique of performance split down into three major categories: average, parametric and nonparametric methodologies. We primarily focus on the inputs and outputs of business while determining metrics for calculating performance. This paper did not distinguish a productive and inefficient structure, but it attempts to explain potential approaches to assess performance and recognize the effects of analyzes. The research identified the selected unit's "relative" efficiency but did not estimate absolute efficiency. In specific terms, it shows us how well a unit performs according to specified parameters for a specific category. The DEA method was based upon extreme points and compared each unit with the best performers. This outcome of the structure makes DEA analysis more sensitive to data structure and errors.

Huan et al.(2004) delivered a comprehensive study to review and analyse the supply chain operations reference (SCOR) method. Operational, Design, Strategies were used as the main cateries for research in the study. The model was distinguished in four categories source make, delivery and plan. Although computational and theoretical models suggest addressing organizational and architecture challenges, there are few systematic models for strategic planning. The Business model was a strategic planning technique that helps managers reduce the complexities of supply chain management. The supply chain council created a supply chain management model. It was powerfully developed in manufacturing processes and is about to become an industry norm facilitating supply chain management over the next decade. The study brought out the light on the SCOR paradigm that analyzed its effectiveness and vulnerability and explored how managers may help them make strategic decisions. It was used as a distribution paradigm for assessing, positioning and delivering supply chain technology applications. It is in its growing period of life and has the potential for being a market norm.

Yusuf et al.(2004) investigated and furnished the Supply chain capabilities and competitive objectives. In the study, 600 UK agile production firms participated. The analysis was guided by a theoretical model connecting supply chain policies with strategic goals. This paper discussed the evolving trends in the convergence of the supply chain and investigated the link between emerging patterns and strategic goals. There was little impact on the research on the conventional paradigm of partnership action. Lean and agile supply chain models do not harm competition and system performance. Assimilation would necessitate the sleek model to improve Internet-based data, include several lean system competitors, and focus on cohesive design and production. However, rather than cost and quality, the efficient supply chain influenced costs and time-based new product introduction objectives.

Castelli Lorenzo et al.(2004) focus and examined the DEA model to evaluate efficiency related to the hierarchically structured units. The numerical examples were considered in the study. It was concluded from the study that different rates of cooperation between subunits of the hierarchical structures were meant to be addressed in the two-stage scenario. They impose balance restrictions and equate the two separate models, while other types of synchronization ensured the overall relative output of a DMU measured by analogy with all current sub-units in both situations.

Halkos et al.(2004) investigated and furnished the study related to the Greek commercial banks; Data Envelopment Analysis was used as a statistical tool to measure the efficiency. The data used in the analysis were gathered and evaluated from the banks' accounts and profit and loss reports. Several parameters are used to investigate bank performance, such as financial ratios, each ratio offering technological performance guidelines. Confirmatory factor analyses may be used as a replacement or a supplement to ratio analysis to measure a person's effectiveness. The efficient frontier management approaches appear to be better than the traditional standard measurement of the financial ratio. DEA is used to compare financial measures because DEA offers one goal-scorer, ranking, and future success targets per each DMU entity. The results obtained from the DEA Input-output prototype should be carefully regarded due to some of the variables' extreme correlation coefficient. In DMU success evaluations, it was essential to use DEA and ratio review to support one

another. The study concluded that the Greek financial sector's efficiency has a clear connection between quality and size. The factors mentioned above suggest that bank profitability is less due to the increase in traditional banking functions in the Athens stock exchange sector and more because financial institutions have become more involved.

Quayle (2003) scrutinized the influence of supply chain management practices in UK industrial small scale Enterprises. The findings, focused on a sample of 288 companies, suggest a lack of successful transition to the new competitive supply chains from general opposing partnerships. The study further helped to conclude the policy, planning, promotion, cost management, and teamwork. The creation of manufacturers, e-commerce, and workers' production is the least priority for small businesses. Small businesses needed to consider the expectations of their clients and the preferences of their suppliers. In terms of SME market development and profitability, consumer superiority is a significant aspect.

Sahay et al.(2003) delivered a comprehensive study aimed to examine the supply chain practices in Indian Industry. A joint survey of 156 organizations carried out in the paper .the four dimensions supply chain strategy, supply chain integration, inventory management and information technology was considered in the study. The study discussed that the Indian economy needed to spend 14 per cent of its GDP on warehousing with a gross domestic product (GDP) of over 474,3 billion dollars. India's supply chain approach matched with company policy by streamlining supply chain management processes. The study has consequences for indigenous enterprises. This analysis proposed that the supply chain approach combined with the company plan by Indian organizations. In India, the trade between industry and company is in its infancy. The research enabled the local economy in other developed economies to determine their supply chain activities. The work paved the way to more detailed studies on essential processes defined for managing supply chain activities. The research concluded that IT could streamline supplier management processes to achieve organizational efficiency and create relationships to optimize inventory and benefit.

Hollings et al.(2003) carried out the exploratory research to analyses the use of ratio in the Data Envelopment Analysis. It represented the fundamental process of output or the complexity of the usable data. This research discussed the DEA structure utilized by the lender, Charnes, and Cooper when applying a ratio model. The study helped to conclude that the data in utilizing DEA ratios can be followed. The usage of ratios is often unavoidable, and the BCC DEA method must use in these situations. When not, the results would be grotesque and technologically inaccurate, it was essential to follow the underlying model carefully to ensure that the outcomes match the underlying development pattern as always in DEA.

Narsimhan et al.(2002) explored the effect of supply chain integration on the relationship between diversification and performance. The research was conducted in the manufacturing firms of Japan and Korea. The article suggests that the synchronized application of SCI and liquidity strategies has an important impact on company performance although Multiple regression was used as a statistical tool in the study. The study also suggested that the SCI might impact a moderating variable on the curvilinear interaction between sustainability and efficiency. External supply chain alignment and external collaboration with vendors and consumers would simply be a precondition for excellent goods and IMDs. In a limited period, the systematic development of SCIs was not quickly accomplished. Thus, the company needed to gradually shift towards other SCI strategies from these SCI strategies, delivering sustainable results as the diversification rates increase. The study also concluded that the link between systematic SC integration and diversification strategies was indispensable to pursue renewable performance growth.

Meza et al.(2002) presented an outline review to enhance the description between the effective Decision-Making Units. The study suggested that potential approaches address technique interdependence and appropriateness for individual situations to overcome DEA deficiencies. The model used different methodologies (BCC, CCRO)to analyze their basic features and explain their properties in various ways. The study recommended that the approaches presented are substantially different and may, therefore, be applied in several respects to strengthen the differentiation between

various strategies for processing data and address DEA's shortcomings in data analysis.

Alder et al.(2002) delivered a comprehensive study on the raking methods of Data Envelopment Analysis. The analytical research was used to analyze the fuzzy logic, guaranty areas, and Discrimination severity functions that provide extra details compared to standard DEA tests. Cross Efficiency, Super efficiency and Benchmarking ranking methods were also used in the analysis. All policy and business in the analysis were widely relevant to these methodologies. It needs to be seen if the last DEA model was built to address all the problems. The Study recommended that the Data envelopment analysis required room for trading, with inaccurate results, area assurance, and cone ratio description. The usage of many such alternative techniques may be another effective technique by using the cross-efficiency theory, which tests all units with the same weight. The DEA's Slack Based tool in the analysis had invoked and commonly included in the compilation of programs and research and development portfolios.

Tan (2001) examined and study the framework of supply chain management literature. This article discussed the literature and development-related supply chain management. It often addresses numerous supply-chain management strategies and supply-chain management conditions. This analysis aimed to clarify precisely how the word used to describe different aspects of the business. The various processes associated with supply chain management of the study conducted by the International production capacity Managers Association (ISM). Combining buying and transportation functions with other vital corporate operations had created a tightly integrated set of production processes. The findings suggested that the behaviour study was significant to sell products and services more effectively and reliably to consumers and colleagues. Many companies, including forming strategic relationships with suppliers and distributors, followed a structured supply chain management approach.

Jacobs (2001) delivered a comprehensive study to investigate alternative methods to examine the hospital's efficiency. Data envelopment analysis and stochastic frontier analysis are the maim statical to used in the study for analysis. The result revealed that

with previous research, the profitability differences between trusts and taxpayers' gains from raising lower performers will still be relatively small. The research results were also found fit to extended scoring precision and robustness through DEA and SFA techniques. It claimed that fundamentally, contrasts might not be the right approach for individual trusts to evaluate the relationship between sets of scores(responses). A large volume of random" "noise" "existed in the study that may be confused for inefficiency unless the DEA's analyzes used the same set of metrics.

(Moss & Stine, 1993) investigated the connection between cash exchange period duration and retail firms scale. The study also tried to evaluate the connection between capital exchange process duration and cash flow to the company. The inventory and the sales-related performance indicators are considered in the study Limited business companies are more likely to boost their CCC by practising techniques that raising their production or turnover times or both. The study helped to conclude that the revenue exchange period duration inversely linked to the company's cash flows. Because longer cash conversion times correlated with smaller businesses, this created an excellent motivation to plan their cash conversion process properly. Contrasting the cash exchange cycle with current and quick ratios implies intense contact. The result was also found that Small business owners should be mindful of variations in the cash flow and current liquidity ratio static values. Although high current and rapid ratios were generally beneficial, they may indicate unnecessary expenditure in working capital.

Objective 4

The fourth objective of the research work was to evaluate the relationship between the Net sales and the Transportation expenses for the considered companies. For the same, the literature review carried out is detailed below. This helped to understand the relationship between the net sales and transport and evaluation tools to be used for the fourth objective.

(Cheng & Chang, 2018) carried out a study to understand the role of seismic risk management in the development of resilient cities. A priority challenge generated by the small expenditure of governments arising from the situation of global economic

distress. The net sales and the transport expense considered as the main key performance indicators in the study. A system of policy support may help policymakers adopt policies on disaster risk management for sustainable growth. A case study carried out in the Tainan Metropolis district of Yongkang in Taiwan. The results of the study suggested an operational framework and proposed planning appropriate policy objectives in a rising management unit. A decision support system can provide the recommended theoretical framework. The findings of this analysis were very helpful for strategy and execution on disaster risk management. In the process of decision-making, integration of several dimensions through a systemic framework needed when addressing the priority problem in the implementation of policies.

Kumari(2017) carried out the study to investigate a way to optimize the performance metrics of Supply Chain Management. Planning cost, Transportation cost, Lead time cost, Carrying cost, and Ordering cost were the key performance indicators selected for the study. Exploratory research as a model and regression and DEA were used to analyze the study. A thesis is a systemic approach, requiring no qualitative research. Within this report, an idea provided as to how optimization strategies differ from industry to industry, and from the results, it comes to know that the transport component of the supply is the primary element in most industries. As we all recognize, transportation plays a significant part in ensuring a transparent supply chain and the expense of sustaining movement from production to distribution. Logistic systems and logistic structures are outbound. For this research, the focus or analysis was outbound because most businesses find that the inbound processes are taken care of to boost the chain's efficiency, and other businesses have multiple measures at the initial stages to boost the chain's output. Therefore, the analysis narrows down to focus extensively on the chain's transport portion, where the stage costs were listed. Optimization methods are used to maximize supply chain main components. The result also indicated that supply chain performance indicators do not restrict the number of samples, and the model supports other optimization items.

(P, 2017) carried out the study to understand the relationship between supply chain performance, management factors and organizational performance of manufacturing

industries, which has been influential in growing the company's success over a few years. The fundamental goal of this study was to determine the significant driver to focus on to enhance supply chain and organizational effectiveness with the help of the Net sales and the considering transport as the main key performance indicator. The result of the study clearly provided the tools to use them to improve decision-making in supply chain efficiency. The results illustrated the primary variable that influences the success of supply chain companies in Tamilnadu-based supply chain management firms. Organizations' effectiveness relies heavily on their ability to plan and develop their supply chain network to optimize customer benefits.

Deepak Bhimrao Magar(2016) carried out research related to the supply chain of retail and manufacturing industries in India. As a sample, 15 industries were selected from the Aurangabad. The well-prepared questionnaire collected the data from the 113 respondents. The Exploratory research model was used in the study. Multiple regression, Annova and Structure equation modelling was used to analyze the study. The result suggested that Supply chain management's key elements played a significant role in recognizing SCM's roles that were better articulated to workers in industrial sectors than retail industries. Quality was enhanced, including articulate and agile functions in an enterprise. Buyer-Supplier partnership is too important to influence SCM issues and difficulties that occur due to demand differences and volatility. The mean for both MSCM and RSCM demonstrates the variation in the value of difference. The analysis also suggested that male workers are more receptive than females. The highest result was 4.14 in segment A and 4.20 in segment E among females among male workers. For buyers-suppliers relationships, M SCM is more relevant than R SCM.

Seiler (2016) investigated and furnished the research to understand the German plastics manufacturing sector's supply chain. The mathematically comprehensible model was used for the analysis. Along with the mathematical approach, Multiple regression was also used for the analysis. The Secondary data of supplier and customer from 30 German industries were selected for the study. This research focused on one industry's supply chain production. It was found that narrowing a value assessment distance from the growing significance of supply chain networks

showed a strong impact. It could even be worth investigating how performance results can be translated to market apps, they add. The research also claimed that Companies would get profit from applications that understand simple network orientation.

Asare et al.(2016) targeted to explain the Supply Chain Management (SCM) practices In Ghana. Agrochemical Industries was selected for the study. The survey was conducted, and 200 responded were interviewed for the analysis. Convenience sampling technique was used to obtain information from both the management staff and the consumers. In the study, it was found from The study reveals that international and domestic manufacturers, dealers and customers, along with agrochemical firms, shape the supply chain; and suggests low supply chain management activities within the supply chain of agrochemical companies. The suggested that the supply chain aims to balance demand with supply and to do that with a limited inventory. Various facets of optimizing the supply chain involve connecting manufacturers to reduce bottlenecks; purchasing wisely to find a compromise between the lowest commodity cost and transport; applying JIT (Just In Time) strategies to improve production flow; ensuring the correct combination and position of factories and warehouses to satisfy consumer markets, and utilizing perfect locations.

Siddhey (2015) focused and examined the Efficacy of supply chain in manufacturing industries. Automobile, Auto Ancillaries, Steel and Pharmaceutical manufacturing industries were selected for the study. the Survey was conducted, and IT, Strategy, Transportation, Supplier relationship, Customer relationship and quality were used as the primary key performance indicators in the study. .Cronobac Alhs, T zest, Z test statically tools wee used in the study. They measured the effectiveness of supply chain management in Indian industrial organizations. The study suggested that Supply chain management is a method in multiple companies to improve their overall efficiency. Growing income by reducing costs and pleasing end-customers is also beneficial. Supply chains practically occur in any company, which is especially noticeable in industrial sectors. Various researchers' research work in Supply Chain Efficacy or Supply Chain Performance or other related fields was discussed. It was found that the effectiveness level of the Supply Chain Effectiveness Element between

Steel Manufacturing and Pharmaceutical Manufacturing Organizations. Whereas, variations in the effectiveness of Product, Warehouse and Production, Distribution, Efficiency, Manufacturer Relationship, Consumer Relationship, Knowledge Network and Supply Chain Effectiveness Policy Measurements organization of steel manufacturing was also noted.

(Muhammad Babar, 2012) carried out a study to identify the utility of supply chain management in Pakistan's apparel industry. The aim was to see whether there is some supply chain connection to fashion industry development. The research was conducted in firms, using primary research tools primarily questionnaire. Quantitative research was conducted, which showed that there is a strong relationship between quality and procurement and a moderate partnership of timely production and preparation as independent supply chain variables on the fashion industry in Pakistan. Of all independent variables(transport), sourcing as an independent variable shows maximum reliability, i.e., 0.706. Even consistency as a 0.691 score element, showing strong reliability. The other two dimensions are planning and timely delivery showing their respective reliability of 0.547 and 0.519. The result indicated that the net sales fashion industry in Pakistan has developed at a relatively good pace over the past 5, 6 years, transportation plays a significant role in fashion industry development. Result Strongly recommends that the supply chain could be given primary importance to keep growing at a fast speed.

Kohli et al.(2011) carried out the empirical research to depicts the importance of collaboration of supply chain (SC) arena in Larger organizations and businesses. The factors included in the study was Information Sharing, Personal Interaction, Trust, Goal Congruence, and Joint planning. The study concluded that the widespread exchange of information, joint planning, and information systems increases the importance that cooperation has perceived. Larger organizations and businesses that work together widely appear to regard partnership effectiveness more highly. Our findings show that comprehensive knowledge sharing, joint planning, and information systems' use continue to increase the importance of cooperation perceived upon adapting to substantial company-specific consequences. The only conceptual alteration we could connect to SC efficiency was the congruence of the goal. The

study verified that Supply chain cooperation was characterized by the exchanging variables jointly. Planning, joint problem solving, assessing, and optimizing joint performance. The core dimensions of collaboration were included in the inter-organizational scope, joint planning and a shared vision to achieve collective targets.

Bouchery et al.(2010) focused on and analysed the sustainable supply chain's key performance indicators. Transportation and Warehouse were concluded as the main factors of the supply chain for the study. This paper's purpose was to include assessment methods for the sustainability evaluation of the results of DSCs. The study recommends using the standard set of quantified KPIs to conduct this evaluation. It was concluded that the methodology for building KPIs in the sense of sustainable DSCs following a review of the current literature; this approach was explained and validated by SD managers. An experiment with a retail chain company was planned to compare SD output in multiple distribution nets to continue this validation process.

Garcia Sanchez (2009) aimed to examine the scale efficiency in Spanish Urban transport. Data Envelopment Analyses compare the effectiveness of transport agencies. Supply, demand, and quality production enable them to catch both economic motivations for the provision of services and characteristics of the transport production's heterogeneity as an essential part of the technical definition. It was concluded that regression was used to understand the environmental heterogeneity elements and found it to have a negative productivity impact. The Study further revealed that slight improvements had been made as showed in the avg scale efficiency index was 51.03%, of pure epoxy 94.91%, and of scale performance 52.02%.

(Manzoni & Islam, 2007) carried out the Logistics as an element of the Supply Chain Management (S Chain Managing Management, for its initials in Spanish) principle of the practical integration of structures between companies into business relationships is not recent. However, it was reinforced by globalization and modern ICTs (Information Processing Technologies). SCM invites various approaches to assess SCN efficiency. The practical SPC or social SCR should be used for separation. DEA is an excellent method for output quantification. The study revealed that the approach was tested in a vast array of Australia's business enterprises. Early results of CG's

effectiveness was a Supply Chain in the financial system had attained some positive outcomes. An attractive 'Efficiency Scorecard' depicted the opportunity to quantify the increasing aspect of Supply Chain's input and value.

2.3 Research Gap

An analysis of recent studies as done in this chapter on the performance measurement framework and the supply chain's effectiveness has shown that several scholars' interest has always centred on a particular field of performance measurement. However, the study on a holistic approach to the overall success, the output of the supply chain has largely been overlooked. The research also showed that a systematic approach was required to analyze the supply chain's output measurement structure using practical information (industrial results) coupled with a business scenario (net revenue, debtors, transport, etc.). In the increasing nature of supply chain operations, such processes' efficiency must be measured and tracked, especially in specific contexts. Measuring the influence of all the variables listed above on the supply chain's efficiency is a challenging challenge. In comparison, too many international researchers have carried out operational analyses of the supply chain and performed very restricted work in the Indian background (based on its performance). In addition to these study limitations, the methodology identified to quantify the effect of different variables on the operational performance of particular companies structured to perform this review on the supply chain calculation.

The analytical approach offered fresh insights into supply chain efficiency and efficacy assessment in a developed world, especially India. Much of the Supply Chain Productivity Evaluation Research concerns developing countries with relatively little analysis on this subject in developed countries. This research looks at supply chain efficiency indicators and frameworks in one developing nation that is very different from the industrialized world in terms of supply chain management, the level of capitalism, and the chronology or timeline of transition. The report also established new avenues for work on supply chain management for developed countries. The report brings fresh perspectives on this issue to developed nations, but it also

contributed to the Supply Chain Management Quality Measurement Analysis as an Integrated Supply Chain Performance Measurement System. These are often fields where there has been no prior analysis. Importantly, there is relatively little work in supply chain success and productivity assessment utilizing this hybrid approach to decision-making. This method also comes to recognize the comprehensive perspective on the success of the supply chain. The system offered a holistic perception of the efficiency of the supply chain.

2.4 Research Problem

In the literature review chapter, the objective was to identify and understand the varied dimensions of supply chain performance and organizational performance. The review also covered the existing performance measurement models currently used by industry / proposed by researchers. As seen throughout the review, the existing models for supply chain performance measurement concentrate on the supply chain's challenging quantifiable aspects. Hence a need for performance measurement framework, which would also provide adequate weightage to softer less tangible aspects of the supply chain, is felt. The same has been identified as an existing gap in the literature review. Thus the problem the researcher is tackling is lack of supply chain performance measurement framework, which provides equal/adequate weightage to softer aspects of the supply chain. Lack of empirically tested framework in the Indian manufacturing industry context is yet another problem the researcher is trying to address through this research. The researcher has identified different framework as a basis which adequately covers the softer aspects, and has tried to build a supply chain performance measurement framework based on the same

2.5 Conclusion

This review bordered essential literature areas that could increase comprehension of supply chain performance systems' views and performance assessment variables. It concentrated on the evaluation of supply chain output and the productivity of the supply chain. The literature defined a range of systems and performance assessment considerations for the measurement of supply chain performance. Contemporary

supply chain performance assessment systems, based on literature, assess output in several different ways. The literature has found that approaches such as DEA are used to evaluate Effectiveness and Efficiency, along with numerous other metrics to determine the supply chain's output.

In summary, this study categorises supply chain performance measurement structures in three main frameworks as follows: result-based, hierarchical, and process-based models. Each paradigm focuses only on its point of view and has its advantages and drawbacks, as mentioned above. To address these differences, this review aims to provide a more systematic approach to studying the Supply Chain Performance Appraisal Method by combining both the Supply Chain Macro process and the decision-making phases. This structure will provide a positive picture of the supply chain's progress in developing countries, especially India.

The proposed Conceptual Supply Chain Performance Measurement System, which involves performance measurement variables, would be built through supply chain macro structures. The system would allow companies to make smarter decisions on managing the supply chain at various levels. The technique for analysis was explored in the previous part. It introduces the theory and methodology that has driven the architecture, methodology and methods of the study.

Chapter -3
Research Methodology

3.1 Introduction

A well designed and planned effort to systematically carry out research efforts is elaborated through its Research Methodology. It is a means to address the research dilemma on a systemic basis. It can be understood as a science of understanding how research is conducted scientifically, here we study the different steps taken by the researcher to study the research issue and its reasoning. The researcher designs a methodology for the problem to apply it. The critical aspects of the research approach are the effective method to be used for the problem, the order of precision of the outcome, and the method's reliability to be defined. In this analysis, a quantitative approach is used as a research technique. The study aims to identify them based on characteristics, refine them, and construct statistical models to test theories and interpret findings.

3.2 Research Design

The research design is an action strategy to search the answers logically until the conclusion from the original set of questions. It leads the investigator in the course of obtaining, evaluating and interpreting findings. It is a rational model of evidence that helps the researcher to make inferences regarding the informal interaction between the variables under review.

In this Research, Supply Chain Efficiency Assessment is a comprehensive description of the research expectations. Throughout the research cycle, it is examined what kind of data should be collected and how the data should be collected, and what tools and techniques of research should be used. It is an essential aspect of any research. The Performance Measurement and Effectiveness Assessment of the Supply Chain calls for different aspects and

techniques for the expected project. This research is analytical research based on secondary data. The experimental research method is used for the analysis, referred to as formative studies in research. It is used to analyse the dilemma from an organisational viewpoint for a more rigorous evaluation of the working hypothesis.

3.3 Sample Section and Design

In this study, purposive sampling is used to select five companies from 10 different sectors of Indian manufacturing. Top five companies amongst all the BSE listed companies in the sector based on their Networth in the respective sector were selected. The present study aims to evaluate the performance of these 50 manufacturing industries in India. The table 3.3.1 shows the sample size of 50 specific companies by taking five companies from 10 separate sectors in the Indian context

Sample Size = 50 Companies

Sr no	Sector	Company name	Networth
1	Auto Ancillaries	Bharat Gears Ltd	188.49
2		Fairfield Atlas Ltd	161.82
3		JMT Auto Ltd	167.31
4		The Hi-Tech Gears Ltd	198.18
5		Z F Steering	188.21
6	Automobile	Ashok Leyland Ltd	8,332.43
7		Force Motors Ltd	2,934.87
8		SML ISUZU Ltd	2413.59
9		VE Commercial Vehicles Ltd	3,582.49
10		Honda Cars India Ltd	3,499.18
11	Bearings	Galaxy Bearings Ltd	61.85
12		Harsha Bearing Ltd	51.69
13		Ring Plus Aqua Ltd	93.66
14		SNL Bearings Ltd	64.24
15		Menon Bearings Ltd	90.61

16	Castings, Forgings & Fasteners	Bhagwati Autocast Ltd	66.71
17		Hinduja Foundries Ltd	59.1
18		KIC Metaliks Ltd	84.95
19		Menon and Menon Ltd	79.11
20		Porwal Auto Components Ltd	58.62
21	Cement	ACC Ltd	4,521.28
22		Ambuja Cements Ltd	3521.65
23		Birla Corporation Ltd	3,404.84
24		HeidelbergCement India Ltd	3,171.19
25		J K Cements Ltd	2,892.81
26	Non-Ferrous Metals	Amco India Ltd	88.02
27		Century Aluminium Mfg Co Ltd	62.37
28		Hind Aluminium Industries Ltd	82.25
29		PG Foils Ltd	89.4
30		MMP Industries Ltd	99.5
31	Cables	Aksh Optifibre Ltd	514.01
32		Birla Cable Ltd	371.73
33		CMI Ltd	313.41
34		Sterlite Technologies Ltd	488.21
35		Vindhya Telelinks Ltd	430.5
36	Textiles - Texturizing	Gupta Synthetics Ltd	83.71
37		Mohit Industries Ltd	78.72
38		Shekhawati Poly-Yarn Ltd	68.77
39		Valson Industries Ltd	61.91
40		Weizmann Ltd	70.42
41	Textiles – Weaving	Pradip Overseas Ltd	129.01
42		Faze Three Ltd	131.15
43		Mahendra Petrochemicals Ltd	127.06
44		Orbit Exports Ltd	142.99
45		VTM Ltd	147.5
46	Tires	Balkrishna Industries Ltd	2,678.71
47		MRF Ltd	8,653.30
48		CEAT Ltd	2,751.04
49		JK Tyre & Industries Ltd	2,995.12
50		TVS Srichakra Ltd	2,743.15

Table 3.3: List of Sectors and Companies

3.3.1 Brief of Companies

The Undermentioned profile of the companies is an overview of the organisation and its operations along with the location of the companies and products manufactured by the companies.

Sr no	Sector	Company name	Products	Location
1	Auto Ancillaries	Bharat Gears Ltd	* Hypoid Ring Gear & Pinion * Differential Gears & Crosses * Transmission Gears	Mumbra, Mumbai
2		Fairfield Atlas Ltd	* Gear Components * Axle Components	Kolhapur Maharashtra
3		JMT Auto Ltd	* Engine Components * Gear Components * Axle Components * Excavator Components	Jamshedpur Jharkhand
4		The Hi-Tech Gears Ltd	* Two-Wheeler Transmission * Light Vehicle Transmission, Driveline, Steering * Commercial Vehicle Engine, Transmission	Gurgaon, Haryana

			* Engine Gears	
5		Z F Steering	* Gear Components * Rack & Pinions	Shirur, Pune
6	Automobile	Ashok Leyland Ltd	* Trucks * Buses * Light Vehicles	Guindy, Chennai
7		Force Motors Ltd	* Cars * Tractors * Buses * Light Commercial Vehicle * Goods Carrier * Multi Utility Vehicle	Akurdi, Pune
8		SML ISUZU Ltd	* Buses * Trucks	Shahid Bhagat Singh Nagar, Punjab
9		VE Commercial Vehicles Ltd	* Buses * Trucks	Saket, New Delhi
10		Honda Cars India Ltd	* Cars * Suv	Noida, Uttar Pradesh
11	Bearings	Galaxy Bearings Ltd	* Taper Roller Bearing (Single & Double Raw) * Cylindrical Roller Bearing (Single & Double Raw) * Wheel Hub Bearings	Rajkot, Gujrat
12		Harsha Bearing Ltd	*Brass Cages * Steel Cages * Polyamide Cages	Ahmedabad, Gujarat

13		Ring Plus Aqua Ltd	* Ring Gears * Water Pump Bearings * Flexplates	Nashik, Maharashtra
14		SNL Bearings Ltd	* Small End Cage * Big End Cage * Full Complement Shell * Cage Guided Shell	Mumbai, Maharashtra
15		Menon Bearings Ltd	* Bearings * Bushes * Thrust Washers	Kolhapur, Maharashtra
16	Castings, Forgings & Fasteners	Bhagwati Autocast Ltd	* Autocast * Spherical * Raina Machining	Ahmedabad, Gujarat
17		Hinduja Foundries Ltd	* Cylinder Blocks * Cylinder Heads * Grey Iron	Guindy, Chennai
18		KIC Metaliks Ltd	* Pig Iron	Kolkata, West Bengal
19		Menon and Menon Ltd	* Cylinder Blocks * Cylinder Heads * Grey Iron	Kolhapur, Maharashtra
20		Porwal Auto Components Ltd	* Casting * Machining	Pithampur, Madhya Pradesh
21	Cement	ACC Ltd	* Cement * Readily Mixed Concrete	Mumbai, Maharashtra

			* Construction Chemicals	
22		Ambuja Cements Ltd	* Cement * Portland Composite Cement	Ambujanagar, Gujrat
23		Birla Corporation Ltd	Cement	Kolkata, West Bengal
24		HeidelbergCement India Ltd	Cement	Gurgaon, Haryana
25		J K Cements Ltd	Cement	Kanpur Uttar Pradesh
26	Non-Ferrous Metals	Amco India Ltd	* Tea chest Lining, ORS Substrate * Label Foil, Lamination * Cheese Wrap, Lamination * House Foil for Food Wrapping * Blister Pack for Pharma Products * Strip pack for Pharma products * Tagger, Cable Wrap, Casserole * Fins for HeatExchanger * Cable Wrap(AL Mylar)	New Delhi

27		Century Aluminium Mfg Co Ltd	* Tea chest Lining, ORS Substrate * Label Foil, Lamination * Cheese Wrap, Lamination * House Foil for Food Wrapping * Blister Pack for Pharma Products * Strip pack for Pharma products	Kolkata, West Bengal
28		Hind Aluminium Industries Ltd	* Alloy Wire Rods * Aluminium Conductors * Flipped Wire Rods	Mumbai, Maharashtra
29		PG Foils Ltd	* Bare Aluminium Foil * Blister Lidding Foil * Multilayer Laminated Foil * Pharmaceutical Strip Foil	Pali, Rajasthan
30		MMP Industries Ltd	* Aerated Concrete Aluminium Powders * Aluminium Powders Explosives Grades	Nagpur, Maharashtra

			* Aluminum Conductor Steel Reinforced (ACSR) * All Aluminium Alloy Conductors (AAAC) * All Aluminium Conductors (AAC)	
31	Cables	Aksh Optifibre Ltd	* Optic Fibers * Optic Fibers cables * Ophthalmic Lens	New Delhi
32		Birla Cable Ltd	* Optic Fibers cables * Telecom Fibler Acesseriories	Rewa, Madhya Pradesh
33		CMI Ltd	* EHV Power Cable * Railway Cables * Bare Conductors * Building Wires * Thermocouple Cables * Aerial Bunched Cables	New Delhi
34		Sterlite Technologies Ltd	* Optic Fibers cables	Mumbai, Maharashtra

			* Telecom Fibler Acesseriories	
35		Vindhya Telelinks Ltd	* Cooper Cables * Optic Fibers cables * Power Cables * Telecom Fibre Accessories	New Delhi
36	Textiles - Texturizing	Gupta Synthetics Ltd	Yarns	Ahmedabad, Gujrat
37		Mohit Industries Ltd	Yarns	Surat, Gujrat
38		Shekhawati Poly-Yarn Ltd	Yarns	Mumbai, Maharashtra
39		Valson Industries Ltd	Yarns	Mumbai, Maharashtra
40		Weizmann Ltd	Yarns	Mumbai, Maharashtra
41	Textiles – Weaving	Pradip Overseas Ltd	* Bed in Bag * Comforters * Cushions * Flannel * Curtains * Micro * Quilts * Towels	Ahmedabad, Gujrat
42		Faze Three Ltd	* Bath Mats * Pillows * Area Rugs * Kitchen Textiles * Curtains * Quilts * Towels	Mumbai, Maharashtra
43		Mahendra	* Dobby	Ahmedabad,

		Petrochemicals Ltd	* Fabric * Pillows * Area Rugs	Gujrat
44		Orbit Exports Ltd	* Silky Aspects *Christmas Craft * Fashion jacquards	Mumbai, Maharashtra
45		VTM Ltd	* Dobby * Fabric * Pillows * Area Rugs	Chennai
46	Tires	Balkrishna Industries Ltd	Agriculture and Industrial Tires	Mumbai, Maharashtra
47		MRF Ltd	* Tires * Sports Goods	Chennai
48		CEAT Ltd	Tires	Mumbai, Maharashtra
49		JK Tyre & Industries Ltd	Tires	New Delhi
50		TVS Srichakra Ltd	Tires	Chennai

3.4 Performance Indicators

Performance Indicators are key instruments for tracking and optimising the supply chain's performance to achieve a comparative edge. Performance Indicators also actively connect supply chain stakeholders to achieve breakthrough performance in fulfilling end-customer demands and provide insight into customer needs. Choosing the best key performance indicators is a rather complicated task. The organisation has to define targets and then create performance indicators to help the organisations measure the performance. Some of the performance indicators commonly used in

Supply Chain Management and the same are selected for further study(C. S. Singh et al., 2019)(Nallusamy, 2016).

1. **Average Collection Period**: The average collection time provides the reading of the total number of days that customers pay their bills and indicate that the company's credit and collection policies are successful. However, cash is significant for the company's successful operation. If the items are shipped to the customer without cash collection, it means that the Distribution Network and the cash collection department lack cooperation and that this effect directly to the performance of the supply chain(Gurmail Singh, 2020)(Farris & Hutchison, 2002)(G. Singh & Dutt, 2020)(Y. Zhu et al., 2016)(H. L. Chen, 2011).

Average Collection Period = 365 days or 12 months or four weeks or seven days / Debtors Turnover Ratio

Debtors Turnover Ratio= Net Credit Sales/Average Debtors

2. **Inventory Conversion Period:** Conversion time for inventories shows us how far inventories are bought to be sold on average. It is important to quantify this as it allows us to understand how quickly businesses need to purchase new inventories. It is also significant, as it forms part of the process of money conversion. The cash conversion cycle tells how much time it takes to pay cash for the stock to the time it is paid(Moss & Stine, 1993)(Ruth Banomyong, 2005)(Saudi et al., 2019).

365 days or 12 months or four weeks or seven days / Inventory Turnover ratio

ITR(inventory turnover ratio) = CGS(cost of goods sold / Average Inventory

Average inventory = Opening Inventory + Closing Inventory/2

3. **Inventory Turnover Ratio:** The inventory turnover ratio indicates how many times a business has sold and replaced the product from the product shelf over a given timeframe. A company can measure the days of an inventory turnover form to measure the days it needs to sell the inventory on hand(Raob, 2009)(Gelsomino et al., 2019)(Huang et al., 2019)(Aramyan et al., 2007)(Longinidis & Georgiadis, 2011).

ITR(inventory turnover ratio = CGS(cost of goods sold) / Average Inventory
Average inventory = Opening Inventory + Closing Inventory/2.

4.**Degree of Inventory**: It is an indication of the liquidity relation of the current ratio with the Quick ratio. If the measurement of inventory has a high Quick ratio, it can mean that the output of the supply chain is affected by storage or over storage(Gurmail Singh, 2020)(G. Singh & Dutt, 2020)(Banomyong & Supatn, 2011).
Higher the degree, Higher the stock; less effective supply chain

Current Ratio- Quick Ratio= degree of inventory
Current ratio= Current Assets / Current Liabilities
Quick Ratio= Quick Assets/ Current Liabilities
Quick Assets=Current Assets –Stock-Prepaid Expense.

Current Ratio:
The current ratio balances a company's capacity to pay it's current or short-term (debt and payable) assets (cash, inventory, and receivables), or its ability to pay short term. Real assets on the balance sheet of business represent all assets' value quickly converted into cash within one year.
*# Current ratio= **Current Assets** / Current Liabilities*

Current Assets*: Cash and cash equivalents, Marketable securities, Accounts receivable, prepaid expenses, inventory.*
Current Liabilities: The company's balance sheet debts or commitments due within one year. #: Short-term debt, Accounts payable

Quick ratio:
The quick ratio also tests a company's liquidity by calculating how well its current actives will cover its new liabilities. However, the quick ratio is more conservative because it does not contain all the current ratio. The quick ratio often referred to as the acid-test ratio, includes only assets that can be converted to cash within 90 days or less

Current assets used in the quick ratio include: Cash and cash equivalents, Marketable securities, Accounts receivable

5. Working Capital Turnover Ratio: Working capital is the amount of money and assets needed to conduct daily business. These can include currency, receivable, inventories, fleets of vehicles or transport, Storage facilities(Peng & Zhou, 2019)(Jalalvand et al., 2011)(Bozarth et al., 2007)(Sambasivan et al., 2013).

#Working capital turnover ratio=Net Sales /Average working capital

Working capital=(Current Assets – Current Liabilities)

A high turnover ratio shows that the business's management is highly effective in using its short-term revenue-funded assets and liabilities (i.e., produces higher dollar revenues for each dollar of working capital employed). In comparison, the lower investment ratio into too many accounts and inventories may mean that a business is funding its profits, contributing to unnecessary bad debt or obsolete inventory that directly affects the supply chain.

"*Higher the ratio, higher the sale, good for the supply chain; Less of the working capital affect the creditor payment* ."

Net Sales / Average Working Capital

6. Return on Investments:

Return on Investment [ROI] is a measurement used as part of the investment evaluation used in an organisation to assess the expected outcomes of the planned Investment and to correlate it with the expected Investment's return. There are some other Investment evaluation Methods also such as the NPV (net present value) or the PBP(Payback period), are often analysed to measure the Worthiness of the planned Financial tasks, But the Return on Investment as used as most precise measures of the anticipated returns on long-term Investment (Trkman et al., 2010)(Gandhi, 2011)(P, 2017)(Mahdiloo et al., 2015)(Walters, 2006).

#ROI= Net profit/total assets

7. Debtors Turnover Ratio:

It is an indicator of how easily a business can receive credit from its customers. A business that collects very well would have a lower receivable revenue ratio. The

ratios of a company and its industry peers are also essential to compare. It can be said that Higher the Debtors turnover ratio, better is the credit management of the firm(Ruth Banomyong, 2005)(G. Singh & Dutt, 2020)(Chae, 2009)(Sorak & Dragic, 2013).

- ## Receivable or D**ebtors Turnover Ratio = Net Credit Sales/Average Account Receivable.**

8.Net sales: Supply chain operations can affect sales results. Increased customer retention leads to higher profits, which are usually attributed to the greater probability of consumers shopping with a single provider. When a business wants to create more reliable market flows and provide consumers with greater demand for higher volumes of items, then the distribution of such goods must be versatile, receptive, and reliable. The efficiency of supply chain operations depends heavily(Anderson & Dekker, 2009)(Baymout, 2015)(Balal Ibrahim & Adam Hamid, 2012)(Cooper, 1998).

Net Sales = Gross **Sales** – Returns – Allowances – Discounts

9.Transportation: Transportation relates to transferring items from one place to another place as it travels from the start point of the supply chain to the end consumer. It is an essential supply chain aspect since products were hardly manufactured and sold in the same location. Thus, transport plays a vital position in the supply chain in delivering commodities from one location to another or the ultimate end user(Khodakarami et al., 2014)(Wang et al., 2020)(Ilham et al., 2019)(Goswami et al., 2013)(R. Singh, 2010)(Zhai et al., 2019).

The above-mentioned performance indicators represent the actual image of the organisation's performance and the same are used as output in the Data Envelopment analysis

3.5 Statistical tools

The present study is analytical. For analysing the data, various statistical tools are used in the present study, namely descriptive statistics, including Data Envelopment Analysis, Linear Regression, Multiple Regression, Correlation.

The detailed explanation of statistical tools are given below

3.5.1 Data Envelopment Analysis

Data Envelopment Analysis (DEA) is a statistical programming-based method for calculating the relative utility of decision-making units (DMUs) with various inputs and outputs. Data Envelopment Analysis (DEA) was used for multiple - attribute decision-making problems. DEA was first proposed by Charnes & Cooper to assess decision-making units' relative performance (DMUs). DEA primarily tests DMUs in pairwise contrast. In these pairwise comparisons, DMUs were graded as efficient or ineffective. One of the crucial characteristics of DEA was that it could accommodate several inputs and multiple output versions. The layout required various units used for inputs and outputs, and DMUs were related explicitly to peers or a mix of peers(Ostroff & Schmitt, 1993)(Sarode et al., 2010)(Liang et al., 2006)(Cook et al., 2014).

On the other side, the effects may be responsive to the range of inputs and outputs. DMUs were contrasted, and the findings could not be checked with the right standard. The amount of productive boundary DMUs continues to rise as the number of inputs and outputs decreases. In the literature, some researchers have put a great deal of effort into integrating Multi-Criteria Optimisation (MCO) and DEA to take advantage of DEA to overcome MCO problems and vice versa. Cooper utilised the dual aim design and the DEA model for the supply chain network (Sexton et al., 1986). Much detailed work is often undertaken to examine the interaction between DEA and multi-objective linear programming of binary variables(Vincová, 2005). The DEA was also used for measuring vehicle efficiency scores on various transport network routes using inputs and outputs found to be important in the manufacturing field. For every evaluation of organisational effectiveness, it is essential to measure the overall performance of the organisation. DEA was often used as a multi-criteria assessment dilemma method where DMUs are substitutes, and each DMU is defined by its results in different constraints classified as DEA inputs and outputs. In this study, the DEA method is used to measure the effectiveness of the Supply Chain(C. Chen & Yan,

2011)(Castelli Lorenzo, Raffaele Pesenti, 2004)(Yang et al., 2011)(Ali & Seiford, 1993).

DEA inputs and outputs

DEA was introduced in the literature as a mathematical programming approach for measuring the relative performance of DMUs when multiple inputs and multiple outputs are present. The Inputs and output are the attributes used in the DEA model to measure the effectiveness of the Supply Chain Management. There are various Inputs used in Study for DEA analysis are(WANG & CULLINANE, 2006):

1. **Cost of Production:** The cost of manufacture is its overall cost to manufacture or supply the item in a given quantity. Production costs may include jobs, services, or consumables. Production cost is economically defined as expenditures incurred to procure production factors, such as labour, land, and services, essential to a finished product, such as costs for producing a motor car tire, such as rubber, workforce, components and various manufacturing supplies. The cost of production in the service sector includes the commodity's cost for delivery of services and the labour costs to service employees(Choi & Chun-Hung Chiu, 2012).

2. **Employee Cost:** The Employee cost is the sum of all the salaries paid, employee benefits, and payroll taxes paid by an employer, as well as employee benefit costs. The labour cost is of two types direct and indirect expenses (overhead). Direct costs include salaried employees, including staff on assembly lines, for those who manufacture a product, while indirect costs include support labour, such as manufacturing equipment. When a supplier decides the selling price, the company takes labour, supplies, and overhead costs into account(Leal et al., 2012). The net costs incurred must be expressed in the purchase price; if the selling price is omitted from the calculation, the profit sum is less than anticipated. If the product demand decreases or competitive pressures the company to increase prices, the company must reduce labour costs to stay competitive. A business may also reduce the number of workers, reduce its inventory, demand higher productivity levels, or reduce other production cost factors(Y. Chen et al., 2006).

3. **Power & Fuel Cost:** Power and Fuel Cost includes all costs and expenditures of the supplier, including, without restriction, fuel service paid, secure contract reservation payments (regardless of whether the fuel is bought or shipped, or stocked) incurred in conjunction with administration, sourcing, shipping, storage or supply of fuel(Cheng & Chang, 2018).

4. **Raw Materials:** The charges for raw material related to the materials' prices joining the finished product. They are the cost of goods sold by a manufacturer. The commodities need further storage and finishing in their received former form (such as steel, plastic beads, chemicals, etc.) Raw materials are categorised as direct expenses in listed companies' income performance because they contribute directly to producing a product or delivery of a service. In this case, they are classified as direct expenses in respect of the income statement. As commodity costs change in conjunction with production volumes, they are considered variable costs. The cost-efficient source and purchase of raw materials can be a competitive advantage. In this way, business managers and employees closely monitored raw materials' cost (Reiner & Hofmann, 2006).

5. **Selling Cost:** In monopoly competition and oligopoly, selling costs play a crucial role. Within such business types, businesses must bid for their revenue through investing in ads and advertisements. Furthermore, the producer does not focus on demand and production but must always understand whether earnings are maximised. Within the selling prices, these provide selling people's compensation, dealer fees for showing the items, etc. The expense of ads involves commercials in articles and newspapers, Television, radio and movies. Chamberlin implemented and distinguished between the measurement of sales prices and the cost of output. Selling's cost includes all the expenses expended on the manufacturing, storage, maintenance, and supply of the material to the individual consumers, as they apply to the service services(Jahani Sayyad Noveiri et al., 2019).

6. **Transport Expenses:** The costs incurred in transferring products or property to another place, often passed on to the consumer. Of starters, because a business was to deliver its goods to stores and sell them of sale to customers, that

will usually be caused by travel costs. Transport is a supply chain backbone of Supply Chain(Sexton et al., 1986)(Xu et al., 2009).

Numerous researches explored numerous DEA risks. One pitfall is that the percentiles and amounts (e.g. income per employee, returns on Investment) and exact details (e.g. sales, properties, staff, incomes, etc.) miscalculate the efficiencies ranking. However, we would like to point out that a mixture of ratios/percentiles and raw data is permissible in DEA applications(Elsayed & Shabaan Khalil, 2017)(Sunil KUMAR, 2008). It is too restrictive to conclude that these two forms of data cannot coexist in a model. It is clearly stated with an example that In DEA model, it is allowed to analyses the combination of ratio/percentile and raw data. In conclusion, we assume that DEA inputs and outputs should be used, depicts more than the typical idea of "inputs" and "outputs" in the traditional manufacturing cycle; and DEA is more than a calculation of productivity within the definition of a production method. In addition to being used as an output capacity measure, DEA is a method of "rational benchmarking" that evaluates results through several metrics and allows companies to evaluate their results, quality, efficiency and effectiveness assumptions(Talebi Zarinkamar & Alam-Tabriz, 2014)(Salinas-Jiménez & Smith, 1996)(Li et al., 2019).

3.5.2 Regression

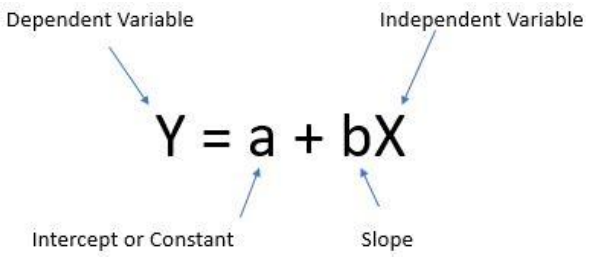
Regression is a statistical tool utilised in economics, valuation and other fields to assess the intensity and complexity of the relationship between a dependent variable (usually referred to as Y) and a selection of other variables (known as independent variables). Multiple regression was used to test the association among predicted factors and explanatory factors. They were using the regression model to predict market expectations. Second, multiple layers of perception are being used to predict the relationship between these independent and dependent variables(Gelman & Stern, 2006). Regression methods are used to predict the future outcome of the dependent variable. Simple linear regression consists of a dependent and independent variable, whereas multiple linear regression analysis requires two or more independent variables(Rentizelas et al., 2019). Regression analysis is a useful way of determining which variables affect a topic of concern. The regression method helps the

organisation to quickly decide which variables matter most, which variables can be overlooked, and whether these factors affect each other. The two widely used form of regression is simple linear regression and multiple linear regression. Simple linear regression utilises an independent variable to describe or forecast the dependent variable Y's value, whereas multiple linear regression utilises two or more independent variables to predict the outcome(Jacobs, 2001).

Obtaining accurate and reliable estimates of regression through regular tedious steps that can disrupt at any time of the study, and evaluating them (the effects of the regression) is often a problem. Regression may benefit finance and trading practitioners and specialists in specific industries. Regression also helped forecast revenue for a business based on temperature, past performance, GDP growth, or other factors. The Dependent Variable is the main factor to be understood or predicted, and the Independent Variables are factors that have an impact on the dependent variable. In this study, the Regression tool is used to measure the various variables' impact on other performance indicators(DeFries & Fulker, 1985).

The type of regression used in the analysis are :

- **Simple linear regression:** $Y = a + bX$
- **Multiple linear regression:** $Y = a + b_1X_1 {}^{+} b_2X_2 + b_3X_3 + ... + b_tX_t +$



Regression analysis is a useful statistical technique used across a supply chain organisation to test how specific independent variables influence dependent variables. The potential outcomes for conducting a regression analysis to provide valuable, workable business insights are endless.

3.5.3 Correlation

Correlation implies there is a calculation of how strongly two factors are connected. A correlational analysis has three potential outcomes: a strong correlation, a negative association, and no correlation. A good correlation is a relation between two variables, both of which move in the same direction. So, whether one variable rise or one reduces, then the other variable improves. A negative correlation is a connection between the two variables that implies a decrease of one variable. The height and temperature above sea level will be an illustration of the negative association. As someone walks up the mountain, it gets colder (the temperature decrease)(Borgström, 2005). There is a negative association when two factors are incompatible. For example, their connection is not between drunk tea and intellectual ability. Prediction, legitimacy, reliability, and theory (predictive validity) are the correlation's primary uses. In this study, the correlation is used to measure the relationship between net sales and Transportation Expenses.

3.6 Conclusion

This chapter describes the theory and methodology that have influenced the architecture, methodology and methods are studied. Approaches are highly motivated by a positive key to addressing the realities of supply chain management and response to supply chain results in India's manufacturing sector. The usage of a qualitative study approach was deemed necessary to understand the social reality from the viewpoint of the Decision Makers. The study used an experimental method and secondary results. These were used to make the process and data triangulation to improve the intensity of the study results. Fifty companies from 10 industrial sectors have been used for testing purposes. The analysis findings resulted from using a deliberately designed systemic, realistic and thematic analytical method and an analytical hierarchy process. Despite the well-prepared analysis method, this thesis still encountered certain shortcomings, which were clarified.

The following chapter identifies the construction of the philosophical structure used for this analysis. The suggested structure is intended to clarify the logical reasoning and course of this analysis.

Chapter 4

Evaluating effectiveness and impact of Transport Expense on Supply Chain performance

4. Introduction

Effective management of the supply chains of different manufacturing sectors has proved to be a very effective tool for ensuring an efficient and consistent distribution of high-quality goods and services at a minimal cost. Effective Management involves leveraging the collective expertise of the participants of the supply chain as effectively as possible to provide competitive, cost-effective goods and services. Hence, to ensure a high degree of effectiveness of the Supply chains, it becomes pertinent to develop a methodology to assess and measure the organisations' supply chains' effectiveness. As a part of the current research effort, a methodology has been proposed to evaluate the supply chain's effectiveness (Xu et al., 2009). The methodology used Data Envelopment Analysis (DEA)-CCRO for the purpose and the factors used as inputs for the purpose included Cost of production, Employee cost, Power and fuel cost, raw material Cost, Selling cost and transport expenses. However, the indices used to indicate supply chains' performance were Average Collection Period, Debtors Ratio, Degree of Inventor, Inventory Conversion Period, Inventory Turnover Ratio, Net sales, Return on Investment and Working Capital Turnover Ratio. The results obtained from the above methodology have been reported as the Slack and the difference in targeted output and actual performance. The analysis was carried out individually for each of the sectors. Secondly, the current chapter deals with assessing transport expenses' impact on the supply chain's performance indicators. The study used Linear Regression to analyze Transport Expenses' impact (Independent Variable) over the Supply Chain performance

indicators (Dependent Variables). The analysis supported the significant impact of specific performance indicators over the supply chain(G. Singh & Dutt, 2020).

4.1 Effectiveness Evaluation of Supply Chain Performance (Sector wise)

The following discussion depicts the evaluation of the effectiveness of the Supply Chain Performance for the considered sectors. DEA CCR model considered "inputs" and "outputs" variables to evaluate the supply chain's performance. DEA analyses each Decision-Making Units (DMU) performance concerning the performance of all the input and output variables. An optimization contingent to compare the performance of input, output variables and produce the results in the form in Return to Scale and Slacks. The weights of each DMU are separately calculated so that the level of maximum effectiveness can be achieved. To achieve the targeted effectiveness of the DMU, the projected data is set by the DEA, and the data achieved by the DMU is calculated. The difference in the projected data and achieved data is also reported as the fluctuation in the variables' performance that directly affects the supply chain's effectiveness.

4.1.1 Auto Ancillaries sector

Table 4.1.1. A portrays the effectiveness of the supply chain of the Auto Ancillaries sector using the DEA-CCR model. The results demonstrate that the supply chain operated at its highest capacity and had the best possible outcome, i.e. 100% for the period of 5 years, i.e. from 2010 to 2014. So there was not any slack reported in this period, i.e. from 2010 to 2014. However, from 2015 to 2019, the supply chains operated at a capacity of 99.89%, 99.89%, 99.76%, 99.46% and 99.04%. An in-depth analysis of the input attributes and the output key performance indicators revealed their contributions to decrease efficiency as depicted in the table 4.1A. Like the decreased efficiency in the year 2015 has been attributed to the increase in the slack of the input attributes considered in the study, i.e. Cost of Production, Employee Costs, Power & Fuel Cost, Raw Materials and Selling Cost by 5.9692, 1.9532, 0.8322, 0.1576 and 0.163 units respectively. Also, as far as output key performance

indicators are concerned, a slack was observed in them from 2015 to 2019, contributing to the decrease in the efficiency of the Supply Chains. For 2015 a slack of 1.648, 0.3016, 0.033, 2.956, 0.2048 and 0.0028 were observed in the Average collection period, Debtors Ratio, Degree of Inventory, Inventory conversion period, Inventory turnover ratio, Net Sales, Return on Investment and Working Capital Turnover Ratio.

The Table4.1.1 B and Table 4.1.1 C demonstrate that from 2015 to 2019, the supply chain's working was not as effective as in the years from 2010 to 2014. In the Input attributes, if the size of the projection units is equal to the Data, it means the supply chain work with its full effectiveness, and in a case, if the size of the data is more significant than the projection units, it states that there is slack in the effectiveness of the particular attribute. In the years where Supply chain works not with full efficiency, the projected production cost is 351.06 to 462.84 and cost is achieved 357.03 to 465.09. Although the difference is visible in Employee Cost as the projected cost is 43.42 to 64.08 and achieved is45.38 to 65.21in Power and Fuel cost 25.34 to 35.5 and achieved is 26.17 to 24.26, Raw Material Cost 221.85 to 284.46 and achieved is 222.01 to 284.75, Selling Cost 3.64 to 7.22 and achieved is 3.8 to 8.63, Transport Costs 2.84 to 3.18 and achieved is 2.85 to3.26. Even during the non-effective years, the most constant attributes that do not report much difference are power and fuel cost, selling cost, and transport cost. From 2015 to 2019, the results depict the significant difference in all the factors that affect the supply chain's effectiveness. The difference in Average Collection Period the projected output was 58.93 to 70, and the achieved is 57.81 to 62.79, Debtors Ratio the projected output was 7.13 to 7.37. The achieved is 5.73 to 6.83, Degree of Inventory the projected output was 0.8 to 1.34, and the achieved is 0.77 to 1.3, Inventory Conversion period the projected output was 47.19 to 91.31 the achieved is 44.19 to 60.38. , Inventory Turnover ratio the projected output was 8.15 to 10.77, and the achieved is 7.85 to 10.56, Net sales the projected output was 388 to 535.43 and the achieved is 387.66 to 531.81, Return on Investment the projected output was 0.05 to 0.09 and the achieved is .04 to 0.7, And working capital turnover ratio the projected output was 4.42 to 7.86 and the achieved is 4.01 to 7.85.

Table 4.1.1.A: Slack Report of Auto Ancillaries Manufacturing Sector

Sector: Auto Ancillaries				Slack In Input Attributes						Slack in output Key Performance indicators of Supply chain							
Year	RTS of Projected of DMU	Score	Rank	Cost of Production	Employee Cost	Power & Fuel Cost	Raw Materials	Selling Cost	Transport	Average Collection period	Debtors Ratio	Degree of Inventory	Inventory Conversion Period	Inventory Turnover Ratio	Net Sales	Return on Investment	Working Capital Turnover Ratio
2010	**Constant**	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	**Constant**	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2012	**Constant**	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	**Constant**	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2014	**Constant**	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	**Decreasing**	0.99898	6	5.969	1.9532	0.83	0.158	0.163	0	1.648	0.3016	0.03	2.956	0.2048	0	0.0028	0
2016	**Decreasing**	0.99898	6	1.872	0	0	0	0.4548	0.077	3.1778	1.0084	0.16	22.08	0.1102	0	0.0012	0.2208
2017	**Decreasing**	0.9976	8	0	1.9864	0.02	0	0.3184	0	0.015	1.5272	0.04	4.803	0	0	0.0182	1.475
2018	**Decreasing**	0.99462	9	0.356	0	0	0	0.192	0.013	3.4548	1.0228	0.12	20.84	0.1524	0	0.0036	0.265
2019	**Decreasing**	0.9904	10	3.056	1.1268	0	1.283	1.409	0	6.768	1.2736	0	29.57	0.2724	0	0.0052	0.3832

Table 4.1.1.B: Slack Report of Input Variables of Auto Ancillaries Sector

	Cost of Production			Employee Cost			Power & Fuel Cost			Raw Materials			Selling Cost			Transport		
DMU	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)
2010	182.01	182.01	0	21.8	21.8	0	13.96	13.96	0	100.78	100.78	0	1.56	1.56	0	1.77	1.77	0
2011	253.25	253.25	0	29.27	29.27	0	18.78	18.78	0	162	162	0	2.67	2.67	0	2.36	2.36	0
2012	317.34	317.34	0	35.15	35.15	0	23.46	23.46	0	203.2	203.2	0	3.53	3.53	0	2.65	2.65	0
2013	278.43	278.43	0	36.63	36.63	0	22.54	22.54	0	165.88	165.88	0	2.78	2.78	0	2.67	2.67	0
2014	294.12	294.12	0	40.12	40.12	0	22.93	22.93	0	182.99	182.99	0	4.01	4.01	0	3.09	3.09	0
2015	357.03	351.06	-1.68	45.38	43.42	-2.51	26.17	25.34	-2.93	222.01	221.85	-0.08	3.8	3.64	-2.84	3.04	3.04	0
2016	329.9	328.03	-0.63	47.17	47.17	0	24.42	24.42	0	197.57	197.57	0	4.03	3.58	-7.33	3.26	3.18	-4.33
2017	340.4	340.4	0	51.14	49.16	-4.4	24.26	24.24	-0.22	204.59	204.59	0	4.58	4.27	-4.7	2.91	2.91	0
2018	401.69	401.34	-0.11	57.37	57.37	0	29.59	29.59	0	243.37	243.37	0	6.66	6.46	-3.45	2.85	2.84	-0.88
2019	465.9	462.84	-0.9	65.21	64.08	-4.46	32.5	32.5	0	285.75	284.46	-0.82	8.63	7.22	-12.64	3.57	3.57	0

Table 4.1.1.C: Slack Report of Output Variables of Auto Ancillaries Sector

Average Collection period			Debtors Ratio			Degree of Inventory			Inventory Conversion Period			Inventory Turnover Ratio			Net Sales			Return on Investment			Working Capital Turnover Ratio		
Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)
51.68	51.68	0	8.31	8.31	0	0.91	0.91	0	75.2	75.2	0	7.2	7.2	0	212.92	212.92	0	0.11	0.11	0	8.38	8.38	0
43.51	43.51	0	9.65	9.65	0	0.87	0.87	0	53.98	53.98	0	10.04	10.04	0	302.81	302.81	0	0.14	0.14	0	9.22	9.22	0
44.98	44.98	0	8.97	8.97	0	0.7	0.7	0	46.05	46.05	0	11.26	11.26	0	379	379	0	0.15	0.15	0	8.89	8.89	0
57.27	57.27	0	7.19	7.19	0	0.78	0.78	0	51.24	51.24	0	9.76	9.76	0	323.01	323.01	0	0.09	0.09	0	9.11	9.11	0
57.75	57.75	0	6.81	6.81	0	0.53	0.53	0	50.55	50.55	0	9.89	9.89	0	343.63	343.63	0	0.08	0.08	0	15.35	15.35	0
57.2	58.93	2.33	6.83	7.13	7.52	0.77	0.8	5.46	44.19	47.19	7.33	10.56	10.77	2.6	402.91	403.32	0.1	0.09	0.09	2.01	7.85	7.86	0.1
57.81	61.04	6.09	6.62	7.64	14.76	0.92	1.08	6.57	51.64	73.85	18.3	10.58	10.69	3.77	387.66	388	0.1	0.08	0.08	7.86	6.43	6.65	9.63
61	61.15	0.27	6.07	7.62	22.74	1	1.04	5.82	56.08	60.95	19.1	9.39	9.43	0.24	394.83	395.8	0.24	0.06	0.08	15	4.28	5.76	28.95
64.72	68.49	6.65	5.73	6.79	16.43	1.03	1.17	4.95	57.39	78.94	16.6	8.47	8.64	5.98	467.53	469.44	0.55	0.06	0.07	149	4.01	4.28	14.22
62.79	70	16.34	6.02	7.37	16.41	1.3	1.34	1.01	60.38	91.31	22.8	7.85	8.15	11.1	531.81	535.43	1.01	0.05	0.05	-61.8	4.01	4.42	18.55

4.1.2 Automobile Sector

Table 4.1.2.A portrays the effectiveness of the supply chain of the Automobile sector. The results demonstrate that the supply chain operates at its highest capacity and had the best possible outcome, i.e. 100% for the period of 4 years, i.e. from 2010 to 2012 and 2014. So there was not any slack reported in this period, i.e. from 2010 to 2012 and 2014. However, in 2013 and from 2015 to 2019, the supply chains operated at a capacity of 99.66%, 99.88%, 99.88%, 99.85%,99.15% and 98.57%. An in-depth analysis of the input attributes and the output key performance indicators revealed their contributions to decrease efficiency as depicted in the table 4.1.2A. The decreased efficiency in 2015 has been attributed to the increase in the slack of the input attributes considered in the study, i.e. Cost of Production, Employee Costs, Power & Fuel Cost and Raw Materials Cost by0.7902, 17.2398, 4.809 and 0.3722 units respectively. Also, as far as output key performance indicators are concerned, a slack was observed in them in the years in 2013 and from 2015 to 2019, contributing to the decrease in the supply chain's efficiency. For 2015 a slack of 0.273, 0.6286, 0.0088, 0.8414, 04176, 0.0122 and 32064 was observed in the Average collection period, Debtors, Degree of Inventory, Inventory conversion period, Inventory turnover ratio, Return on Investment and Working Capital Turnover Ratio.

Table 4.1.2A and Table 4.1.2B shows that the Input attributes if the size of the projection units is equal to the Data it means the supply chain work with its full effectiveness, and in a case if the size of the data is more significant than the projection units, it states that there is slack in the effectiveness of the particular attribute. The cost of Production, Employee cost, Fuel and power cost and transport cost shows the significant difference in the projection and the data claimed by that attributes from 0.04 per cent to 4.57 per cent, 0.36 per cent to 3.72 per cent, 0.48 per cent to 4.92 per cent and 1.48 per cent to 4.79 per cent. Due to this difference in attributes supply chain did not work effectively. The other attributes, which are the key performance indicators of the supply chain, show delay in collecting money 5.29 units to 26.82 units, as shown in the average collection period and debtors turnover ratio. The degree of inventory, Inventory Turnover Ratio, and Inventory

Conversion period shows the considerable fluctuation in the stock's conversion as the projection is higher than the actual outcome. Return on investment and working capital turnover ratio shows that the difference in the projection and the actual data is relatively high from 15.48 units to 399.40 units and 4.32 units to 131.53 units. It means the sector does not get the return as the amount invested.

In comparison to all the attributes, Net sales remained constant and did not report any high fluctuation. However, measuring the results shows that the company fall from the planned goal as needed. That also indicates that the effectiveness of the supply chain will not suit the majority of the years.

Table 4.1.2.A: Slack Report of Automobile Sector

Sector: Automobile				Slack In Input Attributes						Slack in output Key Performance indicators of Supply chain							
Year	RTS of Projected of DMU	Score	Rank	Cost of Production	Employee Cost	Power & Fuel Cost	Raw Materials	Selling Cost	Transport	Average Collection period	Debtors Ratio	Degree of Inventory	Inventory Conversion Period	Inventory Turnover Ratio	Net Sales	Return on Investment	Working Capital Turnover Ratio
2010	**Constant**	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	**Constant**	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2012	**Constant**	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	**Decreasing**	0.99668	8	0.751	2.6636	0	0	1.93	0	1.0528	0	0	0.5268	0.1322	8.38	0.0464	0.2314
2014	**Constant**	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	**Decreasing**	0.99882	5	0.79	17.2398	4.809	0.372	0	0	0.273	0.6286	0.01	0.8414	0.4176	0	0.0122	3.2064
2016	**Decreasing**	0.9988	6	11.43	49.7992	16.444	0	0	14.94	8.137	11.998	0.15	11.0302	8.4244	0	0.035	2.6618
2017	**Decreasing**	0.99856	7	92.07	26.2972	1.3536	0	0	0.6118	0.26	0.2232	0.01	0	0.5434	0	0.0184	4.6292
2018	**Decreasing**	0.99158	9	5.394	44.8616	4.706	0	0	13.0096	6.6292	9.782	0.17	9.8204	8.6618	0	0.0294	1.3906
2019	**Decreasing**	0.9857	10	3.902	46.852	3.717	0	0	19.275	10.5588	13.8394	0.23	12.7262	12.9244	0	0.0428	0.4858

Table 4.1.2.B: Slack Report of Input Variable of Automobile Sector

	Cost of Production			Employee Cost			Power & Fuel Cost			Raw Materials			Selling Cost			Transport Cost		
DMU	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)
2010	2377	2377	0	611.94	611.94	0	50.63	50.63	0	2056.06	2056.06	0	439.06	439.06	0	35.82	35.82	0
2011	3141.85	3141.85	0	919.99	919.99	0	57.64	57.64	0	2679.69	2679.69	0	767.33	767.33	0	46.03	46.03	0
2012	3691.65	3691.65	0	1212.05	1212.05	0	100.45	100.45	0	3111.87	3111.87	0	1003.63	1003.63	0	71.69	71.69	0
2013	3539.43	3538.68	-0.04	1222.85	1220.18	-1.02	102.7	102.7	0	2945.12	2945.12	0	933.98	932.05	-2.84	65.12	65.12	0
2014	3828.33	3828.33	0	1179.69	1179.69	0	113.68	113.68	0	3186.1	3186.1	0	955.84	955.84	0	82.65	82.65	0
2015	5230.57	5229.78	-1.24	1369.34	1352.1	-0.36	139.49	134.68	-1.08	4452.67	4452.3	-0.74	1064.1	1064.1	0	83.19	83.19	0
2016	6217.98	6206.55	-2.61	2110.26	2060.46	-1.03	191.63	175.19	-4.92	5305.17	5305.17	0	1720.93	1720.93	0	110.86	95.92	-4.79
2017	6115.94	6023.88	-0.88	2023.87	1997.57	-3.72	189.47	188.11	-1.35	5284.74	5284.74	0	1681.95	1681.95	0	86.58	85.97	-1.48
2018	7678.18	7672.79	-4.57	2418.89	2374.03	-0.5	216.69	211.99	-0.69	6324.58	6324.58	0	2166.64	2166.64	0	119.41	106.4	-3.41
2019	8763.65	8759.75	-3.19	2840.56	2793.71	-0.44	240.62	236.9	-0.48	7441.28	7441.28	0	2505.24	2505.24	0	135.39	116.11	-4.39

Table 4.1.2 C: Slack Report of Output Variable of Automobile Sector

Average Collection period			Debtors Ratio			Degree of Inventory			Inventory Conversion Period			Inventory Turnover Ratio			Net Sales			Return on Investment			Working Capital Turnover Ratio		
Data	Projection	Diff. %	Data	Projection	Diff. %	Data	Projection	Diff. %	Data	Projection	Diff. %	Data	Projection	Diff. %	Data	Projection	Diff. %	Data	Projection	Diff. %	Data	Projection	Diff. %
36.6	36.6	0	24.25	24.25	0	0.56	0.56	0	51.71	51.71	0	8.96	8.96	0	3136.86	3136.86	0	0.08	0.08	0	12.53	12.53	0
28.85	28.85	0	15.21	15.21	0	0.71	0.71	0	48.73	48.73	0	8.74	8.74	0	4349.19	4349.19	0	0.12	0.12	0	17.02	17.02	0
25.92	25.92	0	23.09	23.09	0	0.67	0.67	0	48.8	48.8	0	8.65	8.65	0	5144.91	5144.91	0	0.28	0.28	0	5.73	5.73	0
26.05	27.17	5.29	23.28	23.34	0.34	0.66	0.66	0.34	49.74	50.46	1.22	8.54	8.69	2.5	5072.6	5087.64	0.76	0.14	0.19	399.4	23.2	23.45	4.32
28.98	28.98	0	22.89	22.89	0	0.57	0.57	0	48.96	48.96	0	10.34	10.34	0	5251.74	5251.74	0	0.07	0.07	0	7.27	7.27	0
23.27	23.59	0.93	23.34	23.99	5.94	0.5	0.51	3.27	41.17	42.04	3.38	12.4	12.83	3.07	7183	7189.72	0.12	0.08	0.09	15.48	4.42	7.63	131.5
21.08	29.24	26.82	23.27	35.3	84.71	0.66	0.81	45.65	42.7	53.76	42.73	10.95	19.39	60.91	9257.79	9271.03	0.12	0.09	0.13	41.71	15.91	18.59	109.2
21.53	21.8	3.39	22.75	23.04	0.64	0.58	0.6	4.21	45.17	45.22	0.15	9.13	9.69	5.21	9045.95	9063.15	0.15	0.1	0.12	33.86	6.3	10.94	67.78
23.77	30.79	15.97	23.74	33.6	118.59	0.59	0.76	60.88	47.57	57.63	35.8	9.71	18.49	67.61	11408.9	11497.1	0.88	0.1	0.13	23.73	13.58	15.06	14.14
25.13	36.34	26.42	21.3	35.27	162.46	0.68	0.91	69.18	49.31	62.56	38.57	9.15	22.24	123.2	12500.9	12679.3	1.54	0.13	0.17	37.12	14.41	15.09	5.28

4.1.3 Bearing Sector

The supply chain's effectiveness through the DEA -CCR model of the Bearing Sector is discussed in Table 4.1.3A. The results demonstrate that the supply chain operated at its highest capacity and had the best possible outcome, i.e. 100% for the period of 4 years, i.e. from 2010 to 2012 and 2017. So there was not any slack reported in this period, i.e. from 2010 to 2012 and 2017. However, from 2013 to 2016 and 2018 & 2019 , the supply chains operated at a capacity of 99.94%, 97.69%, 96.2%, 98.43%,99.54% and 98.76%. An in-depth analysis of the input attributes and the output key performance indicators revealed their contributions to decrease efficiency as depicted in the table 4.1.3A. Like the decreased efficiency in the year 2015 has been attributed to the increase in the slack of the input attributes considered in the study, i.e. Cost of Production, Employee Costs, Power & Fuel Cost, Raw Materials cost, Selling Cost and Transport Cost by 0.2542, 3.41, 0.7518, 11.60, 1.0582 and 3.963 units respectively. Also as far as output key performance indicators are concerned a slack was observed in them as well in the years from 2013 to 2016 and 2018 & 2019 contributing towards the decrease in the efficiency of the Supply Chains. Like for the year 2015 a slack of 3.7022, 1.8778, 0.4142, 22.0828, 2.5722, 0.0726, 0.216 and 0.3482 were respectively observed in the Average collection period, Debtors Ratio, Degree of Inventory, Inventory conversion period, Inventory turnover ratio, Net Sales, Return on Investment and Working Capital Turnover Ratio.

Table 4.1.3B and 4.1.3C demonstrates the effectiveness of the particular sector's supply chain during the span of the ten years. The difference in the projection and the actual data is very high that shows that Bearing sector should control their expenses. The Employee cost, Power and fuel cost, Raw material cost, Selling cost and transport cost depicts the difference to make the supply chain more effective 0.20 per cent to 19.9 per cent, 2.03 per cent to 10.51 per cent, 0.33 per cent to 9.11 per cent, 0.36 per cent to 12.16 per cent and 3.06 per cent to 10.13 per cent respectively.

The output attributes as key performance indicators of the supply chain also show the big difference in the targeted data and the data achieved. Due to this difference in attributes supply chain did not work effectively. The other attributes, which are the key performance indicators of the supply chain, show delay in collecting money by

0.26 per cent to 31.76 per cent as shown in the average collection period and the debtors turnover ratio. The degree of inventory, Inventory Turnover Ratio, and Inventory Conversion period shows the massive fluctuation in the stock's conversion as the projection is high than the actual outcome of 0.06 per cent to 39.46 per cent. Return on investment and working capital turnover ratio shows that the difference in the projection and the actual data is relatively high from 6.15 per cent to 353.03 per cent and 3.22 per cent to 17.90 per cent. It means the sector does not get the return as the amount invested.

In comparison to all the attributes, Net sales did also not perform well and report high fluctuation from 0.43 per cent to 13.29 per cent. However, measuring the results shows that the company fall from the planned goal as needed. Nonetheless, calculating success means that the organization may not fall below the goal as appropriate. This indicates again that the manufacturing line's effectiveness does not correlate to the rest of the years.

Table 4.1.3.A Slack Report of Bearing Sector

Sector: Bearings				Slack In Input Attributes						Slack in output Key Performance indicators of Supply chain						
Year	RTS of Projected of DMU	Score	Rank	Cost of Production	Employee Cost	Power & Fuel Cost	Raw Materials	Selling Cost	Transport	Average Collection period	Debtors Ratio	Degree of Inventory	Inventory Conversion Period	Inventory Turnover Ratio	Net Sales	Return on Investment	Working Capital Turnover Ratio
2010	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2012	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	Decreasing	0.9994	5	1.001	0.0174	0.2914	0	0	0.0434	3.1536	0.0108	0	1.597	0	0.308	0.0164	0.1414
2014	Decreasing	0.9769	9	0	2.6456	1.7216	0.112	0.9508	2.6146	9.518	1	0.1246	11.5726	3.2924	0.0292	0.152	0.6408
2015	Decreasing	0.962	10	0.2542	3.41	0.7518	11.6058	1.0582	3.963	6.7022	1.8778	0.4142	22.0828	2.5722	0.0726	0.216	0.3482
2016	Decreasing	0.9843	8	0	2.1608	0	0.6	1.1622	4.5634	0.4946	0.1946	0	5.7116	0	0.0128	0.1748	0.0048
2017	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2018	Decreasing	0.9954	6	0	0.0224	0.02	0.7272	0.0186	0.203	2.7396	0.1766	0.0722	1.5888	0.2846	0	0.0116	0.0694
2019	Decreasing	0.9876	7	0	3.9396	0.0386	17.3768	0.7312	2.9892	7.7708	1.0214	0.0778	14.9952	8.7172	0.1598	0.4294	0.1842

Table 4.1.3.B Slack Report of Input Variables of Bearing Sector

	Cost of Production			Employee Cost			Power & Fuel Cost			Raw Materials			Selling Cost			Transport		
DMU	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)
2010	53.51	53.51	0	6.23	6.23	0	2.52	2.52	0	42.83	42.83	0	2.23	2.23	0	3.69	3.69	0
2011	81.4	81.4	0	5.71	5.71	0	3.06	3.06	0	37.88	37.88	0	2.73	2.73	0	3.47	3.47	0
2012	92.97	92.97	0	5.65	5.65	0	4.51	4.51	0	61.9	61.9	0	1.96	1.96	0	4.92	4.92	0
2013	89.03	88.03	-1.4	6.24	6.22	-0.2	4.66	4.37	-3.51	52.16	52.16	0	3.47	3.47	0	6.23	6.19	-3.06
2014	111.78	111.78	0	11.68	9.03	-18	6.71	4.99	-10.5	64.65	64.54	-0.3	4.45	3.5	-12	7.8	5.18	-8.41
2015	126.94	126.68	-1.3	13.65	10.24	-19	6.59	5.84	-7.6	69.51	57.9	-9.1	5.21	4.15	-10	9.36	5.39	-10.1
2016	110.54	110.54	0	11.9	9.74	-16	5.49	5.49	0	55.63	55.03	-0.4	4.53	3.36	-10	10.18	5.62	-9.91
2017	113.29	113.29	0	12.08	12.08	0	3.26	3.26	0	59.43	59.43	0	4.59	4.59	0	10.64	10.64	0
2018	147.23	147.23	0	15.68	15.66	-0.2	3.61	3.59	-2.03	85.92	85.19	-1.3	5.88	5.86	-0.4	12.83	12.63	-7.1
2019	181.12	181.12	0	17.52	13.58	-11	4.73	4.69	-3.13	108.93	91.55	-6	7.82	7.09	-7.5	14.7	11.71	-9.27

Table 4.1.3.C Slack Report of Output Variables of Bearing Sector

Average Collection period			Debtors Ratio			Degree of Inventory			Inventory Conversion Period			Inventory Turnover Ratio			Net Sales			Return on Investment			Working Capital Turnover Ratio		
Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)
69.3	69.3	0	4.5	4.45	0	31.5	31.54	0	85.4	85.35	0	27.2	27.22	0	34.48	34.48	0	0.45	0.45	0	2.22	2.22	0
54.5	54.5	0	5.6	5.59	0	57.2	57.23	0	67.4	67.44	0	20.2	20.24	0	49.93	49.93	0	0.71	0.71	0	3.17	3.17	0
54.4	54.4	0	5.4	5.44	0	64.2	64.18	0	68.4	68.38	0	21.6	21.56	0	60.4	60.4	0	0.79	0.79	0	3.25	3.25	0
64.4	67.6	4.76	4.8	4.83	0.26	55.1	55.11	0.06	75.3	76.92	4.99	25	25.03	0.06	55.57	55.92	0.43	0.63	0.64	25.82	2.75	2.9	3.22
62.9	73.3	20.37	4.9	6.03	23.47	61.8	65.99	26.52	70.6	83.41	26.73	23.3	27.91	20.32	77.15	78.44	4.3	0.58	0.76	353	3.35	4.05	17.9
68.2	76.7	21.81	4.9	6.99	42.52	72.2	79.59	39.46	74.4	99.15	35.04	22.2	26.6	31.68	78.9	82.36	5.74	0.67	0.94	109.1	3.35	3.82	16.5
70.1	70.6	15.84	4.7	4.94	5.49	67	72.63	1.71	79.2	86.12	9.77	25.7	27.47	1.71	68.85	68.89	2.44	0.65	0.86	9.32	2.94	2.95	8.37
64.8	64.8	0	4.9	4.88	0	72.2	72.16	0	67.2	67.17	0	25.6	25.57	0	71.67	71.67	0	0.56	0.56	0	2.68	2.68	0
62.6	65.7	3.86	5.2	5.42	4.39	103	102.6	10.35	60.6	62.36	5.19	22.1	22.43	3.1	88.76	89.45	0.47	0.81	0.83	6.15	3.69	3.78	2.82
58.4	66.3	31.76	5.5	6.6	20.74	121	128	9.87	61.1	76.87	29.85	23.6	33.31	16.17	109.7	110.25	13.29	0.7	1.16	30.58	3.61	3.8	11.52

4.1.4 Castings, Forgings & Fasteners Sector

The supply chain's effectiveness through the DEA -CCR model of the casting and forging Sector is discussed in Table 4.1.4.A. The results demonstrate that the supply chain operated at its highest capacity and had the best possible outcome, i.e. 100% for the period of 3 years, i.e. from 2010 to 2011 and 2014. So there was not any slack reported in this period, i.e. from 2010 to 2011 and 2014. However, from 2012 to 2013 and 2015 to 2019, the supply chains operated at a capacity of 99.2%, 98.78%, 98.93%, 96.51%,98.72% , 99.18% and 99.25%. An in-depth analysis of the input attributes and the output key performance indicators revealed their contributions to decrease efficiency as depicted in the table 4.1.4A. Like the decreased efficiency in the year 2015 has been attributed to the increase in the slack of the input attributes considered in the study, i.e. Cost of Production, Employee Costs, Power & Fuel Cost, Raw Materials Cost and Selling Cost by 0.462, 0.0958, 0.669, 1.065, and 1.3 units respectively. Also as far as output key performance indicators are concerned a slack was observed in them as well in the years from 2012 to 2013 and 2015 to 2019 contributing towards the decrease in the efficiency of the Supply Chains. Like for the year 2015 a slack of 6.5114, 0.0194, 0.0568, 1.9808, 16594, 1.5694, 0.058 and 13.6308 were respectively observed in the Average collection period, Debtors Ratio, Degree of Inventory, Inventory conversion period, Inventory turnover ratio, Net Sales, Return on Investment and Working Capital Turnover Ratio.

Table 4.1.4.B and 4.1.4.C demonstrate the effectiveness of the particular sector's supply chain during the span of the ten years. The difference in the projection and the actual data is very high that shows that Castings, Forgings & Fasteners Sector should control their expenses. The cost of production, Employee cost, Power and fuel cost, Selling cost and transport cost depicts the difference to make the supply chain more effective 0.11 per cent to 1.34 per cent, 0.12 per cent to 5.70 per cent, 0.70 per cent to 7.48 per cent, 1.76 per cent to 29.68 per cent and 1.87 per cent to 8.66 per cent respectively. The output attributes as key performance indicators of the supply chain also show the big difference in the targeted data and the data achieved. Due to this difference in attributes supply chain did not work effectively.

The other attributes, which are the key performance indicators of the supply chain, show delay in collecting money by 0.83 per cent to 50.02 per cent as shown in the average collection period and the debtors turnover ratio. The degree of inventory, Inventory Turnover Ratio, and Inventory Conversion period shows the massive fluctuation in the stock conversion as the projection is high than the actual outcome of 0.83 per cent to 53.06 per cent. Return on investment and working capital turnover ratio shows that the difference in the projection and the actual data is relatively high from 18.97 per cent to 1109.82 per cent and 16.03 per cent to 120.95 per cent. It means the sector does not get the return as the amount invested. In comparison to all the attributes, Net sales show the consistent performance and did not report high fluctuation works with full efficiency, but performance does fluctuate with the projected and the data received from 0.78 per cent to 3.83 per cent. Measuring the performance indicates, though, that the business slips below the expected objective when appropriate. However, the measurement of performance ensures that the organization does not slip below the aim as necessary. This again suggests that the development line's quality is not compatible with the rest of the years.

Table 4.1.4.A Slack Report of Castings, Forgings & Fasteners Sector

Sector: Castings & Forgings				Slack In Input Attributes						Slack in output Key Performance indicators of Supply chain							
Year	RTS of Projected of DMU	Score	Rank	Cost of Production	Employee Cost	Power & Fuel Cost	Raw Materials	Selling Cost	Transport	Average Collection period	Debtors Ratio	Degree of Inventory	Inventory Conversion Period	Inventory Turnover Ratio	Net Sales	Return on Investment	Working Capital Turnover Ratio
2010	**Constant**	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	**Constant**	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2012	**Decreasing**	0.992	5	0.359	0	0.653	0	0.061	0.1098	4.5586	0	0.0964	1.1218	0	0	0.0094	1.2072
2013	**Decreasing**	0.9878	8	0.655	0.121	0.296	0	0.096	0	4.8298	0	0.0552	2.8358	0.199	0	0.012	2.609
2014	**Constant**	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	**Decreasing**	0.9893	7	0.462	0.0958	0.669	1.065	1.3	0	6.5114	0.0194	0.0568	1.9808	1.6594	1.5606	0.058	13.6308
2016	**Decreasing**	0.9651	10	3.277	0.5872	1.244	0	1.501	0.1508	9.3318	1.2192	0.2486	3.9124	2.8294	0	0.0886	18.285
2017	**Decreasing**	0.9872	9	1.038	0	0.379	0	0.79	0.0726	2.8684	3.3692	0.0852	2.7212	3.5144	0	0.0844	17.804
2018	**Decreasing**	0.9918	6	0.827	0	0.293	0	0.504	0.0246	0	2.09	0.0386	0.8042	1.7894	0	0.0512	67.5604
2019	**Decreasing**	0.9925	4	0	0.0138	0	0	0.04	0.0106	12.8216	0.7404	0.017	3.1808	3.2964	0	0.0196	1.4494

Table 4.1.4.B Slack Report of Input Variables of Castings, Forgings & Fasteners Sector

	Cost of Production			Employee Cost			Power & Fuel Cost			Raw Materials			Selling Cost			Transport		
DMU	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)
2010	198.6	198.6	0	18.3	18.3	0	17.2	17.23	0	142.5	142.52	0	3.64	3.64	0	0.79	0.79	0
2011	145.9	145.9	0	21.1	21.1	0	19.1	19.09	0	84.08	84.08	0	1.76	1.76	0	1.08	1.08	0
2012	196.9	196.6	-0.1	24.3	24.3	0	22.4	21.74	-7.48	126.9	126.93	0	1.87	1.81	-1.76	1.29	1.18	-4.07
2013	218.5	217.9	-0.1	26.4	26.3	-1.3	21.1	20.84	-3.65	147.4	147.4	0	1.71	1.61	-4.89	1.29	1.29	0
2014	223.7	223.7	0	26.5	26.5	0	20.3	20.32	0	149	148.97	0	1.46	1.46	0	1.3	1.3	0
2015	248.1	247.6	-0.1	31.6	31.5	-0.9	27.3	26.66	-6.18	160.6	159.56	-1.13	2.74	1.44	-29.68	1.37	1.37	0
2016	353.3	350	-1.3	52.4	51.8	-5.7	46.8	45.6	-8.26	194.2	194.19	0	3.22	1.71	-31.46	1.62	1.47	-8.66
2017	193.7	192.7	-0.5	25.5	25.5	0	22.9	22.55	-1.2	111.2	111.15	0	2.33	1.54	-18.64	1.49	1.41	-6.1
2018	415.1	414.3	-0.3	52.8	52.8	0	49.5	49.23	-0.7	248.7	248.67	0	3.6	3.09	-8.58	1.58	1.56	-1.87
2019	463.5	463.5	0	60.5	60.5	-0.1	48.1	48.1	0	295.7	295.67	0	4.6	4.56	-5.02	1.79	1.78	-2.04

Table 4.1.4.C Slack Report of Output Variables of Castings, Forgings & Fasteners Sector

Average Collection period			Debtors Ratio			Degree of Inventory			Inventory Conversion Period			Inventory Turnover Ratio			Net Sales			Return on Investment			Working Capital Turnover Ratio		
Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)
49.3	49.26	0	9.3	9.34	0	0.7	0.69	0	44	44.05	0	13	13.27	0	191	191.1	0	0.08	0.08	0	26.5	26.5	0
55.7	55.69	0	11	10.8	0	1.1	1.05	0	61	60.94	0	12	12.29	0	188	187.7	0	0.1	0.1	0	14.3	14.3	0
43.4	48.26	14.06	13	13.1	0.83	1	1.1	10.9	50	52.31	1.89	11	10.91	0.83	229	231.4	0.83	0.07	0.08	53	10.9	12.2	16.03
39.6	44.6	33.11	14	14.7	1.3	1	1.05	6.91	54	58.39	4.35	11	10.94	6.37	241	247.4	1.3	0.06	0.08	89.5	18.2	21	20.73
43.1	43.05	0	18	17.6	0	1.1	1.09	0	68	67.77	0	10	10.02	0	242	241.9	0	0.05	0.05	0	15.8	15.8	0
48.4	55.07	50.02	16	16.2	1.21	1	1.05	14.6	59	61.33	13.83	10	11.98	13.66	268	272	1.5	0.03	0.09	180	12	25.9	63.79
50.9	61.1	46.34	12	13.7	8.86	0.6	0.88	53.1	51	57.65	18.96	11	14.25	17.07	344	354.3	3.83	0.08	0.17	1110	11.2	30.1	121
52.2	55.34	14.62	9.7	13.3	21.34	0.5	0.63	25.1	45	47.66	17.01	12	15.92	18.12	202	205	1.37	0.04	0.13	659	13	31.1	80.95
48.9	49.13	0.85	11	12.8	17.65	0.5	0.52	11	32	32.78	4.91	13	14.89	10.57	420	422.8	0.85	0.11	0.16	176	29.6	97.7	106.7
44.5	58.03	15.08	11	12.2	18.97	0.6	0.58	5.93	30	33.34	17.55	14	17.08	17.92	474	475.1	0.78	0.21	0.23	19	161	162	21.69

4.1.5 Cement Sector

The effectiveness of the supply chain through the DEA -CCR model of the Cement Sector is discussed in Table 4.1.5.A. The results demonstrate that the supply chain operated at its highest capacity and had the best possible outcome, i.e. 100% for the period of 4 years, i.e. from 2010 to 2011 and 2016 to 2017. There was no slack reported in this period, i.e. from 2010 to 2011 and 2016 to 2017. However, from 2012 to 2015 and 2018 to 2019 , the supply chains operated at 99.7%, 98.7%, 98.1%, 97.7%, 98.7% and 98.2%. An in-depth analysis of the input attributes and the output key performance indicators revealed their contributions to decrease efficiency as depicted in the table 4.1.5A. Like the decreased efficiency in the year 2015 has been attributed to the increase in the slack of the input attributes considered in the study, i.e. Cost of Production, Employee Costs, Power & Fuel Cost, Raw Materials Cost and Selling Cost by 60.904, 8.5432, 10.593, 43.434 and 4.7856 units respectively. As far as output key performance indicators are concerned, a slack was observed in them in the years from 2010 to 2011 and 2016 to 2017. they are contributing towards the decrease in the efficiency of the Supply Chains. For 2015 a slack of 1.495, 10.0138, 0.0748, 0.7248, 3.4682, 0.0318 and 8.467 was observed in the Average collection period, Debtors Ratio, Degree of Inventory, Inventory conversion period, Inventory turnover ratio, Return on Investment and Working Capital Turnover Ratio.

Table 4.1.5.B and 4.1.5.C demonstrate the effectiveness of the particular sector's supply chain during the span of the ten years. The difference in the projection and the actual data is very high that shows that the Cement Sector should control their expenses. The cost of production, Employee cost, Power and fuel cost, Selling cost and transport cost depicts the difference to make the supply chain more effective 1.35 per cent to 2.98 per cent, 1.81 per cent to 4.98 per cent, 1.02 per cent to 2.39 per cent, 2.54 per cent to 4.47 per cent and 0.66 per cent to 1.91 per cent respectively. The output attributes as key performance indicators of the supply chain also show the big difference in the targeted data and the data achieved. Due to this difference in attributes supply chain did not work effectively.

The other attributes, which are the key performance indicators of the supply chain, show delay in collecting money by 0.70 per cent to 34.90 per cent as shown in the

average collection period and the debtors turnover ratio. The degree of inventory, Inventory Turnover Ratio, and Inventory Conversion period shows the considerable fluctuation in the stock's conversion as the projection is higher than the actual outcome of 1.10 per cent to 34.90 per cent. Return on investment and working capital turnover ratio shows that the difference in the projection and the actual data is relatively high from 12.14 per cent to 133.29 per cent and 0.31 per cent to 69.24 per cent. It means the sector does not get the return as the amount invested. In comparison to all the attributes, Net sales showed the consistent performance and did not report high fluctuation works with full efficiency, but performance does fluctuate with the projected and the data received from 0.31 per cent to 2.54 per cent. Measuring the performance indicates, though, that the business slips below the expected objective when appropriate. However, the measurement of performance ensures that the organization does not slip below the aim as necessary. This again suggests that the development line's quality is not compatible with the rest of the years.

Table 4.1.5.A Slack Report of Cement Sector

Sector: Cement				Slack In Input Attributes						Slack in output Key Performance indicators of Supply chain							
Year	RTS of Projected of DMU	Score	Rank	Cost of Production	Employee Cost	Power & Fuel Cost	Raw Materials	Selling Cost	Transport	Average Collection period	Debtors Ratio	Degree of Inventory	Inventory Conversion Period	Inventory Turnover Ratio	Net Sales	Return on Investment	Working Capital Turnover Ratio
2010	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2012	Decreasing	0.997	5	11.4512	0	6.2022	0	0	0.062	0.03	0.9122	0.0034	0.2306	0.3664	0	0.0242	0
2013	Decreasing	0.987	7	30.4902	2.8564	7.2474	18.8304	0	0.065	0.682	2.8186	0.0238	0	1.4456	0	0.0082	0.5204
2014	Decreasing	0.981	9	0	16.4472	0	38.9656	132.871	3.965	1.0138	1.6648	0.0062	2.333	0.739	0	0.0382	0.61
2015	Decreasing	0.977	10	60.094	8.5432	10.593	43.434	4.7856	0	1.495	10.0138	0.0748	0.7248	3.4682	0	0.0318	8.467
2016	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2018	Decreasing	0.987	6	0	13.4384	0	18.5552	84.4784	1.641	1.6378	5.6918	0.1088	4.292	2.068	0	0.0114	6.7476
2019	Decreasing	0.982	8	0	17.6154	0	36.2514	10.7388	0	1.8426	8.3404	0.1554	5.403	2.9388	0	0.021	1.0576

Table 4.1.5.B Slack Report of Input Variable Cement Sector

	Cost of Production			Employee Cost			Power & Fuel Cost			Raw Materials			Selling Cost			Transport		
DMU	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)
2010	2254	2254.08	0	187	186.81	0	786.5	786.48	0	527.1	527.11	0	707.9	707.9	0	22.1	22.13	0
2011	2722	2721.55	0	236	236.15	0	900.8	900.84	0	538	538.03	0	899.5	899.5	0	26	25.99	0
2012	3119	3107.8	-1.35	284	283.56	0	1127	1120.43	-2.39	557.8	557.75	0	1026	1026.09	0	27.7	27.59	-0.66
2013	3180	3149.35	-1.82	306	303.42	-1.81	1270	1262.62	-1.02	704.4	685.61	-4.47	1097	1096.72	0	35.5	35.45	-0.25
2014	3331	3330.55	0	330	313.46	-2.49	1254	1253.79	0	740	701.06	-2.2	1368	1234.75	-4.91	39.3	35.36	-7.06
2015	3921	3860.73	-2.98	378	369.47	-4.38	1386	1375.49	-1.49	866.2	822.8	-8.05	995.6	990.84	-0.55	48.9	48.89	0
2016	3272	3272.27	0	389	388.64	0	1284	1283.5	0	855.7	855.67	0	1574	1573.81	0	48.7	48.72	0
2017	3440	3440.33	0	400	400.06	0	1154	1153.54	0	785.4	785.36	0	1820	1820.07	0	34.5	34.52	0
2018	3858	3857.94	0	438	424.65	-4.13	1429	1428.93	0	921.8	903.24	-2.54	2126	2041.47	-4.12	42.7	41.04	-1.91
2019	3634	3633.82	0	462	444.65	-4.98	1617	1617.06	0	1133	1096.26	-4.3	1402	1390.81	-0.85	50	50.04	0

Table 4.1.5.C Slack Report of Output Variable of Cement Sector

Average Collection period			Debtors Ratio			Degree of Inventory			Inventory Conversion Period			Inventory Turnover Ratio			Net Sales			Return on Investment			Working Capital Turnover Ratio		
Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)
8.24	8.24	0	54.2	54.19	0	0.4	0.43	0	32.4	32.36	0	11.6	11.6	0	4050	4049.8	0	0.2	0.19	0	11.8	11.77	0
7.76	7.76	0	50.6	50.64	0	0.6	0.57	0	37.4	37.44	0	10.2	10.23	0	4044	4044.3	0	0.1	0.11	0	17.3	17.3	0
7.18	7.23	0.7	52.2	53.3	2.27	0.6	0.62	1.89	39.2	39.51	1.1	9.75	10.16	3.25	4807	4810.3	0.31	0.1	0.12	133.3	26.5	26.57	0.31
8.07	8.91	7.73	46.5	49.78	9.81	0.7	0.72	4.46	43.5	44.09	1.44	8.92	10.48	19.22	5495	5536.4	1.44	0.1	0.1	12.14	14	14.75	5
9.1	10.32	11.96	42.4	44.75	6.74	0.6	0.64	4.07	45.4	48.44	9.14	8.51	9.48	8.75	5469	5699.6	2.07	0.1	0.11	29.79	17.2	17.9	11.51
8.67	10.46	16.85	46.8	57.6	25.81	0.6	0.69	12.51	40.5	42.47	4.47	9.48	13.13	47.24	6066	6150.1	2.54	0.1	0.11	96.91	17.5	26.18	69.24
9.53	9.53	0	45	45.02	0	0.5	0.54	0	39	38.98	0	9.76	9.76	0	6061	6061.2	0	0	0.04	0	13.8	13.78	0
10.4	10.41	0	45.7	45.67	0	0.4	0.43	0	37	37.03	0	10.2	10.2	0	5796	5796.3	0	0.1	0.05	0	18.8	18.83	0
10.9	12.7	14.29	48	54.1	21.13	0.4	0.51	22.72	35.7	40.5	12.65	10.7	12.93	23.32	6788	6884.3	1.36	0.1	0.08	17.66	20.9	27.81	55.81
12.8	14.93	14.72	39.2	48	34.9	0.4	0.6	29.96	37.4	43.61	15.32	10.2	13.28	34.45	7539	7636.1	1.94	0.1	0.11	38.36	30.9	32.46	5.72

4.1.6 Non-ferrous Metals Sector

The effectiveness of the supply chain through the DEA -CCR model of the Non-ferrous Metals Sector is discussed in Table 4.1.6.A .The results demonstrate that the supply chain operates at its highest capacity and had the best possible outcome, i.e. 100% for the period of 4 years, i.e. from 2010 to 2011, 2017 to 2019. There was no slack reported in this period, i.e. from 2010 to 2011, 2017 to 2019. However, from 2012 to 2016 and 2018, the supply chains operated at a capacity of 99.72%, 99.27%, 99.85%, 99.08%, 99.06% and 99.78%. An in-depth analysis of the input attributes and the output key performance indicators revealed their contributions to decrease efficiency as depicted in the table 4.1.6A. The decreased efficiency in 2015 has been attributed to the increase in the slack of the input attributes considered in the study, i.e. Cost of Production, Employee Costs, Power & Fuel Cost, Selling Cost, and transport cost 1.0402, 0.0462, 1.5538, 0.08 and 0.016 units respectively. As far as output key performance indicators are concerned, a slack was observed in them in the years from 2010 to 2011, 2017 to 2019. they were contributing towards the decrease in the efficiency of the Supply Chains. Like for the year 2015 a slack of 10.0642, 0.8988, 0.1866, 8.4812, 3.1632, 0.3296, 0.0216 and 0.4778 units was respectively observed in the Average collection period, Debtors Ratio, Degree of Inventory, Inventory conversion period, Inventory turnover ratio, net sales, Return on Investment and Working Capital Turnover Ratio.

Table 4.1.6 B and 4.1.6.C demonstrate the effectiveness of the particular sector's supply chain during the span of the ten years. The difference in the projection and the actual data is very high that shows that **Non**-ferrous Metals Sector should control their expenses. The cost of production, Employee cost, Power and fuel cost, raw material cost, Selling cost and transport cost depicts the difference to make the supply chain more effective 0.32 per cent to 1.41 per cent, 0.14 per cent to 9.83 per cent, 1.86 per cent to 13.47 per cent, 0.10 per cent to 0.74 per cent, 2.70 per cent and 4.48 per cent and 1.12 per cent to 5.41 per cent respectively. The output attributes as key performance indicators of the supply chain also show the big difference in the targeted data and the data achieved. Due to this difference in attributes supply chain did not work effectively.

The other attributes, which are the key performance indicators of the supply chain, show delay in collecting money 1.05 per cent to 41.41 per cent as shown in the average collection period and the debtors turnover ratio. The degree of inventory, Inventory Turnover Ratio, and Inventory Conversion period shows the massive fluctuation in the stock conversion as the projection is higher than the actual outcome of 3.30 per cent to 33.91 per cent. Return on investment and working capital turnover ratio shows that the difference in the projection and the actual data is relatively high from 0.15 per cent to 2981.24 per cent and 2.62per cent to 27.22 per cent. It means the sector does not get the return as the amount invested. In comparison to all the attributes, Net sales show the consistent performance and did not report high fluctuation works with full efficiency, but performance does fluctuate with the projected and the data received from 0.28 per cent to 1.53 per cent. Measuring the performance indicates, though, that the business slips below the expected objective when appropriate. However, the measurement of performance ensures that the organization does not slip below the aim as necessary. This again suggests that the development line's quality is not compatible with the rest of the years.

Table 4.1.6.A Slack Report of Non-ferrous Metals Sector

Sector: Non-Ferrous Metals				Slack In Input Attributes							Slack in output Key Performance indicators of Supply chain						
Year	RTS of Projected of DMU	Score	Rank	Cost of Production	Employee Cost	Power & Fuel Cost	Raw Materials	Selling Cost	Transport	Average Collection period	Debtors Ratio	Degree of Inventory	Inventory Conversion Period	Inventory Turnover Ratio	Net Sales	Return on Investment	Working Capital Turnover Ratio
2010	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2012	Decreasing	0.9972	7	0	0.0066	0.5522	0.1196	0.0334	0	26.9024	0.4346	0.0696	7.2268	2.259	0	0.0088	0.7018
2013	Decreasing	0.9927	8	1.8968	0.6698	1.4516	0	0.0292	0	0.3214	0.68	0.0754	1.0654	2.707	0	0.0252	0.3614
2014	Decreasing	0.9985	5	0.3548	0	0	0.4984	0.0532	0.0682	6.6022	0.2324	0.1116	0	1.0282	0	0	0.127
2015	Decreasing	0.9908	9	1.0402	0.0462	1.5538	0	0.08	0.016	10.0642	0.8988	0.1866	8.4812	3.1632	0.3296	0.0216	0.4778
2016	Decreasing	0.9906	10	0	0.7738	0.12	1.2712	0	0.0322	9.0582	0.4268	0.2522	7.9368	0.0738	0	0.0078	0.363
2017	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2018	Decreasing	0.9978	6	0	1.8266	0.4178	1.1046	0	0.0622	10.2556	0.7892	0.1344	3.6434	1.5682	0	0.0152	0.2236
2019	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 4.1.6.B Slack Report of Input Variables of Non-ferrous Metals Sector

	Cost of Production			Employee Cost			Power & Fuel Cost			Raw Materials			Selling Cost			Transport		
DMU	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)
2010	146.2	146.22	0	3.96	3.96	0	4.88	4.88	0	128.7	128.67	0	0.96	0.96	0	0.91	0.91	0
2011	167.5	167.53	0	4.58	4.58	0	4.43	4.43	0	155.2	155.2	0	0.79	0.79	0	1.01	1.01	0
2012	204.7	204.65	0	4.97	4.96	-0.14	5.5	4.95	-7.66	184.9	184.74	-0.1	0.79	0.76	-2.7	0.98	0.98	0
2013	224.7	222.85	-1.41	5.65	4.98	-9.83	5.52	4.07	-13.47	205.7	205.73	0	1.11	1.08	-2.93	1.11	1.11	0
2014	243.7	243.35	-0.32	5.92	5.92	0	8.26	8.26	0	220.2	219.68	-0.57	1.79	1.74	-4.48	1.17	1.1	-5.41
2015	262.7	261.61	-0.36	6.79	6.74	-1.57	8.53	6.98	-7.21	241.6	241.58	0	2.24	2.16	-3.91	1.46	1.44	-0.88
2016	303.3	303.3	0	8.47	7.7	-5.2	8.6	8.48	-1.86	274.1	272.83	-0.74	2.57	2.57	0	1.54	1.51	-1.12
2017	253.5	253.54	0	9.09	9.09	0	7	7	0	226.8	226.81	0	2.03	2.03	0	1.41	1.41	0
2018	302.8	302.8	0	11.56	9.73	-8.43	7.32	6.9	-4.8	272	270.89	-0.56	2.21	2.21	0	1.32	1.25	-1.84
2019	289	289.02	0	11.12	11.12	0	7.77	7.77	0	262.7	262.72	0	2.75	2.75	0	3.25	3.25	0

Table 4.1.6.C Slack Report of Output Variables of Non-ferrous Metals Sector

Average Collection period			Debtors Ratio			Degree of Inventory			Inventory Conversion Period			Inventory Turnover Ratio			Net Sales			Return on Investment			Working Capital Turnover Ratio		
Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)
63.8	63.78	0	6.28	6.28	0	1.13	1.13	0	30.9	30.85	0	15.2	15.2	0	155.1	155.1	0	0.05	0.05	0	4.32	4.32	0
58.7	58.66	0	7.6	7.6	0	1.13	1.13	0	35.2	35.15	0	15.7	15.7	0	174.7	174.7	0	0.05	0.05	0	4.43	4.43	0
56.4	83.47	41.41	6.96	7.41	8.07	1.37	1.44	8.44	36.6	43.96	19.05	13.3	15.6	24.11	212.4	212.8	0.28	0.04	0.05	46.94	4.14	4.86	12.98
69.9	70.79	1.05	5.62	6.35	12.87	1.02	1.1	11.43	43	44.36	3.3	11.4	14.2	25.1	233.8	235.6	0.74	0.02	0.05	254.29	4.34	4.73	8.15
65.7	72.34	13.3	6.24	6.48	3.34	1	1.12	8.69	37.6	37.68	0.15	12.2	13.3	17.28	256	256.2	0.15	0.05	0.05	0.15	4.6	4.74	2.62
63	73.93	17.08	6.21	7.16	13.49	1.13	1.33	16.16	36.2	45.18	21.04	10.8	14.1	33.91	279.4	280.7	1.53	0.03	0.05	2981.2	4.21	4.73	10.42
65.4	75.21	12.7	6.03	6.51	10.03	1.06	1.32	26.75	40.2	48.47	25.91	10.6	10.8	1.64	322.4	324.5	0.99	0.05	0.06	21.9	4.41	4.78	27.22
70.9	70.9	0	5.47	5.47	0	1.33	1.33	0	43.1	43.13	0	9.97	9.97	0	274.4	274.4	0	0.07	0.07	0	3.79	3.79	0
71.1	81.57	11.94	5.57	6.37	19.15	1.49	1.63	7.98	48.5	52.31	5.62	10.2	11.8	29.21	326.8	327.4	0.22	0.05	0.06	54.1	3.23	3.46	10.19
69.5	69.51	0	6.39	6.39	0	1.56	1.56	0	53.3	53.27	0	9.28	9.28	0	313.3	313.3	0	0.05	0.05	0	3.86	3.86	0

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4.1.7 Cable Manufacturing Sector

The effectiveness of the supply chain through the DEA -CCR model of the Cable Manufacturing Sector is discussed in Table 4.1.7A. The results demonstrate that the supply chain operates at its highest capacity and had the best possible outcome, i.e. 100% for the period of 8 years, i.e. from 2010 to 2016 and 2019. So there was not any slack reported in this period, i.e. from 2010 to 2016 and 2019. However, in 2017 and 2018, the supply chains operated at 99.64%, and 98.69%. An in-depth analysis of the input attributes and the output key performance indicators revealed their contributions to decrease efficiency as depicted in the table 4.1.7A. Like the decreased efficiency in the year 2017 has been attributed to the increase in the slack of the input attributes considered in the study, i.e. Cost of Production, Employee Costs, Selling Cost and transport cost by 4.8662, 0.5908, 10.1232, 0.4912 and 0.0188 units respectively. Also, as far as output key performance indicators are concerned a slack was observed in them as well in the years from 2010 to 2016 and 2019 contributing towards the decrease in the efficiency of the Supply Chains. Like for the year 2017 a slack of 1.0788, 0.148, 0.904, 0.0094 and 0.0056 units were respectively observed in the Average collection period, Debtors Ratio, Inventory turnover ratio, Return on Investment and Working Capital Turnover Ratio.

Table 4.1.7.B and 4.1.7.C demonstrate the effectiveness of the particular sector's supply chain during the span of the ten years. The difference in the projection and the actual data is very high that shows that Cable Manufacturing Sector should control their expenses. The cost of production, Employee cost, Power and fuel cost, raw material cost, Selling cost and transport cost depicts the difference to make the supply chain more effective 1.20 in 2017 per cent, 1.78 per cent to 2.25 per cent, 1.89 per cent 2018, 0.76 per cent to 3.10 per cent, 4.20 per cent and 4.90 per cent and 5.01 per cent to 8.15 per cent respectively. The output attributes as key performance indicators of the supply chain also show the big difference in the targeted data and the data achieved. Due to this difference in attributes supply chain did not work effectively.

The other attributes, which are the key performance indicators of the supply chain, show a delay in the collection of money 1.32 per cent to 10.87 per cent as shown in the average collection period and the debtors turnover ratio. The degree of inventory, Inventory Turnover Ratio, and Inventory Conversion period shows the massive fluctuation in the stock conversion as the projection is higher than the actual outcome of 0.37 per cent to 19.14 per cent. Return on investment and working capital turnover ratio shows that the difference in the projection and the actual data is relatively high from 36.55 per cent to 41.72 per cent and 0.57percent to 7.78 per cent. It means the sector does not get the return as the amount invested. In comparison to all the attributes, Net sales show the consistent performance and did not report high fluctuation works with full efficiency, but performance does fluctuate with the projected and the data received from 0.37 per cent to 1.40 per cent. Measuring the performance indicates, though, that the business slips below the expected objective when appropriate. However, the measurement of performance ensures that the organization does not slip below the aim as necessary. This again suggests that the development line's quality is not compatible with the rest of the years.

Table 4.1.7.A Slack Report of Cable Sector

Sector: Cable				Slack In Input Attributes						Slack in output Key Performance indicators of Supply chain							
Year	RTS of Projected of DMU	Score	Rank	Cost of Production	Employee Cost	Power & Fuel Cost	Raw Materials	Selling Cost	Transport	Average Collection period	Debtors Ratio	Degree of Inventory	Inventory Conversion Period	Inventory Turnover Ratio	Net Sales	Return on Investment	Working Capital Turnover Ratio
2010	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2012	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2014	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2016	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	Decreasing	0.996	9	4.8662	0.5908	0	10.1232	0.4912	0.0188	1.0788	0.148	0	0	0.904	0	0.0094	0.0056
2018	Decreasing	0.987	10	0	0.618	0.2422	2.8938	0.4744	0.0116	6.3468	0.303	0.0198	0	2.2908	0	0.011	0.164
2019	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 4.1.7.B Slack Report of Input Variables of Cable Sector

	Cost of Production			Employee Cost			Power & Fuel Cost			Raw Materials			Selling Cost			Transport		
DMU	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)
2010	458	457.8	0	15.7	15.68	0	18.8	18.75	0	366	365.84	0	17.6	17.61	0	1.44	1.44	0
2011	456	456.1	0	20.9	20.86	0	20.8	20.79	0	352	352.39	0	19.9	19.86	0	1.56	1.56	0
2012	588	587.8	0	27.7	27.72	0	27.9	27.9	0	464	463.8	0	20.5	20.47	0	1.57	1.57	0
2013	712	711.8	0	32.1	32.11	0	29.4	29.42	0	563	563.42	0	21.7	21.68	0	1.94	1.94	0
2014	649	648.8	0	34	33.97	0	26.9	26.91	0	512	512.01	0	15	15	0	2.03	2.03	0
2015	738	737.7	0	42.3	42.3	0	24.4	24.43	0	567	566.96	0	23.1	23.12	0	2.21	2.21	0
2016	601	601.5	0	51.5	51.52	0	19.3	19.33	0	367	366.8	0	12.5	12.47	0	2.82	2.82	0
2017	675	669.7	-1.2	72.6	71.99	-2.25	21.7	21.68	0	390	380.13	-3.1	18.1	17.56	-4.9	3.22	3.2	-8.2
2018	885	884.9	0	89.1	88.47	-1.78	23.4	23.16	-1.89	511	508.31	-0.8	25.6	25.08	-4.2	3.79	3.78	-5
2019	1370	1370	0	120	120.2	0	26.4	26.42	0	863	863.22	0	32.2	32.24	0	4.27	4.27	0

Table 4.1.7.C Slack Report of Output Variables of Cable Sector

Average Collection period			Debtors Ratio			Degree of Inventory			Inventory Conversion Period			Inventory Turnover Ratio			Net Sales			Return on Investment			Working Capital Turnover Ratio		
Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)
371.7	371.68	0	3.18	3.18	0	0.61	0.61	0	133.13	133.13	0	7.87	7.87	0	557.54	557.54	0	0.08	0.08	0	2.39	2.39	0
389.2	389.18	0	2.68	2.68	0	0.73	0.73	0	56.38	56.38	0	7.64	7.64	0	518.06	518.06	0	0.07	0.07	0	2.3	2.3	0
108.2	108.21	0	3.8	3.8	0	0.73	0.73	0	45.02	45.02	0	12.2	12.24	0	662.24	662.24	0	0.04	0.04	0	2.89	2.89	0
101.4	101.4	0	4.09	4.09	0	0.59	0.59	0	47.95	47.95	0	9.79	9.79	0	827.4	827.4	0	0.04	0.04	0	3.88	3.88	0
103	102.97	0	3.99	3.99	0	0.72	0.72	0	51.34	51.34	0	8.06	8.06	0	753.31	753.31	0	0.06	0.06	0	4.93	4.93	0
105.7	105.66	0	3.71	3.71	0	0.63	0.63	0	49.88	49.88	0	8.54	8.54	0	885.92	885.92	0	0.07	0.07	0	3.06	3.06	0
107.7	107.73	0	3.72	3.72	0	0.52	0.52	0	42.28	42.28	0	10.2	10.19	0	787.27	787.27	0	0.08	0.08	0	3.05	3.05	0
114.9	116.4	1.32	3.28	3.44	4.96	0.53	0.54	0.37	49.03	49.12	0.37	8.49	9.45	6.78	845.94	847.62	0.37	0.06	0.07	41.72	2.82	2.84	0.57
115.2	123.15	6.96	3.28	3.63	10.87	0.59	0.61	8.27	53.81	54.21	1.4	7.74	10.21	19.14	1135.23	1143.4	1.4	0.07	0.08	36.55	3.03	3.23	7.78
124.4	124.36	0	3.18	3.18	0	0.68	0.68	0	60.13	60.13	0	7.74	7.74	0	1725.27	1725.3	0	0.11	0.11	0	4.17	4.17	0

4.1.8. Textile Texturing Sector

The effectiveness of the supply chain through the DEA -CCR model of the Textile Texturing Sector is discussed in Table 4.1.8 A. The results demonstrate that the supply chain operates at its highest capacity and had the best possible outcome, i.e. 100% for the period of 6 years, i.e. from 2010 to 2011, 2015 to 2017 and 2019. So there was not any slack reported in this period, i.e. from 2010 to 2011, 2015 to 2017 and 2019. However, from 2012 to 2014 and 2018, the supply chains operated at a capacity of 99.9%, 99.7%, 99.7% and 99.81%. An in-depth analysis of the input attributes and the output key performance indicators revealed their contributions to decrease efficiency as depicted in the table 4.1.8 A. Like the decreased efficiency in the year 2014 has been attributed to the increase in the slack of the input attributes considered in the study, i.e. Employee Costs, Power & Fuel Cost, Raw Material and Selling Cost by 0.3392, 0.0036, 0.3754 and 0.0092 units respectively. Also, as far as output key performance indicators are concerned a slack was observed in them as well in the years from 2012 to 2014 and 2018 contributing towards the decrease in the efficiency of the Supply Chains. Like for the year 2014 a slack of 0.3524, 0.8154, 0.36, 1.1764, 0.01 and 5.2138 units were respectively observed in the Average collection period, Debtors Ratio, Inventory conversion period, Inventory turnover ratio, Return on Investment and Working Capital Turnover Ratio.

Table 4.1.8.B and 4.1.8.C demonstrate the effectiveness of the particular sector's supply chain during the span of the ten years. The difference in the projection and the actual data is very high that shows that Textile Texturing Sector should control their expenses. The cost of production, Employee cost, Power and fuel cost, raw material cost, Selling cost and transport cost depicts the difference to make the supply chain more effective 0.02 per cent, 4.01 per cent to 10.46 per cent, 0.03 per cent to 1.35 per cent, 0.15 per cent to 0.63 per cent, 0.21 per cent and 14.59 per cent and 0.62 per cent to 8.24 per cent respectively. The output attributes as key performance indicators of the supply chain also show the big difference in the targeted data and the data achieved. Due to this difference in attributes supply chain did not work effectively.

The other attributes, which are the key performance indicators of the supply chain, show delay in the collection of money 1.33 per cent to 63.53 per cent as shown in the

average collection period and the debtors turnover ratio. The degree of inventory, Inventory Turnover Ratio, and Inventory Conversion period shows the massive fluctuation in the stock conversion as the projection is higher than the actual outcome of 0.10 per cent to 29.26 per cent. Return on investment and working capital turnover ratio shows that the difference in the projection and the actual data is relatively high from 23.98 per cent to 299.22 per cent and 4.32percent to 48.21 per cent. It means the sector does not get the return as the amount invested. In comparison to all the attributes, Net sales show the consistent performance and did not report high fluctuation works with full efficiency, but performance does fluctuate with the projected and the data received from 0.10 per cent to 0.30 per cent. Measuring the performance indicates, though, that the business slips below the expected objective when appropriate. However, the measurement of performance ensures that the organization does not slip below the aim as necessary. This again suggests that the quality of the development line is not compatible with the rest of the years

Table 4.1.8.A Slack Report of Textile Texturing Sector

Sector: Textiles				Slack In Input Attributes						Slack in output Key Performance indicators of Supply chain							
Year	RTS of Projected of DMU	Score	Rank	Cost of Production	Employee Cost	Power & Fuel Cost	Raw Materials	Selling Cost	Transport	Average Collection period	Debtors Ratio	Degree of Inventory	Inventory Conversion Period	Inventory Turnover Ratio	Net Sales	Return on Investment	Working Capital Turnover Ratio
2010	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2012	Decreasing	0.999	7	0	0	0.3586	0.396	0.2992	0.317	10.462	0.1454	0.0582	10.0894	0	0	0.0158	0.1194
2013	Decreasing	0.997	9	0	0.7624	0	0.6562	0.3558	0.0058	0.3346	1.645	0.2698	2.3582	1.3746	0	0.0278	5.3026
2014	Decreasing	0.997	10	0	0.3392	0.0036	0.3754	0.0092	0	0.3524	0.8154	0	0.36	1.1764	0	0.01	5.2138
2015	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2016	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2018	Decreasing	0.998	8	0.0304	0.3556	0	0.4794	0.7148	0.0964	16.4578	0.0994	0	3.203	1.4852	0	0.006	0.1616
2019	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 4.1.8.B Slack Report of Input Variables of Textile Texturing Sector

	Cost of Production			Employee Cost			Power & Fuel Cost			Raw Materials			Selling Cost			Transport		
DMU	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)
2010	538	538	0	6.44	6.44	0	7.02	7.02	0	513.2	513.2	0	1.87	1.87	0	0.61	0.61	0
2011	121.3	121.3	0	2.96	2.96	0	8.16	8.16	0	97.43	97.43	0	1.92	1.92	0	0.92	0.92	0
2012	160.2	160.2	0	4.4	4.4	0	12.1	11.72	-1.4	130.3	129.9	-0.2	3.88	3.58	-4.61	1.52	1.2	-8.2
2013	173	173	0	5.83	5.06	-10.5	11.1	11.08	0	142	141.3	-0.6	3.75	3.39	-8.33	1.51	1.5	-0.6
2014	200.5	200.5	0	6.56	6.22	-4.01	14.3	14.32	0	162.3	161.9	-0.6	4.61	4.6	-0.21	1.59	1.59	0
2015	165.7	165.7	0	6.42	6.42	0	12.3	12.25	0	129.3	129.3	0	5.66	5.66	0	1.11	1.11	0
2016	113	113	0	5.68	5.68	0	9.51	9.51	0	82.48	82.48	0	2.79	2.79	0	1.11	1.11	0
2017	99.81	99.81	0	6.4	6.4	0	9.71	9.71	0	71.78	71.78	0	3.14	3.14	0	1	1	0
2018	108.5	108.4	0	7.18	6.83	-5.63	9.51	9.51	0	78.87	78.39	-0.6	3.42	2.71	-14.6	1.13	1.04	-7.6
2019	123.7	123.7	0	7.69	7.69	0	11.7	11.66	0	90.55	90.55	0	4.61	4.61	0	1.74	1.74	0

Table 4.1.8.C Slack Report of Output Variables of Textile Texturing Sector

Average Collection period			Debtors Ratio			Degree of Inventory			Inventory Conversion Period			Inventory Turnover Ratio			Net Sales			Return on Investment			Working Capital Turnover Ratio		
Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)
41.7	41.67	0	21	20.6	0	0.8	0.8	0	23	22.7	0	52	52.2	0	128	128	0	0.1	0.05	0	16	16	0
135	135	0	6.6	6.62	0	1.3	1.25	0	64	64.1	0	12	11.7	0	129	128.8	0	0.1	0.05	0	7.5	7.5	0
69	79.54	11.88	6.7	6.89	3.64	1.2	1.23	4.12	40	50.2	16.93	12	11.9	0.1	172	171.9	0.1	0.1	0.07	59.23	5.9	5.99	4.32
69.2	69.72	1.33	6.3	7.95	19.25	0.9	1.15	29.26	38	40.3	9.9	13	14.5	9.53	185	185.9	0.3	0	0.05	299.2	5.2	10.6	48.21
69.7	70.18	1.45	6.3	7.17	7.18	0.9	0.86	0.3	34	34.3	2.01	15	16.2	7.12	214	214.5	0.3	0	0.05	23.98	6.5	11.8	27.35
87	86.98	0	6.3	6.28	0	0.7	0.65	0	36	36.1	0	14	14.5	0	178	178.4	0	0.1	0.06	0	11	10.6	0
123	123.4	0	6.4	6.4	0	0.7	0.73	0	42	41.5	0	14	13.8	0	117	116.6	0	0.2	0.18	0	6.9	6.87	0
109	108.6	0	8	7.97	0	2.3	2.25	0	28	28.3	0	17	16.7	0	104	104	0	0.2	0.2	0	7	7.04	0
88.4	104.9	63.53	9.5	9.61	1.75	1.5	1.49	0.19	29	32.5	9.04	17	18.3	15.98	114	114.2	0.19	0.1	0.15	93.61	11	11.3	6.25
60.4	60.43	0	9.7	9.65	0	0.8	0.77	0	28	27.5	0	16	15.5	0	132	131.9	0	0.1	0.06	0	11	11	0

4.1.9 Textile Weaving Sector

The effectiveness of the supply chain through the DEA -CCR model of the Textile Weaving Sector is discussed in Table 4.1.9 A. The results demonstrate that the supply chain operates at its highest capacity and had the best possible outcome, i.e. 100% for the period of 6 years, i.e. from 2010 to 2013, 2017 and 2019. So there was not any slack reported in this period, i.e. from 2010 to 2013, 2017 and 2019. However, from 2014 to 2016 and 2018, the supply chains operated at a capacity of 96.39%, 97.29%, 97.33% and 99.03%. An in-depth analysis of the input attributes and the output key performance indicators revealed their contributions to decrease efficiency as depicted in the table 4.1.8 A. Like the decreased efficiency in the year 2016 has been attributed to the increase in the slack of the input attributes considered in the study, i.e. Employee Costs, Power & Fuel Cost, Raw Material and Transportation Cost by 0.5764, 0.43, 2.307 and 0.09 units respectively. Also as far as output key performance indicators are concerned a slack was observed in them as well in the years from 2010 to 2013, 2017 and 2019 contributing towards the decrease in the efficiency of the Supply Chains. Like for the year 2016 a slack of 5.236, 1.18, 0.243, 10.452, 0.657, 0.0192 and 0.87units were respectively observed in the Average collection period, Debtors Ratio, Degree of Inventory, Inventory conversion period, Inventory turnover ratio, Return on Investment and Working Capital Turnover Ratio.

Table 4.1.9.B and 4.1.9.C demonstrate the effectiveness of the particular sector's supply chain during the span of the ten years. The difference in the projection and the actual data is very high that shows that Textile Weaving Sector should control their expenses. The cost of production, Employee cost, Power and fuel cost, raw material cost, Selling cost and transport cost depicts the difference to make the supply chain more effective 1.08 per cent, 3.16 per cent to 9.73 per cent, 1.26 per cent to 7.81 per cent, 0.42 per cent to 3.05 per cent, 2.11 per cent and 11.39 per cent and 4.96 per cent to 9.06 per cent respectively. The output attributes as key performance indicators of the supply chain also show the big difference in the targeted data and the data achieved. Due to this difference in attributes supply chain did not work effectively.

The other attributes, which are the key performance indicators of the supply chain, show delay in collecting money 5.46 per cent to 32.72 per cent as shown in the average collection period and debtors turnover ratio. The degree of inventory, Inventory Turnover Ratio, and Inventory Conversion period shows the massive fluctuation in the stock conversion as the projection is higher than the actual outcome of 2.16 per cent to 27.87 per cent. Return on investment and working capital turnover ratio shows that the difference in the projection and the actual data is relatively high from 24.21 per cent to 41.52 per cent and 16.88 per cent to 45.14 per cent. It means the sector does not get the return as the amount invested. In comparison to all the attributes, Net sales show the consistent performance and did not report high fluctuation works with full efficiency, but performance does fluctuate with the projected and the data received from 2.16 per cent to 4.08 per cent. Measuring the performance indicates, though, that the business slips below the expected objective when appropriate. However, the measurement of performance ensures that the organization does not slip below the aim as necessary. This again suggests that the quality of the development line is not compatible with the rest of the years

Table 4.1.9.A Slack Report of Textile Weaving Sector

Sector: Textiles				Slack In Input Attributes						Slack in output Key Performance indicators of Supply chain							
Year	RTS of Projected of DMU	Score	Rank	Cost of Production	Employee Cost	Power & Fuel Cost	Raw Materials	Selling Cost	Transport	Average Collection period	Debtors Ratio	Degree of Inventory	Inventory Conversion Period	Inventory Turnover Ratio	Net Sales	Return on Investment	Working Capital Turnover Ratio
2010	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2012	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2014	**Decreasing**	0.9639	10	1.7	0	0.26	8.573	0.0918	0.15	4.3492	0.26	0.535	13	0	0.4402	0.0224	0.21
2015	**Decreasing**	0.9729	9	0	0.2292	0	1.897	0.1442	0.09	10.774	0.21	0.5582	8.8922	1.104	0	0.016	0.53
2016	**Decreasing**	0.9733	8	0	0.5764	0.43	2.307	0	0.09	5.236	1.18	0.243	10.452	0.657	0	0.0192	0.87
2017	**Constant**	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2018	**Decreasing**	0.9805	7	0	0.3662	0	0.489	0.0862	0.08	1.6834	0.27	0.0552	3.7658	0	0	0.0154	0.44
2019	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 4.1.9.B Slack Report of Input Variables of Textile Weaving Sector

	Cost of Production			Employee Cost			Power & Fuel Cost			Raw Materials			Selling Cost			Transport		
DMU	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)
2010	340.5	340.5	0	4.12	4.12	0	5.62	5.62	0	318.02	318	0	4.02	4.02	0	1.58	1.58	0
2011	471	471	0	5.84	5.84	0	6.78	6.78	0	420.83	421	0	4.76	4.76	0	1.45	1.45	0
2012	411.2	411.2	0	7.28	7.28	0	7.78	7.78	0	364.14	364	0	6.47	6.47	0	1.68	1.68	0
2013	258.5	258.5	0	6.93	6.93	0	8.99	8.99	0	196.91	197	0	5.25	5.25	0	1.65	1.65	0
2014	229.8	228.1	-1.08	7.98	7.98	0	10.94	10.7	-1.26	185.42	177	-3.05	5.19	5.1	-2.11	1.72	1.57	-9.06
2015	158.6	158.6	0	9.83	9.6	-9.7	12.12	12.1	0	110.08	108	-1.76	5.24	5.1	-11.39	1.7	1.61	-8.41
2016	176.2	176.2	0	12.01	11.4	-5.5	12.77	12.3	-7.81	122.32	120	-2.59	4.48	4.48	0	1.51	1.42	-6.79
2017	136.6	136.6	0	12.92	12.9	0	11.14	11.1	0	83.77	83.8	0	3.99	3.99	0	1.8	1.8	0
2018	125.3	125.3	0	15.06	14.7	-3.2	12.31	12.3	0	73.29	72.8	-0.42	4.57	4.48	-2.31	1.72	1.64	-4.96
2019	126.2	126.2	0	16.3	16.3	0	12.82	12.8	0	70.69	70.7	0	4.64	4.64	0	1.56	1.56	0

Table 4.1.9.C Slack Report of Output Variables of Textile Weaving Sector

Average Collection period			Debtors Ratio			Degree of Inventory			Inventory Conversion Period			Inventory Turnover Ratio			Net Sales			Return on Investment			Working Capital Turnover Ratio		
Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)
80.6	81	0	5.7	5.67	0	2.2	2.15	0	85	85	0	5.86	5.86	0	379.1	379.1	0	0.06	0.1	0	2.05	2.05	0
60.3	60	0	6.6	6.55	0	2.3	2.27	0	76	76.3	0	8.17	8.17	0	514.1	514.1	0	0.08	0.1	0	2.84	2.84	0
70.5	70	0	5.7	5.71	0	2.5	2.45	0	79	78.9	0	7.33	7.33	0	431.5	431.5	0	0.26	0.3	0	3.62	3.62	0
103	103	0	5.6	5.62	0	3	2.99	0	84	83.7	0	7.31	7.31	0	294.2	294.2	0	0.15	0.2	0	3.65	3.65	0
154	172	15	5.3	5.67	32.72	1.8	2.46	23.44	95	115	20	6.94	7.1	4.01	242.2	260.6	4.1	0.18	0.2	24.2	5.05	5.33	16.88
288	300	28	5	5.49	7.11	1.8	2.4	27.87	169	180	22	7.46	8.88	9.95	169	173.1	2.9	0.23	0.3	28.4	3.51	4.15	16.21
213	220	13	5.1	6.48	24.72	2.2	2.57	8.32	129	141	21	9.78	10.62	14.8	170.2	174.7	2.9	0.26	0.3	25.3	4.18	5.1	45.14
172	172	0	6.3	6.34	0	1.9	1.9	0	92	91.7	0	11.6	11.62	0	158.1	158.1	0	0.18	0.2	0	4.32	4.32	0
155	158	5.5	6.3	6.76	5.94	2.5	2.65	3.59	90	94.8	9.8	8.63	8.79	2.16	147.3	150.8	2.2	0.06	0.1	41.5	3.77	4.26	23.27
169	169	0	7.9	7.88	0	2	2	0	91	90.7	0	10	10	0	151.7	151.7	0	0.11	0.1	0	3.23	3.23	0

4.1.10 Tire Manufacturing Sector

The effectiveness of the supply chain through the DEA -CCR model of the Tire Manufacturing Sector is discussed in Table 4.1.10A. The results demonstrate that the supply chain operates at its highest capacity and had the best possible outcome, i.e. 100% for the period of 8 years, i.e. from 2010 to 2014 and 2016 to 2018. So there was not any slack reported in this period, i.e. from 2010 to 2014 and 2016 to 2018. However, from 2015 and 2019, the supply chains operated at a capacity of 96.39%, 97.29%, 99.89% and 99.59%. An in-depth analysis of the input attributes and the output key performance indicators revealed their contributions to decrease efficiency, as depicted in the table 4.1.10 A. Like the decreased efficiency in the year, 2019 has been attributed to the increase in the slack of the input attributes considered in the study, i.e. Cost of Production Employee Costs, Power & Fuel Cost, Raw Material, Selling Cost and Transportation Cost by 7.996, 4.5628, 5.64, 8.3462 and 1.15 units respectively. Also, as far as output key performance indicators are concerned, a slack was observed in them in the years from 2015 and 2019, contributing to the decrease in the efficiency of the Supply Chains. Like for the year 2015 a slack of 11.584, 1.87, 0.132, 10.644, 1.8726, 0.0592 and 1.55 were respectively observed in the Average collection period, Debtors Ratio, Degree of Inventory, Inventory conversion period, Inventory turnover ratio, Return on Investment and Working Capital Turnover Ratio.

Table 4.1.10B and 4.1.10C demonstrate the effectiveness of the 000 particular sector's supply chain during the span of the ten years. The difference in the projection and the actual data is very high that shows that Tire Manufacturing Sector should control their expenses. The Cost of production, Employee cost, Power and fuel cost, raw material cost, Selling cost and transport cost depicts the difference to make the supply chain more effective 0.23 per cent to 0.28 per cent, 2.35 per cent in 2015, 1.28 per cent to 1.42 per cent, 0.06 per cent in 2019, 1.08 per cent and 2.58 per cent and 3.73 per cent to 5.49 per cent respectively. The output attributes as key performance indicators of the supply chain also show the big difference in the targeted data and the data achieved. Due to this difference in attributes supply chain did not work effectively.

In the other attributes, which are the key performance indicators of the supply chain shows delay in the collection of money 10.37 per cent to 29.72 per cent as shown in average collection period and debtors turnover ratio. The degree of inventory, Inventory Turnover Ratio, and Inventory Conversion period shows the considerable fluctuation in the stock conversion as the projection is higher than the actual outcome of 7.89 per cent to 26.25 per cent. Return on investment and working capital turnover ratio shows that the difference in the projection and the actual data is relatively high from 15.79 per cent to 57.37 per cent and 9.16percent to 34.16 per cent. It means the sector does not get the return as the amount invested. Compared to all the attributes, Net sales show the stable performance and did not report high fluctuation works with full efficiency, but performance does fluctuate with the projected and the data received from 0.37 per cent to 1.40 per cent. Measuring the performance indicates, the supply chain works very effectively and uses the rich resources available in the sector despite a few flaws in two years.

Table 4.1.10.A Slack Report of Tire Sector

Sector: Tires				Slack In Input Attributes						Slack in output Key Performance indicators of Supply chain							
Year	RTS of Projected of DMU	Score	Rank	Cost of Production	Employee Cost	Power & Fuel Cost	Raw Materials	Selling Cost	Transport	Average Collection period	Debtors Ratio	Degree of Inventory	Inventory Conversion Period	Inventory Turnover Ratio	Net Sales	Return on Investment	Working Capital Turnover Ratio
2010	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2012	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2014	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2015	Decreasing	0.9899	10	7.996	4.5628	5.64	0	8.3462	1.15	11.584	1.87	0.132	10.644	1.8726	0	0.0592	155
2016	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2018	Constant	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2019	Decreasing	0.9959	9	31.23	0.0044	10.3	6.052	13.134	2.33	6.5618	0.77	0.082	4.2908	1.1202	7.2192	0.0164	0.54

Table 4.1.10.B Slack Report of Input Variables of Tire Sector

	Cost of Production			Employee Cost			Power & Fuel Cost			Raw Materials			Selling Cost			Transport		
DMU	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)
2010	2262	2261.8	0	164.5	164.5	0	129.3	129.3	0	1756	1756	0	162.3	162.32	0	9.05	9.05	0
2011	3304	3303.5	0	198.5	198.5	0	166	166	0	2713	2713	0	205.5	205.54	0	11.73	11.7	0
2012	4203	4203.1	0	227.7	227.7	0	193.7	193.7	0	3526	3526	0	226.5	226.51	0	11.68	11.7	0
2013	4534	4534	0	267.2	267.2	0	236.6	236.6	0	3700	3700	0	275.3	275.27	0	11.76	11.8	0
2014	4615	4615	0	311.4	311.4	0	239.2	239.2	0	3664	3664	0	333.5	333.53	0	14.21	14.2	0
2015	4880	4872	-0.28	379.6	375.1	-2.4	259.6	254	-1.28	3747	3747	0	391.9	383.56	-1.08	16.49	15.3	-3.73
2016	5455	5455	0	513.1	513.1	0	286	286	0	4018	4018	0	414.2	414.19	0	14.44	14.4	0
2017	4789	4789	0	469.8	469.8	0	240.6	240.6	0	3533	3533	0	378.3	378.26	0	15.72	15.7	0
2018	5499	5499	0	505.4	505.4	0	267.9	267.9	0	4109	4109	0	408.2	408.18	0	17.43	17.4	0
2019	6317	6316.7	-0.23	547.4	547.4	0	303.8	293.5	-1.42	4789	4783	-0.06	475.9	462.75	-2.58	21.14	18.8	-5.49

Table 4.1.10.C Slack Report of Output Variables of Tire Sector

Average Collection period			Debtors Ratio			Degree of Inventory			Inventory Conversion Period			Inventory Turnover Ratio			Net Sales			Return on Investment			Working Capital Turnover Ratio		
Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	Diff. (%)	Data	Projection	**Diff. (%)**
47.4	47.38	0	8	8.01	0	0.7	0.66	0	45	44.9	0	8.26	8.26	0	2840	2840	0	0.13	0.1	0	1004	1004	0
42.4	42.4	0	8.9	8.85	0	1	1.02	0	50	49.7	0	7.63	7.63	0	3761	3761	0	0.07	0.1	0	1275	1275	0
44.3	44.26	0	8.4	8.37	0	1	0.99	0	51	51	0	7.42	7.42	0	4784	4784	0	0.06	0.1	0	1663	1663	0
46.9	46.85	0	8	7.96	0	0.9	0.89	0	48	48.4	0	7.76	7.76	0	5370	5370	0	0.07	0.1	0	2045	2045	0
48.7	48.68	0	7.7	7.67	0	0.8	0.83	0	45	44.8	0	8.19	8.19	0	5737	5737	0	0.1	0.1	0	2042	2042	0
48.8	61.54	23	7.8	9.85	29.7	0.7	0.87	17.6	41	52.9	26	8.88	10.92	24.7	6108	6224	2.1	0.12	0.2	57.4	2201	2399	34.16
46.9	46.88	0	8.5	8.49	0	0.7	0.65	0	41	40.9	0	9	9	0	7263	7263	0	0.18	0.2	0	3923	3923	0
45	45	0	8.9	8.89	0	0.8	0.83	0	47	47.4	0	7.78	7.78	0	6124	6124	0	0.12	0.1	0	2512	2512	0
47.5	47.5	0	8.3	8.32	0	0.8	0.78	0	52	52.4	0	7.07	7.07	0	6808	6808	0	0.09	0.1	0	2996	2996	0
48.2	55.28	19	8	8.85	10.4	0.9	0.95	7.89	53	57.9	11	7	8.19	16.2	7582	7725	1.1	0.08	0.1	15.8	3165	3282	9.16

Conclusion:

The supply chain system is a complex system composed of a plurality of stakeholders interconnected; the supply chain made operational of cost and synergy degree of different subsystems significantly impact the supply chain system's overall performance. With this analysis's help, an innovative methodology is demonstrated by integrating reliance research and data envelopment studies to analyze benchmarking outcomes from an analytical study of supply chain processes utilized by businesses from various sectors. Hence, Efficiency and effectiveness must be measured because both terms constitute distinct aspects of performance(García Sánchez, 2009). In this analysis, a model measures the effectiveness and overall efficiency of the organization.

Based on the DEA CCRo method for the output of the supply chain, Effectiveness, efficiency, and performance measurement have a common denominator, which is the supply chain's primary attributes as discussed above. DEA establishes the assessment model; it initially computes the requirements layer's weights and determines the RTS(return to Scale). Then the DEA-CCR is used to evaluate the relative utility of each attribute. Data review of various systems' supply chain has proven to be an outstanding tool in estimating the product envelopment system(Halkos & Salamouris, 2004). The present research suggested a DEA-based approach to measure supply chain networks' relative productivity utilizing costs as input and main performance metrics as output. Remembering that this strategy is not aimed at identifying an optimum proportion of initial allocations. It concentrates on deciding the best percentage of alternatives. Our method can be assumed to be more simple to use. In other terms, the possible advantages of pooling to reduce the disruption of supply chain operations have also been understood in most industries(Çelebi & Bayraktar, 2008)(J. Zhu, 1998). To further boost performance and differentiate themselves from rivals, the realistic advice provided to DMU, supply chain managers should emphasise the commodity group, on the deferment and the transport processes.

It was established in a model that evaluates the efficiency and the effectiveness of the Supply chain from the common denominator that are the leading key performance indicators of the Supply chain. The study of key performance indicators as an input and output confirms our simple high cash flow theories in terms of Cost of Production, Transportation Cost, Fuel Expense, Employee Cost, Raw Material and Selling cost plays a vital role in evaluating the effectiveness of supply chains. Throughout certain instances, a variety of essential primary supply chain efficiency assessment metrics tend in the literature to be given little consideration any of these is to establish the intent of the analysis explicitly, agree on inputs and outputs, pick a model orientation and determine if the data is relative to the raw data. We assume, be more than a standard definition of "inputs", and "outputs" and DEA is more than a calculation of productivity within the notion of a manufacturing process. The DEA is a method of integrated benchmarking that evaluates success in various industries and helps companies measure their competitiveness and quality assumptions. We assume that DEA inputs and outputs can be more of a definition of "inputs" and "outputs" than average in a typical development cycle. DEA is a method of "rational benchmarking" that evaluates the results in several ways and allows companies to check their conclusions regarding output, quality effectiveness and efficiency. Finally, the findings reveal that the cable Manufacturing Sector, the tyre manufacturing sector industry, has the most effective and productive supply chain. It can be seen that the business is dedicated to the goal of growing net profits and to make maximum usage of funds. Expenditures are not overdrawn, and the full capacity of the company is directed at producing optimal performance.

4.2 Impact of the Transportation expenses on Performance indicators of Supply Chain.

Transportation is the backbone of the supply chain. Hence in the underdone discussion, the impact of the transportation expense is measured with Linear regression. Linear regression estimates are used to explain the relationship between the dependent variable, i.e. Average Collection Period, Debtors Ratio, Degree of Inventory, Inventory Conversion Period, Inventory Turnover Ratio, Net Sales, Return on Investment and Working Capital Turnover ratio which are the Performance indicators of Supply Chain and independent variable, i.e. Transport expense.

4.2.1 Auto Ancillaries Sector.

Table.4.2.1: Summary of Linear Regression Analysis of Auto Ancillaries Sector's Transportation Impact on Performance Indicators

Dependent variable		Unstandardized Coefficients	Sig.	R	R Square	F	Sig.
Average Collection period	(Constant)	31.73	0.024				
	Transport	8.57	0.041	.605[a]	0.565	4.608	.041[b]
Debtors Turnover Ratio	(Constant)	12.304	0				
	Transport	-1.805	0.03	.681[a]	0.564	6.916	.030[b]
Degree of Inventory	(Constant)	0.571	0.198				
	Transport	0.11	0.462	.564[a]	0.469	0.597	.462[b]
Inventory Conversion Period	(Constant)	79.089	0.001				
	Transport	8.668	0.044	.697[a]	0.547	2.619	.044[b]
Inventory Turnover Ratio	(Constant)	7.794	0.015				
	Transport	0.606	0.514	.535[a]	0.455	0.467	.514[b]
Net Sales	(Constant)	-45.607	0.641				
	Transport	149.172	0.002	.848[a]	0.719	20.5	.002[b]
Return on Investment	(Constant)	12.096	0.11				
	Transport	-1.542	0.531	.726[a]	0.651	0.429	.531[b]

Working Capital Turnover Ratio	(Constant)	0.211	0.004				
	Transport	-0.043	0.046	.641[a]	0.541	.226[a]	0.051

Table 4.2.1 illustrates that the (R) value which is correlation coefficient and depicts a mixed result of the level of correlation between the variables i.e Average Collection period (.605), Debtors Turnover Ratio (.681), Degree of Inventory (.564), Inventory Conversion Period (.697), Inventory Turnover ratio(.535), Net Sales(.848), Return on Investment (.726), Working Capital Turnover ratio(.641). The R Square value indicated how much the total variation in the dependent variable, can be explained by the independent variable. Average Collection period (.565),Debtors Turnover Ratio (.564), Degree of Inventory (.469), Inventory Conversion Period (.547), Inventory Turnover ratio(.455), Net Sales(.719), Return on Investment (.651), Working Capital Turnover ratio(.541*).* The model established that Transport Expense statistically shows the significant impact of Transport expense on different performance Indicators. Average Collection Period p(.041)<0.05, Debtors Turnover Ratio p(.030)<0.05, Inventory Conversion Period p(.044)<0.05, Net Sales p(.002)<0.05 and Working Capital Turnover Ratio p(.046)<0.05.The three variable Degree of Inventory p(.462)<0.05.Inventory Turnover Ratio p(.514)<0.05, Return On Investment p(.531)<0.05 shows not any significant impact of Transport expense. The following regression equation were formulated.

Average Collection period = 31.730 + 8.570(*Transport*),

Debtors Turnover Ratio = 12.304 -1.805(*Transport*),

Degree of Inventory= 0.571 + 110(*Transport*),

Inventory Conversion Period= 79.089 + 8.668(*Transport*),

Inventory Turnover Ratio= 7.794 + .606(*Transport*),

Net Sales= -45.607 + 149.172(*Transport*).

Return on Investment = 12.096 - 1.542(*Transport*),

Working Capital Turnover Ratio= 0.211 - 0.043(*Transport*)

4.2.2 Automobile Sector.

Table.4.2.2: Summary of Linear Regression Analysis of Automobile Sector's Transportation Impact on Performance Indicators.

Dependent variable		Unstandardized Coefficients	Sig.	R	R Square	F	Sig.
Average Collection period	(Constant)	37.353	0				
	Transport	-0.222	0.015	.737[a]	0.544	9.529	.015[b]
Debtors Turnover Ratio	(Constant)	17.809	0.002				
	Transport	0.174	0.046	.627[a]	0.507	0.961	.046[b]
Degree of Inventory	(Constant)	0.632	0				
	Transport	-0.09	0.879	.456[a]	0.303	0.025	.879[b]
Inventory Conversion Period	(Constant)	52.418	0				
	Transport	0.093	0.044	.691[a]	0.553	1.445	.044[b]
Inventory Turnover Ratio	(Constant)	8.55	0.001				
	Transport	0.021	0.497	.444[a]	0.361	0.507	.497[b]
Net Sales	(Constant)	-2787.321	0.074				
	Transport	197.517	0	.938[a]	0.880	58.78	.000[b]
Return on Investment	(Constant)	0.026	0.678				
	Transport	0.001	0.385	.409[a]	0.396	0.846	.385[b]
Working Capital Turnover Ratio	(Constant)	9784.789	0.119				
	Transport	162.001	0.047	.674[a]	0.524	2.314	.047[b]

Table 4.2.2 Illustrates *multiple correlation coefficient (R) value* indicates a mixed result of the level of correlation between the variables i.e Average Collection period (.737), Debtors Turnover Ratio (.627), Degree of Inventory (.456), Inventory Conversion Period (.691), Inventory Turnover ratio(.444), Net Sales(.938), Return on Investment (.409), Working Capital Turnover ratio(.674). The R Square value

indicated how much the total variation in the dependent variable, can be explained by the independent variable. Average Collection period (.544),Debtors Turnover Ratio (.507), Degree of Inventory (.303), Inventory Conversion Period (.553), Inventory Turnover ratio(.361), Net Sales(.880), Return on Investment (.396), Working Capital Turnover ratio(.524). The model established that Transport Expense statistically shows a significant impact of Transport expense on different performance Indicators. Average Collection Period p(.015)<0.05, Debtors Turnover Ratio p(.046)<0.05, Inventory Conversion Period p(.044)<0.05, Net Sales p(.000)<0.05 and Working Capital Turnover Ratio p(.047)<0.05.The three variable Degree of Inventory p(.879)<0.05.Inventory Turnover Ratio p(.497)<0.05, Return On Investment p(.385)<0.05 shows not any significant impact of Transport expense. The following regression equation were formulated.

Average Collection period = 37.353 - 0.222(*Transport*),

Debtors Turnover Ratio = 17.809 - 0.174(*Transport*),

Degree of Inventory= 0.632 - .090(*Transport*),

Inventory Conversion Period= 52.418 + 0.093(*Transport*),

Inventory Turnover Ratio= 8.550 + 0.021(*Transport*),

Net Sales= -2787.321 + 197.517(*Transport*).

Return on Investment = .026 - .001(*Transport*),

Working Capital Turnover Ratio= 9784.789 + 162.001(*Transport*)

4.2.3 Bearing Sector.

Table.4.2.3: Summary of Linear Regression Analysis of Bearing Sector's Transportation Impact on Performance Indicators.

Dependent variable		Unstandardized Coefficients	Sig.	R	R Square	F	Sig.
Average Collection period	(Constant)	79.545	0				
	Transport	-1.781	0.043	.768[a]	0.628	0.231	.043[b]
Debtors Turnover Ratio	(Constant)	4.755	0				
	Transport	0.173	0.048	.655[a]	0.565	0.555	.048[b]
Degree of Inventory	(Constant)	1.347	0				

	Transport	-0.02	0.848	.570[a]	0.405	0.039	.848[b]
Inventory Conversion Period	(Constant)	86.125	0				
	Transport	-6.981	0.043	.640[a]	0.593	1.918	.043[b]
Inventory Turnover Ratio	(Constant)	5.841	0				
	Transport	0.162	0.633	.573[a]	0.423	0.246	.633[b]
Net Sales	(Constant)	14.267	0.391				
	Transport	76.684	0	.947[a]	0.897	69.45	.000[b]
Return on Investment	(Constant)	0.51	0.002				
	Transport	0.079	0.281	.578[a]	0.443	1.336	.281[b]
Working Capital Turnover Ratio	(Constant)	2.24	0				
	Transport	0.531	0.038	.660[a]	0.535	6.162	.038[b]

Table 4.2.3 illustrates multiple correlation (R) value indicates a mixed result of the level of correlation between the variables i.e Average Collection period (.768), Debtors Turnover Ratio (.655), Degree of Inventory (.570), Inventory Conversion Period (.640), Inventory Turnover ratio(.573), Net Sales(.947), Return on Investment (.578), Working Capital Turnover ratio(.660). The R Square value indicated how much the total variation in the dependent variable, can be explained by the independent variable. Average Collection period (.628),Debtors Turnover Ratio (.565), Degree of Inventory (.405), Inventory Conversion Period (.593), Inventory Turnover ratio(.423), Net Sales(.893), Return on Investment (.443), Working Capital Turnover ratio(.535). The model established that Transport Expense statistically shows a significant impact of Transport expense on different performance Indicators. Average Collection Period p(.043)<0.05, Debtors Turnover Ratio p(.048)<0.05, Inventory Conversion Period p(.043)<0.05, Net Sales p(.000)<0.05 and Working Capital Turnover Ratio p(.038)<0.05.The three variable Degree of Inventory p(.848)<0.05.Inventory Turnover Ratio p(.633)<0.05, Return On Investment p(.281)<0.05 shows not any significant impact of Transport expense. The following regression equation were formulated.

Average Collection period = 79.545 – 1.781(*Transport*),

Debtors Turnover Ratio = 4.755 -- 0.173(*Transport*),

Degree of Inventory= 1.347 – 0.020(*Transport*),

Inventory Conversion Period= 86.125 – 6.981(*Transport*),

Inventory Turnover Ratio= 5.841 + 0.162(*Transport*),

Net Sales= 14.267 + 76.684(*Transport*).

Return on Investment = .510 - .079(*Transport*),

Working Capital Turnover Ratio= 2.240 – 0.531(*Transport*)

4.2.4 Cable Manufacturing Sector.

Table.4.2.4: Summary of Linear Regression Analysis of Cable Manufacturing Sector's Transportation Impact on Performance Indicators.

Dependent variable		Unstandardized Coefficients	Sig.	R	R Square	F	Sig.
Average Collection period	(Constant)	299.514	0.014				
	Transport	-54.471	0.046	.674[a]	0.525	2.322	.046[b]
Debtors Turnover Ratio	(Constant)	3.692	0				
	Transport	-0.081	0.61	.484[a]	0.434	0.281	.610[b]
Degree of Inventory	(Constant)	0.704	0				
	Transport	-0.029	0.303	.462[a]	.431	1.21	.303[b]
Inventory Conversion Period	(Constant)	77.886	0.012				
	Transport	-7.641	0.423	.486[a]	0.382	0.712	.423[b]
Inventory Turnover Ratio	(Constant)	10.023	0				
	Transport	-0.48	0.366	.421[a]	0.303	0.917	.366[b]
Net Sales	(Constant)	104.878	0.521				
	Transport	307.773	0.001	.880[a]	0.775	27.48	.001[b]
Return on Investment	(Constant)	-0.006	0.811				
	Transport	0.025	0.019	.719[a]	0.517	8.558	.019[b]
Working Capital Turnover Ratio	(Constant)	2.688	0.007				
	Transport	0.227	0.045	.573[a]	0.475	0.645	.045[b]

Table 4.2.4 illustrates multiple correlation coefficient (R) value indicates a mixed result of the level of correlation between the variables i.e Average Collection period

(.674), Debtors Turnover Ratio (.484), Degree of Inventory (.462), Inventory Conversion Period (.486), Inventory Turnover ratio(.421), Net Sales(.880), Return on Investment (.719), Working Capital Turnover ratio(.573). The R Square value indicated the how much the total variation in the dependent variable, can be explained by the independent variable . Average Collection period (.525),Debtors Turnover Ratio (.434), Degree of Inventory (.431), Inventory Conversion Period (.382), Inventory Turnover ratio(.303), Net Sales(.775), Return on Investment (.517), Working Capital Turnover ratio(.475). The model established that Transport Expense statistically shows a significant impact of Transport expense on different performance Indicators. Average Collection Period p(.046)<0.05, Net Sales p(.001)<0.05, Return on Investment p(.019)<0.05 and Working Capital Turnover Ratio p(.045)<0.05.The four-variable Debtors Turnover Ratio p(.610)<0.05, Degree of Inventory p(.303)<0.05.Inventory Conversion Period p(.423)<0.05, Inventory Turnover Ratio p(.366)<0.05 shows not any significant impact of Transport expense. The following regression equation were formulated.

Average Collection period = 299.514 – 54.471(*Transport*),

Debtors Turnover Ratio = 3.692 -- 0.081(*Transport*),

Degree of Inventory= 0.704 – 0.029(*Transport*),

Inventory Conversion Period= 77.886 – 7.641(*Transport*),

Inventory Turnover Ratio= 10.023 - 0.480(*Transport*),

Net Sales= 104.878 + 307.773(*Transport*).

Return on Investment = -.006 + 0.025(*Transport*),

Working Capital Turnover Ratio= 2.688 + 0.227(*Transport*)

4.2.5 Castings, Forgings & Fasteners Sector.

Table. 4.2.5: Summary of Linear Regression Analysis of Castings, Forgings & Fasteners Sector's Transportation Impact on Performance Indicators.

Dependent variable		Unstandardized Coefficients	Sig.	R	R Square	F	Sig.
Average Collection period	(Constant)	50.951	0				
	Transport	-2.367	0.705	.538[a]	0.419	0.154	.705[b]
Debtors Turnover	(Constant)	11.623	0.039				

Ratio							
	Transport	0.599	0.864	.562[a]	0.404	0.031	.864[b]
Degree of Inventory	(Constant)	1.358	0.006				
	Transport	-0.411	0.155	.485[a]	0.336	2.465	.155[b]
Inventory Conversion Period	(Constant)	74.98	0.004				
	Transport	-18.778	0.041	.642[a]	0.596	1.946	.041[b]
Inventory Turnover Ratio	(Constant)	11.522	0.001				
	Transport	0.118	0.945	.425[a]	0.301	0.005	.945[b]
Net Sales	(Constant)	-100.226	0.355				
	Transport	279.429	0.005	.802[a]	0.643	14.41	.005[b]
Return on Investment	(Constant)	0.218	0.002				
	Transport	-0.144	0.003	.827[a]	0.683	17.26	.003[b]
Working Capital Turnover Ratio	(Constant)	-75.462	0.303				
	Transport	78.441	0.041	.689[a]	0.541	2.52	.041[b]

Table 4.2.5 illustrates multiple correlation coefficient (R) value indicates a mixed result of the level of correlation between the variables i.e Average Collection period (.538), Debtors Turnover Ratio (.562), Degree of Inventory (.485), Inventory Conversion Period (.642), Inventory Turnover ratio(.425), Net Sales(.802), Return on Investment (.827), Working Capital Turnover ratio(.689). The R Square value indicated the how much the total variation in the dependent variable, can be explained by the independent variable . Average Collection period (.419),Debtors Turnover Ratio (.404), Degree of Inventory (.336), Inventory Conversion Period (.596), Inventory Turnover ratio(.301), Net Sales(.643), Return on Investment (.683), Working Capital Turnover ratio(.541). The model established that Transport Expense statistically shows the significant impact of Transport expense on different performance Indicators. Inventory Conversion Period p(.041)<0.05, Net Sales p(.005)<0.05, Return on Investment p(.003)<0.05 and Working Capital Turnover Ratio p(.041)<0.05.The four-variable Average Collection Period p(.705)<0.05 ,Debtors Turnover Ratio p(.864)<0.05 , Degree of Inventory p(.155)<0.05 ., Inventory

Turnover Ratio p(.945)<0.05 shows not any significantly impact of Transport expense. The following regression equation were formulated.

Average Collection period = 50.951 – 2.367(*Transport*),

Debtors Turnover Ratio = 11.623 + 0.599(*Transport*),

Degree of Inventory= 1.358 – 0.411(*Transport*),

Inventory Conversion Period= 74.980 – 18.778(*Transport*),

Inventory Turnover Ratio= 11.522 - 0.118(*Transport*),

Net Sales= -100.226 + 279.429(*Transport*).

Return on Investment = 0.218 - 0.144(*Transport*),

Working Capital Turnover Ratio= -75.462 + 78.441(*Transport*)

4.2.6 Cement Sector.

Table: 4.2.6 Summary of Linear Regression Analysis of Cement Sector's Transportation Impact on Performance Indicators

Dependent variable		Unstandardized Coefficients	Sig.	R	R Square	F	Sig.
Average Collection period	(Constant)	5.139	0.019				
	Transport	0.11	0.04	.654[a]	0.427	5.967	.040[b]
Debtors Turnover Ratio	(Constant)	60.304	0				
	Transport	0.353	0.006	.793[a]	0.629	13.59	.006[b]
Degree of Inventory	(Constant)	0.56	0.003				
	Transport	-0.101	0.835	.476[a]	0.306	0.046	.835[b]
Inventory Conversion Period	(Constant)	34.394	0				
	Transport	0.116	0.78	.413[a]	0.398	0.871	.378[b]
Inventory Turnover Ratio	(Constant)	11.11	0				
	Transport	-0.031	0.306	.461[a]	0.313	1.198	.306[b]
Net Sales	(Constant)	1949.38	0.023				
	Transport	97.539	0.001	.888[a]	0.788	29.777	.001[b]
Return on Investment	(Constant)	0.186	0.002				
	Transport	0.203	0.033	.674[a]	0.454	6.659	.033[b]
Working	(Constant)	8.804	0.393				

Capital Turnover Ratio							
	Transport	0.014	0.957	.420[a]	0.398	0.003	.957[b]

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Table 4.2.6 illustrates multiple correlation (R) value indicates a mixed result of the level of correlation between the variables i.e Average Collection period (.654), Debtors Turnover Ratio (.793), Degree of Inventory (.476), Inventory Conversion Period (.413), Inventory Turnover ratio(.461), Net Sales(.888), Return on Investment (.674), Working Capital Turnover ratio(.420). The R Square value indicated the how much the total variation in the dependent variable, can be explained by the independent variable . Average Collection period (.427),Debtors Turnover Ratio (.629), Degree of Inventory (.306), Inventory Conversion Period (.398), Inventory Turnover ratio(.313), Net Sales(.788), Return on Investment (.454), Working Capital Turnover ratio(.398). The model established that Transport Expense statistically shows a significant impact of Transport expense on different performance Indicators. Average Collection Period p(.040)<0.05, Debtors Turnover Ratio p(.006)<0.05, Net Sales p(.001)<0.05 and Return on Investment p(.033)<0.05.The four-variable Degree of Inventory p(.835)<0.05, Inventory Conversion Period p(.378)<05, Inventory Turnover Ratio p(.306)<0.05, Working Capital Turnover Ratio p(.957)<0.05 shows not any significant impact of Transport expense. The following regression equation were formulated.

Average Collection period = 5.139 + 0.110(*Transport*),

Debtors Turnover Ratio = 60.304 + 0.353(*Transport*),

Degree of Inventory= 0.560 – 0.101(*Transport*),

Inventory Conversion Period= 34.394 + 116(*Transport*),

Inventory Turnover Ratio= 11.110 - .031(*Transport*),

Net Sales= 1949.379 + 97.539(*Transport*).

Return on Investment = 0.186 + 0.203(*Transport*),

Working Capital Turnover Ratio= 8.804 + 0.014(*Transport*)

4.2.7 Non-Ferrous Metals Sector.

Table. 4.2.7: Summary of Linear Regression Analysis of Non-Ferrous Metals Sector's Transportation Impact on Performance Indicators.

Dependent variable	Unstandardized Coefficients		Sig.	R	R Square	F	Sig.
Average Collection period	(Constant)	61.038	0				
	Transport	3.107	0.237	.412[a]	0.317	1.634	.237[b]
Debtors Turnover Ratio	(Constant)	6.367	0				
	Transport	-0.091	0.796	.494[a]	0.309	0.071	.796[b]
Degree of Inventory	(Constant)	0.983	0				
	Transport	0.169	0.042	.675[a]	0.531	3.953	.042[b]
Inventory Conversion Period	(Constant)	29.845	0				
	Transport	7.494	0.011	.758[a]	0.575	10.825	.011[b]
Inventory Turnover Ratio	(Constant)	14.822	0				
	Transport	-2.079	0.048	.636[a]	0.505	5.439	.048[b]
Net Sales	(Constant)	180.76	0.002				
	Transport	52.308	0.044	.688[a]	0.546	4.223	.044[b]
Return on Investment	(Constant)	0.024	0.182				
	Transport	0.008	0.478	.355[a]	0.248	0.555	.478[b]
Working Capital Turnover Ratio	(Constant)	4.393	0				
	Transport	-0.183	0.387	.308[a]	0.295	0.839	.387[b]

Table 4.2.7 illustrates multiple correlation coefficient correlation *(R) value* indicates a mixed result of the level of correlation between the variables i.e Average Collection period (.412), Debtors Turnover Ratio (.494), Degree of Inventory (.675), Inventory Conversion Period (.758), Inventory Turnover ratio(.636), Net Sales(.688), Return on Investment (.355), Working Capital Turnover ratio(.308). The R Square value indicated the how much the total variation in the dependent variable, can be explained by the independent variable . Average Collection period (.317),Debtors Turnover Ratio (.309), Degree of Inventory (.531), Inventory Conversion Period (.575), Inventory Turnover ratio(.505), Net Sales(.546), Return on Investment (.248), Working Capital Turnover ratio(.295). The model established that Transport Expense statistically shows the significant impact of Transport expense on different performance Indicators. Degree of Inventory $p(.042)<0.05$, Inventory Conversion Period $p(.011)<0.05$, Inventory Turnover Ratio $p(.048)<0.05$ and Net Sales

p(.044)<0.05. The four-variable Average Collection Period p(.237)<0.05, Debtor Turnover Ratio p(.796)<05, Return on Investment p(.478)<0.05, Working Capital Turnover Ratio p(.387)<0.05 shows not any significant impact of Transport expense. The following regression equation were formulated.

Average Collection period = 61.038 + 3.107(*Transport*),

Debtors Turnover Ratio = 6.367 - 0.091(*Transport*),

Degree of Inventory= 0.983 + 0.169(*Transport*),

Inventory Conversion Period= 29.845 + 7.494(*Transport*),

Inventory Turnover Ratio= 14.822 - 2.079(*Transport*),

Net Sales= 180.756 + 52.308(*Transport*).

Return on Investment = 0.024 + 0.008(*Transport*),

Working Capital Turnover Ratio= 4.393 - 0.183(*Transport*)

4.2.8 Textiles – Texturizing Sector.

Table: 4.2.8 Summary of Linear Regression Analysis of Textiles – Texturizing Sector's Transportation Impact on Performance Indicators.

Dependent variable		Unstandardized Coefficients	Sig.	R	R Square	F	Sig.
Average Collection period	(Constant)	113.64	0.013				
	Transport	-23.209	0.433	.480[a]	0.378	0.681	.433[b]
Debtors Turnover Ratio	(Constant)	17.04	0.006				
	Transport	-6.865	0.098	.552[a]	0.405	3.506	.098[b]
Degree of Inventory	(Constant)	1.482	0.039				
	Transport	-0.326	0.51	.437[a]	0.356	0.475	.510[b]
Inventory Conversion Period	(Constant)	38.355	0.03				
	Transport	-1.818	0.878	.456[a]	0.303	0.025	.878[b]
Inventory Turnover Ratio	(Constant)	43.587	0.007				
	Transport	-20.822	0.041	.610[a]	0.572	4.734	.041[b]
Net Sales	(Constant)	76.713	0.086				
	Transport	57.654	0.049	.651[a]	0.504	3.493	.049[b]
Return on Investment	(Constant)	-0.083	0.347				
	Transport	0.048	0.488	.449[a]	0.362	0.528	.488[b]

Working Capital Turnover Ratio	(Constant)	45.628	0.062				
	Transport	-35.649	0.044	.605[a]	0.566	4.614	.044[b]

Table 4.2.8 illustrates multiple correlation coefficient (R) value indicates a mixed result of the level of correlation between the variables i.e Average Collection period (.480), Debtors Turnover Ratio (.552), Degree of Inventory (.437), Inventory Conversion Period (.456), Inventory Turnover ratio(.610), Net Sales(.651), Return on Investment (.449), Working Capital Turnover ratio(.605). The R Square value indicated the how much the total variation in the dependent variable, can be explained by the independent variable . Average Collection period (.378),Debtors Turnover Ratio (.405), Degree of Inventory (.356), Inventory Conversion Period (.303), Inventory Turnover ratio(.572), Net Sales(.504), Return on Investment (.362), Working Capital Turnover ratio(.566). The model established that Transport Expense statistically shows the significant impact of Transport expense on different performance Indicators. Inventory Turnover Ratio p(.041)<0.05 , Net Sales p(.049)<0.05 and Working Capital Turnover Ratio p(.044)<0.05. The five variable Average Collection Period p(.433)<0.05 , Debtor Turnover Ratio p(.098)<05, Degree of Inventory p(.510)<0.05 , Inventory Conversion Period p(.878)<0.05 and Return on Investment p(.488)<0.05 shows not any significantly impact of Transport expense .The following regression equation were formulated.

.**Average Collection period** = 113.640 – 23.209(*Transport*),

Debtors Turnover Ratio = 17.040 – 6.865(*Transport*),

Degree of Inventory= 1.482 – 0.326(*Transport*),

Inventory Conversion Period= 38.355 – 1.818(*Transport*),

Inventory Turnover Ratio= 43.587 - 20.822(*Transport*),

Net Sales= 76.713 + 57.654(*Transport*).

Return on Investment = -0.083 + 0.048(*Transport*),

Working Capital Turnover Ratio= 45.628 – 35.649(*Transport*)

4.2.9 Textiles – Weaving Sector.

Table: 4.2.9 Summary of Linear Regression Analysis of Textiles – Weaving Sector with Transportation Impact on Performance Indicators

Dependent variable		Unstandardized Coefficients	Sig.	R	R Square	F	Sig.
Average Collection period	(Constant)	-177.45	0.638				
	Transport	197.89	0.047	.702[a]	0.691	0.802	.047[b]
Debtors Turnover Ratio	(Constant)	8.669	0.092				
	Transport	-1.663	0.564	.408[a]	0.393	0.362	.564[b]
Degree of Inventory	(Constant)	3.166	0.15				
	Transport	-0.587	0.642	.469[a]	0.328	0.234	.642[b]
Inventory Conversion Period	(Constant)	47.316	0.765				
	Transport	31.547	0.044	.619[a]	0.514	0.114	.044[b]
Inventory Turnover Ratio	(Constant)	5.372	0.575				
	Transport	1.794	0.757	.412[a]	0.313	0.102	.757[b]
Net Sales	(Constant)	1200	0.096				
	Transport	570.72	0.05	.661[a]	0.513	2.16	.040[b]
Return on Investment	(Constant)	0.45	0.411				
	Transport	-0.293	0.381	.412[a]	0.397	0.86	.381[b]
Working Capital Turnover Ratio	(Constant)	2.795	0.756				
	Transport	-0.53	0.923	.435[a]	0.301	0.01	.923[b]

Table 4.2.9 illustrates multiple correlation coefficient (R) value indicates a mixed result of the level of correlation between the variables i.e Average Collection period (.702), Debtors Turnover Ratio (.408), Degree of Inventory (.469), Inventory Conversion Period (.619), Inventory Turnover ratio(.412), Net Sales(.661), Return on Investment (.412), Working Capital Turnover ratio(.435). The R Square value indicated the how much the total variation in the dependent variable, can be explained by the independent variable . Average Collection period (.691),Debtors Turnover

Ratio (.393), Degree of Inventory (.328), Inventory Conversion Period (.514), Inventory Turnover ratio(.313), Net Sales(.513), Return on Investment (.397), Working Capital Turnover ratio(.301). The model established that Transport Expense statistically shows a significant impact of Transport expense on different performance Indicators. Average Collection Period p(.047)<0.05 , Inventory conversion Period p(.044)<0.05 and Net Sales p(.040)<0.05. The five variable Debtor Turnover Ratio p(.564)<05, Degree of Inventory p(.642)<0.05, Inventory Conversion Period p(.757)<0.05, Return on Investment p(.381)<0.05 and Working Capital Turnover Ratio p(.923)<0.05 shows not any significant impact of Transport expense. The following regression equation were formulated.

Average Collection period = -177.445 – 197.894(*Transport*),

Debtors Turnover Ratio = 8.669 – 1.663(*Transport*),

Degree of Inventory= 3.166 – 0.587(*Transport*),

Inventory Conversion Period= 47.316 – 31.547(*Transport*),

Inventory Turnover Ratio= 5.372 – 1.794(*Transport*),

Net Sales= 1199.994 + 570.720(*Transport*).

Return on Investment = 0.450 - 0.293(*Transport*),

Working Capital Turnover Ratio= 2.795 – 0.530(*Transport*)

4.2.10 Tire Manufacturing Sector.

Table: 4.2.10.A Summary of Linear Regression Analysis of Tire Manufacturing Sector's Transportation Impact on Performance Indicators

Dependent variable		Unstandardized Coefficients	Sig.	R	R Square	F	Sig.
Average Collection period	(Constant)	42.917	0				
	Transport	0.256	0.043	.632[a]	0.587	1.835	.043[b]
Debtors Turnover Ratio	(Constant)	8.41	0				
	Transport	-0.012	0.783	.400[a]	0.322	0.081	.783[b]
Degree of Inventory	(Constant)	0.866	0.002				
	Transport	-0.003	0.814	.386[a]	0.207	0.059	.814[b]
Inventory Conversion	(Constant)	42.755	0				

Period							
	Transport	0.322	0.466	.461[a]	0.368	0.585	.466[b]
Inventory Turnover Ratio	(Constant)	8.709	0				
	Transport	-0.056	0.047	.790[a]	0.684	0.733	.047[b]
Net Sales	(Constant)	283.09	0.805				
	Transport	372.74	0.001	.869[a]	0.755	24.617	.001[b]
Return on Investment	(Constant)	0.102	0.098				
	Transport	0.001	0.973	.412[a]	0.302	0.001	.973[b]
Working Capital Turnover Ratio	(Constant)	-327.91	0.735				
	Transport	181.18	0.021	.711[a]	0.505	8.172	.021[b]

Table 4.2.10 illustrates *multiple correlation coefficient (R) value* indicates a mixed result of the level of correlation between the variables i.e Average Collection period (.632), Debtors Turnover Ratio (.400), Degree of Inventory (.386), Inventory Conversion Period (.461), Inventory Turnover ratio(.790), Net Sales(.869), Return on Investment (.412), Working Capital Turnover ratio(.711). The R Square value indicated the how much the total variation in the dependent variable, can be explained by the independent variable . Average Collection period (.587),Debtors Turnover Ratio (.322), Degree of Inventory (.207), Inventory Conversion Period (.368), Inventory Turnover ratio(.684), Net Sales(.755), Return on Investment (.302), Working Capital Turnover ratio(.505). The model established that Transport Expense statistically shows a significant impact of Transport expense on different performance Indicators. Average Collection Period p(.047)<0.05 , Inventory conversion Period p(.044)<0.05 , Net Sales p(.040)<0.05 and Working Capital Turnover Ratio p(.923)<0.05.The four-variable Debtor Turnover Ratio p(.783)<05, Degree of Inventory p(.814)<0.05 , Inventory Conversion Period p(.466)<0.05 ,and Return on Investment p(.973)<0.05 shows not any significantly impact of Transport expense. The following regression equation were formulated.

Average Collection period = 42.917 – .256(*Transport*),

Debtors Turnover Ratio = 8.410 – 0.012(*Transport*),

Degree of Inventory= 0.866 – 0.003(*Transport*),

Inventory Conversion Period= 42.7555 – 0.322(*Transport*),

Inventory Turnover Ratio= 8.709 – .056(*Transport*),

Net Sales= 283.093 + 372.741(*Transport*).

Return on Investment = 0.102 + 0.001(*Transport*),

Working Capital Turnover Ratio= -327.911 + 181.181(*Transport*)

Conclusion

This study determined the impact of transport costs on performance indicators Supply chain using a linear regression model. Key performance metrics have a favourable association with the company-specific backbone of the supply chain, i.e., transport variable—reliable findings from a linear regression analysis point to various assumptions. However, certain sector-specific factors tend to be related to the operation of the supply chain.

Ten different equations from ten different sectors effectively illustrate the impact of travel costs on multiple performance metrics. The transport variable indicates the significant and non-significant effect on the constant, the relation between the dependent variable and the independent variables is seen, and the output metrics are shown in the value. The equation description implies that the organisation's management should mutually prepare for separate variables that should influence or create a consistent relationship between dependent and independent variables. Using the equation, the transport variables that affect the (Dependent variable) available for analysis will easily represent the field's supply chain performance.

Chapter 5

Impact of Supply Chain performance over Net Sales and relationship between Net Sales and Transportation Expenses

Supply Chain performance Indicators play a crucial role in assessing the performance of the supply chain. The role of these indicators and measures in the company's performance cannot be overstated because they influence political, tactical and administrative planning and control. Performance assessment and metrics have an essential role in setting goals, assessing performance, and deciding potential action courses. The effect of multiple indicators on the organisation's outcome and the relationship between variables addresses the current and potential complexities of handling supply chains.

5.1 Relationship of Performance Indicators of Supply chain with Net Sales

Multiple regression analyses are used to determine the relationship of performance indicators with net sales. In the analysis Net Sales is used as the dependent variable and the performance indicators i.e Average Collection Period, Debtors Ratio, Degree of Inventory, Inventory Conversion Period, Inventory Turnover Ratio, Return on Investment and Working Capital Turnover ratio are used as the predictor variables.

5.1.1 Auto Ancillaries Sector.

Table.5.1.1 A: Summary of Multiple Regression Analysis of Auto Ancillaries Sector with all the Performance Indicators

	Unstandardized Coefficients	Standardized Coefficients Beta	t	Sig.	VIF
(Constant)	4841.866		1.238	0.433	
Transport	-31.786	-0.181	-0.11	0.93	251.509
Average Collection period	-31.514	-2.54	-0.888	0.538	756.213
Debtors Turnover Ratio	-285.62	-4.304	-0.925	0.525	2002.894

Degree of Inventory	628.766	1.493	0.571	0.67	632.27
Inventory Conversion Period	-15.77	-1.565	-1.649	0.347	83.36
Inventory Turnover Ratio	-83.527	-1.225	-1.859	0.314	40.172
Return on Investment	4402.57	1.685	1.401	0.395	133.774
Working Capital Turnover Ratio	19.431	0.755	0.38	0.769	366.361

The results of the Multiple Regression Analysis demonstrates that the all the variables have high VIF value, It indicates that some of the variables have the high correlation with the dependent variable '***Net Sales'*** and should affect the result of the Regression analysis. So four variables the '***Average Collection Period',' Debtors Turnover Ratio',' Degree of Inventory***' and '***Inventory Conversion Period***' are excluded from the model.

Table.5.1.1 B: Summary of Multiple Regression Analysis of Auto Ancillaries Sector with selective Performance Indicators

	Unstandardized Coefficients B	**Standardized Beta**	**t**	**Sig.**	**VIF**	**R**	**Adjusted R Square**	**F**	**Sig.**
(Constant)	33.661								
Transport	173.559	0.987	3.516	0.017	3.491				
Inventory Turnover Ratio	-14.225	-0.209	-0.867	0.426	2.568				
Return on Investment	726.411	0.278	0.924	0.398	4.014				
Working Capital Turnover Ratio	10.087	0.392	2.286	0.041	1.304	.942[a]	0.797	9.833	.014

Table 5.1.1 B illustrates the relationship between Performance Indicators of Supply chain with Net Sales. The results of the regression indicated that the model explained 80 %(Adjusted R Square 0.797) of the variation explained by the independent variables that affect the dependent variable '***Net Sales***'. The table shows that the

independent variables overall statistically significantly predict the dependent variable, ***'Net Sales***' F=9.833, p=.014. While Performance indicators which are independent variables '***Transport***' and '***Working Capital Turnover Ratio***' contributed significantly to the model (p(.017)<0.05 & p(.041)<0.05) but 'Inventory Turnover Ratio' p(.426)>0.05 'Return on Investment' p(.398)>0.05 has no significant contribution to the model. Along with Standardized Beta Coefficient (.987) indicated that one unit increase in 'transport ', 'net sales ' is likely to increase by .98 units. Similarly, one unit change in 'Inventory turnover ratio'' was likely to affect 'Net Sales ' by -.20 units, the effect of 'Return on investment ' was likely to be .27 units and Working Capital Turnover Ratio effects the 'Net sales' by .39 units.

The final predictive model was

Regression Equation: $Y=\beta 0+ \beta 1X1+ \beta 2X2+ \beta 3X3+\ldots\ldots+\varepsilon$

Net Sales= 33.661+ 173.55(*Transport*) -14.22(*Inventory Turnover Ratio*)+ 726.41(*Return on Investment*) +10.087(*Working Capital Turnover Ratio*)

5.2: Automobiles Sector.

Table. 5.1.2.A Summary of Multiple Regression Analysis of Automobiles Sector with all the Performance Indicators

	Unstandardized Coefficients	Standardized Coefficients Beta	t	Sig.	VIF
(Constant)	-45804.966		-1.456	0.383	
Transport	113.898	0.541	1.539	0.367	9.59
Average Collection period	-377.658	-0.539	-0.895	0.535	28.21
Debtors Turnover Ratio	822.825	0.877	1.961	0.3	15.54
Degree of Inventory	8132.169	0.173	0.832	0.558	3.364
Inventory Conversion Period	517.495	0.586	0.861	0.548	35.95
Inventory Turnover Ratio	690.193	0.28	0.785	0.576	9.867
Return on Investment	31961.077	0.508	2.183	0.273	4.212
Working Capital Turnover Ratio	0.357	0.58	1.779	0.326	8.237

The results of the Multiple Regression Analysis demonstrates that the all the variables have high VIF value, It indicates that some of the variables have the high correlation

with the dependent variable '***Net Sales'*** and should affect the result of the Regression analysis. so two variables the '***Average Collection Period'***, and '***Inventory Conversion Period***' are excluded from the model

Table.5.1.2.B Summary of Multiple Regression Analysis of Automobiles Sector with selective Performance Indicators

	Unstandardized Coefficients B	**Standardized Beta**	**T**	**Sig.**	**VIF**	**R**	**Adjusted R Square**	**F**	**Sig.**
(Constant)	-22692.191								
Transport	170.428	0.81	6.597	0.007	1.942				
Debtors Turnover Ratio	510.553	0.544	2.81	0.047	4.842				
Degree of Inventory	11316.5	0.241	1.616	0.205	2.868				
Inventory Turnover Ratio	120.969	0.049	0.399	0.717	1.952				
Return on Investment	22903.341	0.364	2.796	0.048	2.189				
Working Capital Turnover Ratio	0.209	0.34	2.391	0.047	2.601	.988[a]	0.93	20.99	.015

Table 5.1.2.B illustrates the relationship between Performance Indicators of Supply chain with Net Sales. The results of the regression indicated that the model explained 93%(Adjusted R Square 0.930) of the variation explained by the independent variables that affect the dependent variable '***Net Sales***'. The table shows that the independent variables overall statistically significantly predict the dependent variable, ***'Net Sales***' F=20.911, p=.015. While Performance indicators which are independent variables '***Transport***', '***Debtors Turnover Ratio'***, '***Return on Investment***' and '***Working Capital Turnover Ratio***' contributed significantly to the model (p(.007)<0.05, p(.047)<0.05, p(.048)<0.05 & p(.047)<0.05) but '***Degree of Inventory***' p(.205)>0.05 '***Inventory Turnover Ratio'*** p(.717)>0.05 has no significant contribution to the model . Along with Standardized Beta Coefficient (.810) indicated that one unit increase in 'transport ', 'net sales ' is likely to increase by .81 units, similarly, one unit change in 'Debtors Turnover Ratio' was likely to affect 'Net Sales ' by .54 units, the effect of 'Degree of Inventory' was likely to be .24 units,

Inventory Turnover Ratio and Return on Investment effects 'Net sales' by .04 units and .36 units respectively and Working Capital Turnover Ratio effects the 'Net sales' by .34 units.

The final predictive model was

Regression Equation: $Y=\beta 0+ \beta 1X1+ \beta 2X2+ \beta 3X3+\ldots\ldots+\varepsilon$

Net Sales= -22692.19 + 170.428(*Transport*)+ 510.53(*Debtors Turnover Ratio*) + 11316.50(*Degree of Inventory*) +120.96(*Inventory Turnover Ratio*)+ 22903.34(*Return on Investment*) + .209(*Working Capital Turnover Ratio*)

5.1.3: Bearing Manufacturing Sector.

Table.5.1.3 A Summary of Multiple Regression Analysis of Bearing Manufacturing Sector with all the Performance Indicators.

	Unstandardized Coefficients	Standardized Coefficients Beta	t	Sig.	VIF
(Constant)	1087.767		1.145	0.457	
Transport	-69.48	-0.858	-0.803	0.569	339.2
Average Collection period	9.214	1.209	1.18	0.447	311.4
Debtors Turnover Ratio	-88.723	-0.745	-0.841	0.555	232.9
Degree of Inventory	309.839	1.075	1.429	0.389	168
Inventory Conversion Period	-16.044	-3.145	-1.631	0.35	1104
Inventory Turnover Ratio	-148.179	-1.716	-1.673	0.343	312.3
Return on Investment	226.914	0.583	0.866	0.546	134.6
Working Capital Turnover Ratio	147.189	1.463	1.778	0.326	201.2

The results of the Multiple Regression Analysis demonstrates that the all the variables have high VIF value, It indicates that some of the variables have the high correlation with the dependent variable '***Net Sales'*** and should affect the result of the Regression analysis. so two variables the '***Average Collection Period'***, and '***Inventory Conversion Period***' are excluded from the model

Table.5.1.3.B: Summary of Multiple Regression Analysis of Bearing Manufacturing Sector with selective Performance Indicators

	Unstandardized Coefficients B	Standardized Beta	t	Sig.	VIF	R	Adjusted R Square	F	Sig.
(Constant)	-168.537								
Transport	70.254	0.868	7.494	0.005	3.174				
Debtors Turnover Ratio	65.197	0.548	2.476	0.049	9.579				
Degree of Inventory	-42.022	-0.146	-1.163	0.329	3.719				
Inventory Turnover Ratio	-2.922	-0.034	-0.185	0.865	7.888				
Return on Investment	177.301	0.456	1.876	0.047	9.976				
Working Capital Turnover Ratio	16.473	0.164	1.091	0.045	5.335	.994	0.962	38.97	.006

Table 5.1.3.B illustrates the relationship between Performance Indicators of Supply chain with Net Sales. The results of the regression indicated that the model explained 96%(Adjusted R Square 0.962) of the variation explained by the independent variables that affect the dependent variable '***Net Sales***'. The table shows that the independent variables overall statistically significantly predict the dependent variable, ***'Net Sales***' F=38.966, p=.006. While Performance indicators which are independent variables '***Transport***', '***Debtors Turnover Ratio'***, '***Return on Investment***' and '***Working Capital Turnover Ratio***' contributed significantly to the model (p(.005)<0.05, p(.049)<0.05, p(.047)<0.05 & p(.045)<0.05) but '***Degree of Inventory***' p(.329)>0.05 '***Inventory Turnover Ratio'*** p(.865)>0.05 has no significant contribution to the model . Along with Standardized Beta Coefficient (.868) indicated that one unit increase in 'transport ', 'net sales ' is likely to increase by .87 units, similarly, one unit change in 'Debtors Turnover Ratio' was likely to affect 'Net Sales

’ by .58 units,

the effect of ‘Degree of Inventory’ was likely to be -.15 units, Inventory Turnover Ratio and Return on Investment effects ‘Net sales’ by -.03 units and .46 units respectively and Working Capital Turnover Ratio effects the ‘Net sales’ by .16 units.

The final predictive model was

Regression Equation: $Y=\beta 0+ \beta 1X1+ \beta 2X2+ \beta 3X3+\ldots\ldots+\varepsilon$

Net Sales= -168.53 + 70.25(*Transport*)+ 65.197 (*Debtors Turnover Ratio*) -42.022 (*Degree of Inventory*) -2.922(*Inventory Turnover Ratio*)+ 177.301(*Return on Investment*) + 16.47(*Working Capital Turnover Ratio*)

5.1.4: Cables Manufacturing Sector.

Table: 5.1.4.A Summary of Multiple Regression Analysis of Cables Manufacturing Sector with all the Performance Indicators

	Unstandardized Coefficients	Standardized Coefficients Beta	t	Sig.	VIF
(Constant)	-4020.311		-0.52	0.695	
Transport	482.867	1.381	0.82	0.563	36.155
Average Collection period	1.74	0.571	0.302	0.813	45.622
Debtors Turnover Ratio	583.627	0.738	0.327	0.799	65.009
Degree of Inventory	2285.348	0.52	0.782	0.578	5.637
Inventory Conversion Period	-0.253	-0.019	-0.03	0.981	5.128
Inventory Turnover Ratio	10.208	0.044	0.069	0.956	5.098
Return on Investment	2190.107	0.221	0.299	0.815	6.952
Working Capital Turnover Ratio	-85.411	-0.203	-0.191	0.88	14.427

The results of the Multiple Regression Analysis demonstrates that the all the variables have high VIF value, It indicates that some of the variables have the high correlation with the dependent variable ‘***Net Sales’*** and should affect the result of the Regression analysis. so two variables the ‘***Average Collection Period’***, and ‘***Inventory Conversion Period***’ are excluded from the model

Table. 5.1.4.B Summary of Multiple Regression Analysis of Cables Manufacturing Sector with selective Performance Indicators

	Unstandardized Coefficients B	Standardized Beta	t	Sig.	VIF	R	Adjusted R Square	F	Sig.
(Constant)	-1571.294								
Transport	286.479	0.819	2.291	0.016	4.292				
Debtors Turnover Ratio	53.963	0.068	0.119	0.013	9.987				
Degree of Inventory	1811.367	0.412	1.239	0.034	3.714				
Inventory Turnover Ratio	24.043	0.103	0.277	0.048	4.634				
Return on Investment	3594.446	0.362	1.076	0.041	3.802				
Working Capital Turnover Ratio	-6.923	-0.016	-0.033	0.176	8.46	.954	0.732	5.096	.0305

Table 5.1.4.B illustrates the relationship between Performance Indicators of Supply chain with Net Sales. The results of the regression indicated that the model explained 73%(Adjusted R Square 0.732) of the variation explained by the independent variables that affect the dependent variable '***Net Sales***'. The table shows that the independent variables overall statistically significantly predict the dependent variable, ***'Net Sales***' F=5.096, p=.0305. While Performance indicators which are independent variables '***Transport***', '***Debtors Turnover Ratio'***, '***Degree of Inventory***', '***Inventory Turnover Ratio' and*** '***Return on Investment***' contributed significantly to the model (p(.016)<0.05, p(.013)<0.05, p(.034)<0.05, p(.048)<0.05) & p(.041)<0.05) but '***Degree of Inventory***' p(.176)>0.05 has no significant contribution to the model . Along with Standardized Beta Coefficient (.819) indicated that one unit increase in 'transport ', 'net sales ' is likely to increase by .82 units; similarly, one unit change in 'Debtors Turnover Ratio' was likely to affect 'Net Sales ' by .07 units, the effect of 'Degree of Inventory' was likely to be .41 units, Inventory Turnover Ratio and Return on Investment effects 'Net sales' by .10 units and .36 units respectively. Working Capital Turnover Ratio effects the 'Net sales' by -.01 units.

The final predictive model was

Regression Equation: $Y=\beta 0+ \beta 1X1+ \beta 2X2+ \beta 3X3+\ldots\ldots+\varepsilon$

Net Sales= -1571.294 + 286.479(*Transport*)+ 53.963 (*Debtors Turnover Ratio*) +1811.367 (*Degree of Inventory*) +24.043(*Inventory Turnover Ratio*)+ 3594.446(*Return on Investment*) -6.923(*Working Capital Turnover Ratio*)

5.1.5: Castings, Forgings & Fasteners Sector.

Table.5.1.5.A Summary of Multiple Regression Analysis of Castings, Forgings & Fasteners Sector with all the Performance Indicators

	Unstandardized Coefficients	Standardized Coefficients Beta	t	Sig.	VIF
(Constant)	-2187.82		-5.791	0.109	
Transport	152.364	0.437	3.588	0.173	5.512
Average Collection period	-22.656	-1.119	-5.16	0.122	17.448
Debtors Turnover Ratio	-32.563	-0.899	-2.96	0.207	34.248
Degree of Inventory	1445.198	3.508	6.221	0.101	117.995
Inventory Conversion Period	2.704	0.33	1.373	0.401	21.367
Inventory Turnover Ratio	229.481	3.07	6.663	0.095	78.789
Return on Investment	-6367.646	-3.192	-6.521	0.097	88.902
Working Capital Turnover Ratio	-2.671	-1.228	-5.276	0.119	20.111

The results of the Multiple Regression Analysis demonstrates that the all the variables have high VIF value, It indicates that some of the variables have the high correlation with the dependent variable '***Net Sales'*** and should affect the result of the Regression analysis. So four variables the '***Average Collection Period'***,***' Degree of Inventory***', '***Inventory Turnover Ratio'*** and '***Inventory Conversion Period***' are excluded from the model.

Table. 5.1.5.B Summary of Multiple Regression Analysis of Castings, Forgings & Fasteners Sector with selective Performance Indicators

	Unstandardized Coefficients B	Standardized Beta	t	Sig.	VIF	R	Adjusted R Square	F	Sig.
(Constant)	133.169								
Transport	96.058	.276	.720	.040	4.071				
Debtors Turnover Ratio	.112	.003	.015	.048	1.127				
Return on Investment	-733.714	-.368	-1.052	.341	3.389				
Working Capital Turnover Ratio	.986	.454	1.984	.041	1.451	.905[a]	.676	5.686	.042[b]

Table 5.1.5.B illustrates the relationship between Performance Indicators of Supply chain with Net Sales. The results of the regression indicated that the model explained 77.6 %(Adjusted R Square 0.776) of the variation explained by the independent variables that affect the dependent variable '***Net Sales***'. The table shows that the independent variables overall statistically significantly predict the dependent variable, ***'Net Sales***' F=5.686, p=.042. While Performance indicators which are independent variables '***Transport***', '***Debtor Turnover Ratio***' and '***Working Capital Turnover Ratio***' contributed significantly to the model (p(.040)<0.05, p(.048)<0.05 & p(.041)<0.05) but Return on Investment' p(.341)>0.05 has no significant contribution to the model. Along with Standardized Beta Coefficient (.276) indicated that one unit increase in 'transport ', 'net sales ' is likely to increase by .28 units; similarly, one unit change in 'Debtors turnover ratio'' was likely to affect 'Net Sales ' by .01 units, the effect of 'Return on investment ' was likely to be -.37 units and Working Capital Turnover Ratio effects the 'Net sales' by .45 units.

The final predictive model was

Regression Equation: $Y=\beta 0+ \beta 1X1+ \beta 2X2+ \beta 3X3+\ldots\ldots+\varepsilon$

Net Sales= 133.169+ 96.058(*Transport*) + .112(*Debtors Turnover Ratio*)- 733.714(*Return on Investment*) +.986(*Working Capital Turnover Ratio*)

5.1.6: Cement Sector.

Table: 5.1.6.A Summary of Multiple Regression Analysis of Cement Sector with all the Performance Indicators.

	Unstandardized Coefficients	Standardized Coefficients Beta	T	Sig.	VIF
(Constant)	-1146.736		-0.27	0.832	
Transport	56.705	0.516	22.87	0.028	4.102
Average Collection period	1520.466	2.328	28.351	0.022	54.303
Debtors Turnover Ratio	452.687	1.833	22.146	0.029	55.178
Degree of Inventory	4439.999	0.4	5.402	0.117	44.192
Inventory Conversion Period	-234.384	-0.79	-5.396	0.117	172.56
Inventory Turnover Ratio	-2444.431	-1.931	-8.855	0.072	382.95
Return on Investment	4625.375	0.167	4.472	0.14	11.203
Working Capital Turnover Ratio	-16.187	-0.105	-6.172	0.102	2.323

The results of the Multiple Regression Analysis demonstrates that the all the variables have high VIF value, It indicates that some of the variables have the high correlation with the dependent variable '***Net Sales'*** and should affect the result of the Regression analysis. So three variables, the '***Average Collection Period'***, '***Inventory Turnover Ratio'*** and '***Inventory Conversion Period.***' Are excluded from the model.

Table: 5.1.6.B Summary of Multiple Regression Analysis of Cement Sector with selective Performance Indicators

	Unstandardized Coefficients B	Standardized Beta	t	Sig.	VIF	R	Adjusted R Square	F	Sig.
(Constant)	8553.735								
Transport	66.274	0.603	2.127	0.04	3.168				
Debtors Turnover Ratio	-74.768	-0.303	-1.02	0.365	3.471				
Degree of Inventory	-379.755	-0.342	-1.858	0.137	1.331				
Return on Investment	669.69	0.024	0.094	0.029	2.573				
Working Capital Turnover Ratio	17.314	0.112	0.539	0.018	1.701	.948	0.771	7.077	.041

Table 5.1.6.B illustrates the relationship between Performance Indicators of Supply chain with Net Sales. The results of the regression indicated that the model explained 77%(Adjusted R Square 0.771) of the variation explained by the independent variables that affect the dependent variable '***Net Sales***'. The table shows that the independent variables overall statistically significantly predict the dependent variable, ***'Net Sales***' F=7.077, p=.041. While Performance indicators which are independent variables '***Transport***', '***Return on Investment***' ***and*** '***Working Capital Turnover Ratio'*** contributed significantly to the model (p(.040)<0.05, p(.029)<0.05) & p(.018)<0.05) but '***Debtors Turnover Ratio***' and '***Degree of Inventory***' p(.365)>0.05 and p(.137)>0.05 has no significant contribution to the model. Along with Standardized Beta Coefficient (.603) indicated that one unit increase in 'transport ', 'net sales ' is likely to increase by .60 units; similarly, one unit change in 'Debtors Turnover Ratio' was likely to affect 'Net Sales ' by -.30 units, the effect of 'Degree of Inventory' was likely to be -.34 units, Return on Investment effects 'Net sales' by .02 units. Working Capital Turnover Ratio effects the 'Net sales' by .11 units.

The final predictive model was

Regression Equation: $Y=\beta 0+ \beta 1X1+ \beta 2X2+ \beta 3X3+\ldots\ldots+\varepsilon$

Net Sales= 8553.735+ 66.274(*Transport*) -74.768(*Debtors Turnover Ratio*) -379.755(*Degree of Inventory*)+669.690(*Return on Investment*) +17.314(*Working Capital Turnover Ratio*)

5.1.7 Non-Ferrous Metals Sector.

Table: 5.1.7.A Summary of Multiple Regression Analysis of Non-Ferrous Metals Sector with all the Performance Indicators.

	Unstandardized Coefficients	Standardized Coefficients Beta	T	Sig.	VIF
(Constant)	1376.836		0.67	0.624	
Transport	16.758	0.188	0.193	0.879	13.294
Average Collection period	-3.881	-0.329	-0.222	0.861	30.707
Debtors Turnover Ratio	44.342	0.481	0.333	0.795	29.159
Degree of Inventory	-352.693	-1.166	-0.74	0.594	34.65
Inventory Conversion Period	3.177	0.353	0.298	0.816	19.636
Inventory Turnover Ratio	-27.487	-1.009	-0.891	0.537	17.929
Return on Investment	672.598	0.237	0.454	0.728	3.787

Working Capital Turnover Ratio	-136.255	-0.912	-0.731	0.598	21.75

The results of the Multiple Regression Analysis demonstrates that the all the variables have high VIF value, It indicates that some of the variables have the high correlation with the dependent variable '***Net Sales'*** and should affect the result of the Regression analysis. So two variables the '***Average Collection Period' and*** '***Inventory Conversion Period'*** are excluded from the model.

Table: 5.1.7.B Summary of Multiple Regression Analysis of Non-Ferrous Metals Sector with selective Performance Indicators

	Unstandardized Coefficients B	**Standardized Beta**	**t**	**Sig.**	**VIF**	**R**	**Adjusted R Square**	**F**	**Sig.**
(Constant)	542.89								
Transport	15	0.169	0.567	0.03	3.057				
Debtors Turnover Ratio	26.614	0.289	0.86	0.038	3.899				
Inventory Turnover Ratio	32.885	0.368	0.875	0.045	6.091				
Return on Investment	-53.221	-0.019	-0.083	0.938	1.775				
Working Capital Turnover Ratio	-9.756	-0.065	-0.286	0.789	1.798	.940	0.739	6.107	.042

Table 5.1.7.B illustrates the relationship between Performance Indicators of Supply chain with Net Sales. The results of the regression indicated that the model explained 74 %(Adjusted R Square 0.739) of the variation explained by the independent variables that affect the dependent variable '***Net Sales***'. The table shows that the independent variables overall statistically significantly predict the dependent variable, ***'Net Sales***' F=6.107, p=.042. While Performance indicators which are independent variables '***Transport***', '***Debtors Turnover Ratio***' and '***Inventory Turnover Ratio***' contributed significantly to the model (p(.030)<0.05, p(.038)<0.05 & p(.045)<0.05) but '***Return on Investment***' p(.938)>0.05 '***Working Capital Turnover Ratio***' p(.789)>0.05 has no significant contribution to the model. Along with Standardized Beta Coefficient (.169) indicated that one unit increase in 'transport ', 'net sales ' is likely to increase by .17 units; similarly, one unit change in 'Debtors turnover ratio'

was likely to affect 'Net Sales ' by .29 units, the effect of 'Inventory Turnover Ratio' and 'Return on investment ' was likely to be .37 units and -.01 and Working Capital Turnover Ratio effects the 'Net sales' by -.07 units.

The final predictive model was

Regression Equation: $Y=\beta 0+ \beta 1X1+ \beta 2X2+ \beta 3X3+\ldots\ldots+\varepsilon$

Net Sales= 542.89+ 15(*Transport*) +26.614(*Debtors Turnover Ratio)* +32.885(*Inventory Turnover Ratio*) -53.221(*Return on Investment*) -9.756(*Working Capital Turnover Ratio*)

5.1.8: Textiles – Texturizing Sector.

Table: 5.1.8.A Summary of Multiple Regression Analysis of Textiles – Texturizing Sector with all the Performance Indicators

	Unstandardized Coefficients	Standardized Coefficients Beta	t	Sig.	VIF
(Constant)	221.38		0.841	0.555	
Transport	35.501	0.339	0.332	0.796	25.835
Average Collection period	-0.071	-0.056	-0.023	0.985	148.37
Debtors Turnover Ratio	-17.689	-2.104	-1.205	0.441	75.073
Degree of Inventory	-1.602	-0.021	-0.072	0.954	2.114
Inventory Conversion Period	-1.097	-0.342	-0.183	0.885	86.26
Inventory Turnover Ratio	5.008	1.635	0.993	0.502	66.855
Return on Investment	361.158	0.661	0.427	0.743	58.997
Working Capital Turnover Ratio	0.459	0.259	0.405	0.755	10.072

The results of the Multiple Regression Analysis demonstrates that the all the variables have high VIF value, It indicates that some of the variables have the high correlation with the dependent variable '***Net Sales'*** and should affect the result of the Regression analysis. so three variables the '***Average Collection Period'***, '***Inventory Conversion Period***' and '***Inventory Turnover Ratio'*** and are excluded from the model

Table: 5.1.8.B Summary of Multiple Regression Analysis of Textiles – Texturizing Sector with selective Performance Indicators

	Unstandardized Coefficients B	Standardized Beta	t	Sig.	VIF	R	Adjusted R Square	F	Sig.
(Constant)	67.658								
Transport	83.418	0.798	2.2	0.043	3.432				
Debtors Turnover Ratio	-0.27	-0.032	-0.111	0.917	2.18				
Degree of Inventory	-16.02	-0.211	-0.852	0.442	1.598				
Return on Investment	208.79	0.382	1.436	0.024	1.846				
Working Capital Turnover Ratio	1.2	0.676	2.44	0.041	2.005	.920[a]	0.755	4.42	.047[b]

Table 5.1.8.B illustrates the relationship between Performance Indicators of Supply chain with Net Sales. The results of the regression indicated that the model explained 75% (Adjusted R Square 0.755) of the variation explained by the independent variables that affect the dependent variable '***Net Sales***'. The table shows that the independent variables overall statistically significantly predict the dependent variable, ***'Net Sales***' F=4.420, p=.047. While Performance indicators which are independent variables '***Transport***', '***Return on Investment***' ***and*** '***Working Capital Turnover Ratio'*** contributed significantly to the model (p(.043)<0.05, p(.024)<0.05) & p(.041)<0.05) but '***Debtors Turnover Ratio***' and '***Degree of Inventory***' p(.917)>0.05 and p(.442)>0.05 has no significant contribution to the model. Along with Standardized Beta Coefficient (.798) indicated that one unit increase in 'transport ', 'net sales ' is likely to increase by .80 units; similarly, one unit change in 'Debtors Turnover Ratio' was likely to affect 'Net Sales ' by -.32 units, the effect of 'Degree of Inventory' was likely to be -.21 units, Return on Investment effects 'Net sales' by .38 units. Working Capital Turnover Ratio effects the 'Net sales' by .67 units.

The final predictive model was

Regression Equation: $Y=\beta 0+ \beta 1X1+ \beta 2X2+ \beta 3X3+\ldots\ldots+\varepsilon$

Net Sales= 67.658+ 83.418(*Transport*) -.270(*Debtors Turnover Ratio*) -16.020(*Degree of Inventory*)+208.790(*Return on Investment*) +1.200(*Working Capital Turnover Ratio*)

5.1.9: **Textiles – Weaving Sector.**

Table: 5.1.9.A Summary of Multiple Regression Analysis of Textiles – Weaving Sector with all the Performance Indicators

	Unstandardized Coefficients	Standardized Coefficients Beta	t	Sig.	VIF
(Constant)	-573.282		-0.59	0.661	
Transport	233.019	0.188	0.732	0.598	4.067
Average Collection period	-5.575	-2.952	-3.267	0.189	50.185
Debtors Turnover Ratio	24.559	0.159	0.593	0.659	4.395
Degree of Inventory	-51.674	-0.145	-0.908	0.531	1.577
Inventory Conversion Period	10.021	2.152	2.38	0.253	50.279
Inventory Turnover Ratio	38.033	0.49	1.069	0.479	12.913
Return on Investment	305.738	0.233	0.6	0.656	9.251
Working Capital Turnover Ratio	-29.108	-0.353	-0.955	0.515	8.384

The results of the Multiple Regression Analysis demonstrates that the all the variables have high VIF value, It indicates that some of the variables have the high correlation with the dependent variable '***Net Sales'*** and should affect the result of the Regression analysis. So two variables, the '***Average Collection Period'*** and '***Inventory Conversion Period***' are excluded from the model.

Table: 5.1.9.B Summary of Multiple Regression Analysis of Textiles – Weaving Sector with selective Performance Indicators

	Unstandardized Coefficients B	Standardized Beta	t	Sig.	VIF	R	Adjusted R Square	F	Sig.
(Constant	1127.518								
Transport	504.901	0.408	0.974	0.021	1.178				
Debtors Turnover Ratio	60.842	0.393	0.529	0.033	3.694				
Degree of Inventory	38.008	0.107	0.262	0.048	1.114				
Inventory Turnover Ratio	-67.714	-0.873	-1.221	0.309	3.43				
Return on Investmen	-667.888	-0.508	-0.635	0.571	4.302				
Working Capital Turnover Ratio	31.872	0.386	0.507	0.047	3.89	.744[a]	0.641	2.619	.048[b]

Table 5.1.9.B illustrates the relationship between Performance Indicators of Supply chain with Net Sales. The results of the regression indicated that the model explained 64%(Adjusted R Square 0.641) of the variation explained by the independent variables that affect the dependent variable '***Net Sales***'. The table shows that the independent variables overall statistically significantly predict the dependent variable, ***'Net Sales***' F=2.619, p=.048. While Performance indicators which are independent variables '***Transport***', '***Debtors Turnover Ratio'***, '***Degree of Inventory***' and '***Working Capital Turnover Ratio***' contributed significantly to the model (p(.021)<0.05, p(.033)<0.05, p(.048)<0.05 & p(.047)<0.05) but '***Inventory Turnover Ratio***' p(.309)>0.05 '***Return On Investment'*** p(.571)>0.05 has no significant contribution to the model . Along with Standardized Beta Coefficient (.408) indicated that one unit increase in 'transport ', 'net sales ' is likely to increase by .41 units; similarly, one unit change in 'Debtors Turnover Ratio' was likely to affect 'Net Sales ' by .39 units, the effect of 'Degree of Inventory' was likely to be .10 units, Inventory Turnover Ratio and Return on Investment effects 'Net sales' by -.87 units and -.50 units respectively. Working Capital Turnover Ratio effects the 'Net sales' by .38 units.

The final predictive model was

Regression Equation: $Y=\beta 0+ \beta 1X1+ \beta 2X2+ \beta 3X3+\ldots\ldots+\varepsilon$

Net Sales= 1127.518 + 504.901(*Transport*)+ 60.842(*Debtors Turnover Ratio*) + 38.008(*Degree of Inventory*) -67.714(*Inventory Turnover Ratio*)-667.888(*Return on Investment*) + 31.872(*Working Capital Turnover Ratio*)

5.1.10: Tire Manufacturing Sector.

Table: 5.1.10.A Summary of Multiple Regression Analysis of Tire Manufacturing Sector with all the Performance Indicators

	Unstandardized Coefficients	Standardized Coefficients Beta	T	Sig.	VIF
(Constant)	143414.801		0.368	0.776	
Transport	212.391	0.495	0.668	0.625	99.026
Average Collection period	-830.951	-1.148	-0.288	0.822	2866.1
Debtors Turnover Ratio	-2445.867	-0.677	-0.294	0.818	954.57
Degree of Inventory	-7214.022	-0.6	-0.276	0.828	848.74
Inventory Conversion Period	-866.412	-2.492	-0.476	0.717	4938.3
Inventory Turnover Ratio	-4572.796	-2.076	-0.434	0.739	4128
Return on Investment	-30806.713	-0.753	-0.588	0.662	295.93

Working Capital Turnover Ratio	1.914	1.137	1.369	0.402	124.32

The results of the Multiple Regression Analysis demonstrates that the all the variables have high VIF value, It indicates that some of the variables have the high correlation with the dependent variable '***Net Sales'*** and should affect the result of the Regression analysis. So three variables, the '***Average Collection Period',*** '***Inventory Conversion Period***' and ***'Return on Investment'*** are excluded from the model.

Table: 5.10.B Summary of Multiple Regression Analysis of Tire Manufacturing Sector with selective Performance Indicators.

	Unstandardized Coefficients B	Standardized Beta	T	Sig.	VIF	R	Adjusted R Square	F	Sig.
(Constant)	1616.834								
Transport	152.89	0.356	3.21	0.033	3.06				
Debtors Turnover Ratio	-538.341	-0.149	-2.019	0.114	1.355				
Degree of Inventory	2338.043	0.194	2.03	0.112	2.276				
Inventory Turnover Ratio	182.14	0.083	0.882	0.028	2.183				
Working Capital Turnover Ratio	1.274	0.757	6.805	0.002	3.073	.992[a]	0.964	48.87	.001[b]

Table 5.1.10.B illustrates the relationship between Performance Indicators of Supply chain with Net Sales. The results of the regression indicated that the model explained 96%(Adjusted R Square 0.964) of the variation explained by the independent variables that affect the dependent variable '***Net Sales***'. The table shows that the independent variables overall statistically significantly predict the dependent variable, ***'Net Sales***' F=48.480, p=.001. While Performance indicators which are independent variables '***Transport***', '***Inventory Turnover Ratio***' ***and*** '***Working Capital Turnover Ratio'*** contributed significantly to the model (p(.033)<0.05, p(.028)<0.05) & p(.002)<0.05) but '***Debtors Turnover Ratio***' and '***Degree of Inventory***' p(.114)>0.05 and p(.112)>0.05 has no significant contribution to the model. Along with Standardized Beta Coefficient (.356) indicated that one unit increase in 'transport ', 'net sales ' is likely to increase by .35 units; similarly, one unit change in 'Debtors

Turnover Ratio' was likely to affect 'Net Sales ' by -.15 units,

the effect of 'Degree of Inventory' was likely to be .19 units, Inventory Turnover Ratio effects 'Net sales' by .08 units and Working Capital Turnover Ratio effects the 'Net sales' by .75 units.

The final predictive model was

Regression Equation: $Y=\beta 0+ \beta 1X1+ \beta 2X2+ \beta 3X3+\ldots\ldots+\varepsilon$

Net Sales= 1616.834+ 152.890(*Transport*) -.538.341(*Debtors Turnover Ratio*) +2338.043(*Degree of Inventory*)+182.140(*Inventory Turnover Ratio*) +1.274(*Working Capital Turnover Ratio*)

Conclusion

This work was carried out to assess SC partnership's organisational and overall working partnership using multiple linear regression models of primary success variables and the company-specific production vector Net Profits. Reliable findings from the regression analysis lead to a variety of assumptions. Next, certain industry-specific factors appear to be a sector for a company's perception of the importance of supply chain cooperation. Ten separate equations for ten different sectors correctly represent the impact and interaction of various primary success indicators on net profits. Various variables have large multi-collinearity values expressed by the high VIF, the significance is excluded from the analysis, and the individual variables have not influenced the equation. The other factors display the positive and detrimental influence on the constant, the relation between the dependent variable and the independent variables, and the net sales are seen in the value. The equation definition means that the organisation's management should schedule various factors that should influence or create a consistent partnership between dependent and independent variables. Using the equation, all stakeholder variables responsible for net sales (Dependent variable) available for analysis may quickly represent net sales. The relationship of main performance metrics is measured with net Sales in operational productivity and the amount of staff for overall performance, and businesses who collaborate broadly tend to consider collaborative performance more strongly. Since altering for significant firm-specific impacts, our results show that the cooperative sharing of knowledge on variables and information

structures' usage helps determine the partnership's importance. Finally, goal congruity was the only quantitative variable contributing to performance and efficiency in the supply chain.

5.2 Interrelationship of Net Sales and Transportation Expenses

Correlation is a statistic that measures the degree to which two variables move in relation to each other. In Underdone Analysis the relationship is determined between the Net sales and the Transportation.

5.2.1: Auto Ancillaries Manufacturing Sector

Table 5.2.1: Coefficient of correlation of Auto Ancillaries Sector

Correlations			
		Transport	Net Sales
Transport	Pearson Correlation	1	.848**
	Sig. (2-tailed)		0.002
	N	10	10
Net Sales	Pearson Correlation	.848**	1
	Sig. (2-tailed)	0.002	
	N	10	10

A Pearson correlation was executed to determine the relationship between Transportation and Net sales of Auto Ancillaries Sector.

The model states that p.002 < .05, it conclude that the relationship between Net Sales and Transport has a statistically significant linear relationship. The correlation coefficient for Transportation and Net sales is 0.848. The direction of the relationship is highly positive (i.e., Transportation and Net sales are positively correlated), intends these variables tend to increase together (i.e., Transportation is associated with Net sales).

5.2.2 Automobile Manufacturing Sector

Table 5.2.2: Coefficient of correlation of Automobiles Sector

Correlations			
		Transport	Net Sales
Transport	Pearson Correlation	1	.938**
	Sig. (2-tailed)		0
	N	10	10
Net Sales	Pearson Correlation	.938**	1
	Sig. (2-tailed)	0	
	N	10	10

A Pearson correlation was executed to determine the relationship between Transportation and Net sales of Automobiles Sector.

The model states that p.000 < .05 so it concludes that the relationship between Net Sales and Transport has a statistically significant linear relationship. The correlation coefficient for Transportation and Net sales is 0.938. The direction of the relationship is highly positive (i.e., Transportation and Net sales are positively correlated), intends these variables tend to increase together (i.e., Transportation is associated with Net sales).

5.2.3 Bearing Manufacturing Sector

Table 5.2.3: Coefficient of correlation of Bearing Manufacturing Sector

Correlations			
		Transport	Net Sales
Transport	Pearson Correlation	1	.947**
	Sig. (2-tailed)		0
	N	10	10
Net Sales	Pearson Correlation	.947**	1
	Sig. (2-tailed)	0	
	N	10	10

A Pearson correlation was executed to determine the relationship between Transportation and Net sales of Bearing Manufacturing Sector.

The model states that p.000 < .05 so it concludes that relationship between Net Sales and Transport has a statistically significant linear relationship. The correlation coefficient for Transportation and Net sales is 0.947. The direction of the relationship is highly positive (i.e., Transportation and Net sales are positively correlated), intends these variables tend to increase together (i.e., Transportation is associated with Net sales).

5.2.4 Cables Manufacturing Sector

Table 5.2.4: Coefficient of correlation of Cable Manufacturing Sector

Correlations			
		Transport	Net Sales
Transport	Pearson Correlation	1	.880**
	Sig. (2-tailed)		0.001
	N	10	10
Net Sales	Pearson Correlation	.880**	1
	Sig. (2-tailed)	0.001	
	N	10	10

A Pearson correlation was executed to determine the relationship between Transportation and Net sales of Cable Manufacturing Sector.

The model states that p.001 < .05 so it concludes that relationship between Net Sales and Transport has a statistically significant linear relationship. The correlation coefficient for Transportation and Net sales is 0.880. The direction of the relationship is highly positive (i.e., Transportation and Net sales are positively correlated), intends these variables tend to increase together (i.e., Transportation is associated with Net sales).

5.2.5 Castings, Forgings & Fasteners Sector

Table 5.2.5: Coefficient of correlation of Castings, Forgings & Fasteners Sector

Correlations			
		Transport	Net Sales
Transport	Pearson Correlation	1	.802**
	Sig. (2-tailed)		0.005
	N	10	10

Net Sales	Pearson Correlation	.802**	1
	Sig. (2-tailed)	0.005	
	N	10	10

A Pearson correlation was executed to determine the relationship between Transportation and Net sales of Castings, Forgings & Fasteners Sector.

The model states that p.005 < .05 so it concludes that relationship between Net Sales and Transport has a statistically significant linear relationship. The correlation coefficient for Transportation and Net sales is 0.802. The direction of the relationship is highly positive (i.e., Transportation and Net sales are positively correlated), intends these variables tend to increase together (i.e., Transportation is associated with Net sales).

5.2.6 Cement Sector

Table 5.2.6: Coefficient of correlation of Cement Sector

Correlation			
		Transport	Net Sales
Transport	Pearson Correlation	1	.888**
	Sig. (2-tailed)		0.001
	N	10	10
Net Sales	Pearson Correlation	.888**	1
	Sig. (2-tailed)	0.001	
	N	10	10

A Pearson correlation was executed to determine the relationship between Transportation and Net sales of Cement Sector.

The model states that p.001 < .05 so it concludes that relationship between Net Sales and Transport has a statistically significant linear relationship. The correlation coefficient for Transportation and Net sales is 0.888. The direction of the relationship is highly positive (i.e., Transportation and Net sales are positively correlated), intends these variables tend to increase together (i.e., Transportation is associated with Net sales).

5.2.7 Non-Ferrous Metals Sector

Table 5.2.7: Coefficient of correlation of Non-Ferrous Metals Sector

Correlations			
		Transport	Net Sales
Transport	Pearson Correlation	1	0.688
	Sig. (2-tailed)		0.044
	N	10	10
Net Sales	Pearson Correlation	0.688	1
	Sig. (2-tailed)	0.044	
	N	10	10

A Pearson correlation was executed to determine the relationship between Transportation and Net sales of Non-Ferrous Metals Sector.

The model states that p.044 < .05 concludes that the relationship between Net Sales and Transport has a statistically significant linear relationship. The correlation coefficient for Transportation and Net sales is 0.688. The direction of the relationship is highly positive (i.e., Transportation and Net sales are positively correlated), intends these variables tend to increase together (i.e., Transportation is associated with Net sales).

5.2.8 Textiles – Texturizing Sector

Table 5.2.8: Coefficient of correlation of Textiles – Texturizing Sector

Correlations			
		Transport	Net Sales
Transport	Pearson Correlation	1	0.551
	Sig. (2-tailed)		0.099
	N	10	10
Net Sales	Pearson Correlation	0.551	1
	Sig. (2-tailed)	0.099	
	N	10	10

A Pearson correlation was executed to determine the relationship between Transportation and Net sales of Textiles – Texturizing Sector.

The model states that p.099 > .05 so it concludes that relationship between Net Sales and Transport has no statistically significant linear relationship. The correlation

coefficient for Transportation and Net sales is 0.551. The direction of the relationship is positive (i.e., Transportation and Net sales are positively correlated), intends these variables tend to increase together (i.e., Transportation is associated with Net sales).

5.2.9 Textiles – Weaving Sector

Table 5.2.9 A: Coefficient of correlation of Textiles – Weaving Sector

Correlations			
		Transport	Net Sales
Transport	Pearson Correlation	1	0.461
	Sig. (2-tailed)		0.08
	N	10	10
Net Sales	Pearson Correlation	0.461	1
	Sig. (2-tailed)	0.08	
	N	10	10

A Pearson correlation was executed to determine the relationship between Transportation and Net sales of Textiles – Weaving Sector.

The model states that p.099 > .05 concludes that the relationship between Net Sales and Transport has no statistically significant linear relationship. The correlation coefficient for Transportation and Net sales is 0.461. The direction of the relationship is positive (i.e., Transportation and Net sales are positively correlated), intends these variables tend to increase together (i.e., Transportation is associated with Net sales).

5.2.10 Tires Manufacturing Sector

Table 5.20 A: Coefficient of correlation of Non-Ferrous Metals Sector

Correlations			
		Transport	Net Sales
Transport	Pearson Correlation	1	.869**
	Sig. (2-tailed)		0.001
	N	10	10
Net Sales	Pearson Correlation	.869**	1
	Sig. (2-tailed)	0.001	
	N	10	10

A Pearson correlation was executed to determine the relationship between Transportation and Net sales of Non-Ferrous Metals Sector...

The model states that p.001 < .05 so it concludes that relationship between Net Sales and Transport has a statistically significant linear relationship. The correlation coefficient for Transportation and Net sales is 0.869. The direction of the relationship is highly positive (i.e., Transportation and Net sales are positively correlated), intends these variables tend to increase together (i.e., Transportation is associated with Net sales).

Conclusion

According to the results of Correlation the parameters such as net sales and transport. Net profits are the primary indicators of the organisation's success, and transport is the backbone and the primary key performance metric for the supply chain. Net revenue and travel costs are crucial decision-making variables whose joint estimation is vital for the optimum strategy suggested. These reports further highlight the highly correlated industries to transport and revenue and the outcomes of the sector's suggested techniques to raise net income. Besides, these numerical results have meant that collaborative decision-making, synchronized operation of centralised management, is critical to lowering the vendor and buyer's running expense and managing supply chain operation and design.

Logistics could not put its benefits to full play without well-developed transport networks. A sound transport system for logistics operations will have improved logistic performance, minimize operational costs and encourage service quality. Improving transit systems requires the efforts of both the public and private sectors. A well-functioning logistics system could improve the productivity of both industry and government.

The supply chain plays an increasingly important part of the company's operations. Transportation and supply chain networks have mutual interdependence that logistics management requires to carry out the task and, meanwhile, an effective logistics system will help enhance the traffic climate and the growth of transport. As transport represents the highest cost among logistics systems' related components, improving

transport efficiency could impact the supply chain system's entire output. Transportation plays an integral part in the logistics system, and its operations occur in separate parts of the supply chain. Without a transport link, a robust supply chain can not put its ability to full play. The logistics system review in a broad context will help combine the benefits of various use situations to address their present drawback. The review of transport processes offers a better picture of transport applications of supply chain operations. Logistics growth will continue to be vigorous in the decades to come, and logistics principles will be applicable in various fields.

Chapter: 6

Conclusion and Findings

6.1 Introduction

Supply Chain Management is being utilised in multiple organisation as a method to enhance its overall performance. It is also beneficial to raise revenues by reducing prices and pleasing end-customers. Supply chains occur in every organisation but are highly evident in industrial sectors that involve a direct circulation of products from producer to manufacturing facilities to the consumer.

The concept of measuring efficiency is linked to the different key performance indicators through their performance. The current research examined the comprehensive performance measurement of supply chain management by integrating key performance indicators' efficiency and performance. Pertinently, It has been noted that there is considerably less study in the field of supply chain calculation utilising this combined method.

A new era of understanding of the dynamics of the strategic edge and the function of acquisition. More and more, we are witnessing a transformation in which vendors and customers are inextricably related through the entire chain of events that move raw materials from their source of production across a variety of value-added activities to the ultimate customer. The output is no longer determined through a single transaction; rivalry is instead judged to be a network of co-operating entities competing with other supply chain organisations. The coordination of numerous global networks of corporate activity is now a primary source of competitive advantage. The key is to bring in breakthrough changes and improvements that extend the knowledge of value-added network members around the framework. Leading suppliers, retailers and many others are all interested in the chain of customer loyalty delivery as design partners, risk-sharers and more efficient engines. These attempts to integrate this value-added network

to achieve both customer value and competitive benefit are referred to as supply chain management. As an attempt, there are some of the observations mentioned below.

6.2 Findings

Objective 1

With regard to evaluate the effectiveness of supply chain of different industries on the basis of established indicators below stated as the relevant findings in this regard:

- It was found after the DEA review that there was no deficit in expenses considered in the study for two years, i.e. 2010 and 2011 hence it can be regarded that for companies (Sector wise) considered in the study the supply chains of those companies performed at best possible efficiency and efficiency level.
- Supply chain of four sectors Castings, Forgings & Fasteners, Cement manufacturing, Non-Ferrous Metals, textile texturing sector and Auto Ancillaries sector in 2012 and Auto Ancillaries sector, Automobile sector, Castings, Forgings & Fasteners, cable manufacturing sectors in 2017 did not perform up to the mark as per the expectations. The Data Envelopment Analysis depicts that remaining sectors functioned in compliance with the strategy and had achieved acceptable results.
- In 2014, the Bearing Manufacturing Supply Chain Sector, Cement Industry, Non-Ferrous Metals Sector, Textiles – Texturizing Sector, Textiles – Weaving Sector and in 2019 the Auto Ancillary Sector, Automobile Sector, Castings, Forging & Fasteners Sector, Cement Sector and Tire Manufacturing Sector did not operate efficiently. The remaining five sector's supply chain works successfully and consistently in both years.
- The supply chain of Auto Ancillaries sector, cable manufacturing sector, Textiles Weaving sector and tire manufacturing sector in 2013 and Cement manufacturing sector, Cable manufacturing sector, Textiles Texturizing and Tire manufacturing sector in 2016 works very effectively. These years, the above said sectors' supply chain shows tremendous works and work with its full efficiency.
- The Data Envelopment analysis illustrates that 2015 and 2018 are years wherein the

supply chain operates very ineffectively; only two industries perform up to the mark; cable manufacturing industry, Textiles – Texturizing and Bearings manufacturing sector, tyre manufacturing sector respectively.

- The most effective and efficient supply chain seems to belong to the cable and tyre manufacturing sector. Only in the two years 2017, 2018 and 2015, 2019 are the years in which the supply chain reports the slack. The industry has recorded the remaining eight years as a perfect example of a robust supply chain.
- Bearing manufacturing Sector, Textiles Texturizing sector and Textiles Weaving sector are the sectors whose supply chain perform well in the six years out of total ten years of analysis.2010,2011,2017 and 2019 are the best years for the above-said sectors.
- The Data Envelopment Analysis reports that the Auto Ancillaries sectors' supply chain frequently performs efficiently from 2010 to 2014, but the efficiency decreases drastically from 2015 to 2019.
- The automobile, cement and non-ferrous metals sectors demonstrate that the supply chain is beneficial and efficient in just four years. The majority of years recorded that the supply chain was inefficient.
- Castings, Forgings & Fasteners sector reported the least effective supply chain. Supply chain only performs well in 2010,2011 and 2014, the remaining seven years of analysis supply chain of the sector perform under the mark.

Objective 2

With regard to ascertain the relationship of the considered Performance Indicators of Supply chain with Net Sales below sated as the relevant findings in this regard:

- Multiple Regression Analysis illustrated that Two output metrics of the Supply Chain Average Collection Period and the Inventory conversion Period are positively correlated with the dependent variable net sales in all ten sectors, thus always influencing the relationship between the other variable and the net sales.
- Multiple regression analysis states that Auto ancillaries sectors, Castings, Forgings &

Fasteners sector, Cement Manufacturing Sector, Non-Ferrous Metals sector, Textiles – Texturising sector and tire manufacturing sector also shows the highly correlated relationship of the other variables like Debtors Turnover Ratio, Degree of Inventory, Inventory Turnover Ratio and Return on Investment respectively.

- The equations of all the sectors from multiple regression portray that transport variable appears as a many perfect metrics that have a favourable relationship to the sector's actual output, i.e. net sales.
- Debtors Turnover ratio indicates a significant association with net sales in all sectors except the Cement Manufacturing and Textiles – Texturising sector.
- The working capital turnover ratio indicates a significant association to net profits in all sectors except the Cable Manufacturing and Non-Ferrous Metals sectors.
- Return on investment is a factor which has a significant relationship to the net sales in 5 sectors only, net sales in four sectors have a no significant relationship, and one sector is positively correlated with net sales.
- Multiple regression also report that Degree of inventory and the inventory turnover ratio variable is a very least significant variable, most of the times these variables are highly positively correlated with the dependent variable net sales or shows the insignificant relationship with the net sales.

Objective 3

With regard to evaluate the relationship between the Net sales and the Transportation expenses for the considered companies below sated as the relevant findings in this regard:

- The Linear Regression analysis illustrated the significant impact of the transport variable on Inventory Conversion Period in the Auto Ancillaries Sector, Automobile Sector, Bearing Sector, Castings, Forgings & Fasteners Non-Ferrous Metals Sector and Textiles – Weaving Sector. The Cable Manufacturing Sector, Cement manufacturing Sector, Textiles – Texturizing Sector and Tire Manufacturing Sector has no significant impact on transport.
- The linear regression equation shows that the Average Collection Period and

Working capital Turnover Ratio has a significant relationship with the Transport variable in all the sectors except three sectors. Transport variable did not significantly impact the said variable in the following sectors; Castings, Forgings & Fasteners Sector, Non-Ferrous Metals Sector, Textiles – Texturizing Sector and Cement Sector Non-Ferrous Metals Sector, Textiles – Weaving Sector'.

- Debtors Turnover Ratio, Inventory Turnover Ratio and Return on Investment denote the significant relationship with the transport variable in four sectors Auto Ancillaries Sector, Automobile Sector, Bearing Sector, Cement Sector, Non-Ferrous Metals Sector, Textiles – Texturizing Sector, Tire Manufacturing Sector, Cable Manufacturing Sector, Castings Forgings & Fasteners Sector collectively.
- Degree of inventory is the variable which is the least effective and does not show any significant impact of transport in most of the sectors. Two sectors Auto Ancillaries and Non-Ferrous Metals implies the significant impact of transport on the variables.
- Net sales are the only variable that shows the impact of the transport variable in all the sectors.
- Automobile Sector and Bearing Manufacturing Sector shows the significant impact of the transport variable on the performance indicators. Degree of Inventory, Inventory Turnover Ratio and Return on Investment variables do not imply any significant impact of said variable.
- Casting, Forgings & Fasteners Sector, Cement Sector and Non-Ferrous Metals Sector signify that the four variables out of seven variables show the significant relationship between the transport and other independent variables.
- The linear regression portrays the Cable Manufacturing Sector, Textiles – Texturizing Sector and Tire Manufacturing Sector signify the impact of transport variable on three available only; i.e. Net Sales, Return on Investment, Working Capital Turnover Ratio, Inventory Turnover Ratio collectively.
- The linear regression equation represents that Textiles Weaving is a Sector in which the transport variable shows the least impact on the other variables. Only the two-variable Inventory Conversion Period and Net Sales show a significant relationship with the transport variables.
- Auto Ancillaries Sector is only a sector in which the transport variable implies the

significant relationship between the transport and all the variables.

Objective 4

With regard to evaluate the relationship between the Net sales and the Transportation expenses for the considered companies below sated as the relevant findings in this regard:

- The Pearson correlation analysis depicts that all the sectors positively correlate between the transport expense and Net sales.
- Two sectors cable manufacturing and tire manufacturing sectors also implied the efficient supply chain with the correlation analysis.
- The supply chain of Castings, Forgings & Fasteners sector is least effective, but the correlation between the transport and net sales shows a positive relation.
- Correlation analysis interprets the Auto Ancillaries sector has a high positive relation between Net sales and transport as well as the sector also display the significant impact of the transport on the net sales.
- Transport and net sales sow the highly positive correlation in the Auto Ancillaries sector, Automobile sector, Bearings sector, Cables sector, Castings, Forgings & Fasteners sector, Cement manufacturing sector and Tires manufacturing sector. The r square value varies from .802 to .947.
- Non-Ferrous Metals sector, Textiles – Texturising sector and Textiles – Weaving sector also shows the positive correlation but not compared to the highly correlated sectors the r square value varies from .461 to .688.
- Investment in transport in the supply chain is often entirely associated with the rise in net profits. These two factors depend on each other. Transport prices tend to increase net sales or net sales increases as an investment in transport increases.

6.3 Suggestions

The study uncovers the explanation for the cause of inefficient supply chain. There are various Factors causes are the rise in the cost of manufacturing, the cost of workers, the cost of electricity and gasoline, the cost of raw materials, the cost of sales and the cost of transport. These expenditures directly influence the effectiveness and competitiveness of supply chain performance. There are also external variables that have affected these investments, such as the government's policies on natural resources, which are often used as raw materials, natural hazards, pandemics, the International Crude Petroleum Price and economic policies. The above said expenditures also influence the variable of the output, which are the key performance indicator of the supply chain performance.

All Manufacturing Sectors do need to enhance their storage and distribution practises. It can be said that India's industrial organisations are engaged in safe supply chain practices, and there is a broad scope for development so that they can update their practices and gain operational performance. In comparison, revolution across the data system breaks the boundary and become part of the supply chain. Supply Chain Management is applied globally and acts as a method to leverage the success of companies. Also, it has been practised in India since the last ten years and hence leaves space for work to be carried out in the Indian manufacturing field. The study demonstrates that Indian manufacturing companies are skilled enough to handle the supply chain's productivity and can set an essential precedent in the field of the supply chain.

From the findings, it can be inferred that all Indian manufacturing companies are professional enough to handle the supply chain's productivity. However, specific improvements in the current supply chain will make these manufacturing Sectors more effective. Recommendations for the Manufacturing sectors are as follows:

Auto Ancillaries Manufacturing Sector, Bearing Manufacturing Sector and Non-Ferrous Metals Sector must aim to boost efficiency, storage, and inventory measurements. These companies also recommend that these companies improve their

cost-effectiveness by looking for and applying new methods of reducing costs and eliminating scrap, excess, or surplus products .

Tires Manufacturing Sector and Cables manufacturing Sector can seek to improve efficiency by enhancing waste management, it is recommended that these organisations should work with other organisations who may use scrap, landfill, leftover goods as inputs and may generate other valuable products.

Castings, Forgings & Fasteners Sector, Cement Manufacturing Sector and Automobile Manufacturing Sector have been shown to have weaker supply chain performance in individual measurements that need to be worked. The study suggested different ideas to enhance performance of supply chain . The creation of new goods, the feasibility of developing various new products, stakeholders' role in the launch of innovative products, the procurement of raw materials from different markets, and the customer's demands ,other versatile factor also attracts the attention of the producers. If there is demand in the market then only supply can be move and different ideas related to supply chain can be implemented. Non-Ferrous Metals manufacturing companies can boost the supplier partnership dimension's efficiency by reflecting on the supplier's responsiveness to modifying and financial, logistic structures. This can be accomplished by building confidence and long-term partnerships with suppliers..,

Textiles – Texturizing and Weaving's Sectors are processing companies (Texting and weaving) had to pay close attention to the Factory and Product dimension to improve the supply chain's overall productivity. It is proposed that textile manufacturing companies concentrate on preparation and purchasing, inventory costs, storage costs, idle time control, idle inventory management, classification, and production and delivery processes. It is proposed that the best purchasing strategy for packaging products should be to order more than the quantity of final piece during each time or each quarter, plus the inventory levels determined by the volume of discarded packaging. This strategy will minimise the buffer inventory from one cycle to the next so the inventory must be consumed precisely following the production schedule. By adopting this strategy, the company will minimise both the holding / operating expenses and the operational costs.

There are some points which are likely to be recommended to control the increased expenditure in all the manufacturing Sectors:

1. Cost of Production:

Since product production accounts for 80 per cent of the product's cost, it makes sense to start here by looking at a decrease in manufacturing costs.

- **Designing the product Smartly** :

  . In reality, the design/architecture process alone decides 60 per cent of the cost. Product design describes product concept, infrastructure, team structure, technology, feature configurations and off-the-shelf products. This process also lays out production, supply chain, suppliers, consistency, reliability, operation, range, configuration, customisation and derivative goods. These decisions have the most significant effect of all cost-reduction methods for production. It is a lot to remember, but concentrating on top cost-saving strategies is a smart way to start.

- **Lean Manufacturing Strategies:**

  Adopting lean manufacturing practises can lower manufacturing costs by increasing worker efficiency, lowering production throughput times, decreasing inventories, and lowering error and scrap by as much as half. Lean manufacturing's central concept is to achieve something for less, and the reduction of waste is the priority. Waste is characterised as any operation that does not add value from the customer’s point of view. According to research undertaken by the Lean Business Research Center (LERC), 60 per cent of production techniques in traditional industrial processes are waste; they do not bring value to the consumer. Good news is that nearly every organisation has the potential to lower production costs using lean manufacturing methods and other best practices.

- **Focusing on Profitable product :**

  The often-foreseen ability to optimise processes and free up vital capital resulting in increased efficiency, benefit and cash flow rationalises the product line and all its elements. Product line justification focuses on the most lucrative products and on

reducing or outsourcing low-profit products with high overhead requirements that are not consistent with manufacturing cost-reduction strategies.

- **Manufacturing System:**
  The most critical method needed to minimise costs is to monitor, track and evaluate the data involved with each of these procedures. However, finding the best method to do this can be overwhelming, so we have created a free guide on picking a manufacturing system. Download copy now and if the new method is an aid or a hindrance and reducing production costs.

- **Automation of the Production Process:**
  In the middle of intense rivalry amongst suppliers, should be able to use technologies to increase production performance and productivity. There may be a little reluctant since the use of technologies such as digital solutions requires significant investment costs. However, introducing an automatic solution would potentially help to save the running expenses in the long term.

- **Outsourcing:**
  Subcontracting has now become part of capitalism today. However, the value of small-scale industrial sectors under review is not yet evident, so the author would like to propose that manufacturing units must start outsourcing operations other than core business activities to the full extent possible. The researcher knows that the introduction of outsourcing operations may or may not be feasible to a significant degree, but where small-scale production units are feasible, the operations should be redefined and outsourced.

2. **Employee Cost**:

While labour and staff compensation is a considerable burden for companies, they are essential to their survival. There are ways to minimise labour costs and keep the corporation’s head up.

- **Pay Review:**
  Even if financial markets are going up and down, incomes and incomes are just

heading upward. Check the level of pay for each employee in the business and ensure that their compensation level follows recent trends. If the existing workers make more than the other firms in the sector would pay for their jobs, postpone or increase just tokens until payroll is consistent with current pay patterns.

- **Make use of Part Time or Temporary Employee:**
  Using part-time or contract employment does not pay for the insurance, contributions, bonuses, and other insurance that a full-time employee gets. Some businesses use "on-call" workers as a way of lowering labour costs in production. The on-call scheme requires an open calendar that encourages workers to come to work anytime they decide to make money. Employees are qualified in unique roles so that they can participate anytime work available. Labour expenses are a big part of the budget for every new start-up. There are, however, opportunities to streamline the operation by helping to reduce labour costs in production. The six fields listed above lead to a good production base that can minimise manufacturing costs.

3. ## Power and Fuel Cost :

Production companies face a particular range of problems in terms of energy storage. There are points for handling energy consumption in all fields of the manufacturing industry.

- **Switch to the Fuel-efficient machinery:**
  Holding the machinery in a good working state is crucial to make it more cost-effective. Retro-commissioning routinely searches for devices running below acceptable expectations in the plant. Retro-fitting means repairing machinery that is obsolete or unreliable. However, savings from upgraded ageing equipment to also include electrical outlets, generators, vehicles, and computers will add up in the long run. Implement a plan to review and repair all infrastructure and upgrade to more energy savings.

- **Section of the shortest route and Smooth ways**:
  Road surface consistency is an often ignored factor to fuel inefficiency. Power from the motor is being used for as much as advancing acceleration — each jump or jerk of the car strips away the costly angular momentum charged for at the pump. Road

quality is seldom under the management of a fleet. However, it can allow users to avoid poor roads with the navigation system by designing and dispatching pathways that avoid certain areas.

4. **Raw material cost** :

The majority of raw materials used in the manufacturing industry are natural fossils. The price of natural fossils depends primarily on the country's policy and economic changes. The only way to deal with the high cost of raw materials is to continuously monitor the price of raw materials, purchase them and store them while the price is minimal.

5. Selling cost:

Instead of moving sales representatives out of ground level, invest in software such as Inside View, a Cause Event notification programme, to minimise total costs and prevent wasteful usage of sales representatives. To reduce sales costs and improve ROI, motivate sales representatives to spend more time researching prospects and customers.

- **Preparing effective sales strategies:**

Many organisations struggle to gather the data required to set sales and marketing targets correctly, often depending on a single expense factor or, worse, on guesswork. These broad-based budgets require more than just sales expenses or a proportion of business income. Go-to-Market Strategy suggests using a three-pronged approach to establishing revenue targets that combines industry standards, campaign forecasting (depending on the organisation historical statistics, like past and expected ROI but also regulatory requirements) and the importance of the consumer's tenure.

- **Updated training:**

One of the most significant challenges facing businesses is that sales representatives and entrepreneurs only read the old literature sold in the 1970s when the industry and the sales environment were completely different. In truth, they get the incorrect information that boomerangs against them while makes it more difficult for them to sell a product. Building on preparation to ensure that the sales team's abilities are up

to date is a profitable venture.

6. Transport Expense :

A considerable amount of expenditure is generally on transportation for an organisation of any size. As the fuel costs increasing, substitute and modified techniques are needed to help reduce transport costs for the organisation.

- **Reducing Vehicles:**

  Transport executives in large corporations can devote a substantial amount of time choosing each route's best carrier. While this may seem like a smart idea, it is not the safest method of keeping costs down. By decreasing the number of vehicles and identifying all work distributed here between a smaller number of vehicles, these vehicles will typically provide cheaper fares on all networks due to the more significant amount of work provided. Some paths may not be arranged as low as alternative vehicles, but all transport costs must be decreased.

- **Safe and optimum packaging** :

  Optimising space is a massive help in the transportation sector, ensuring that all spaced goods are used for wrapping, including individual product packaging and how they are placed onto pallets for travel. This makes for more effective use of space, lowering the number of crates and reducing any shipment costs.

6.4 Conclusion

The immense global level of business allows companies to optimise all their vital capital to prosper and thrive. This study's primary purpose was to define the core driver to be focused more on enhancing the supply chain and organisational effectiveness. The study results are useful to help decision-making in supply chain efficiency, as this analysis highlights the key variables that affect the performance of supply chain organisations in Indian-based Manufacturing Sectors.

In the Indian Context, the Manufacturing Sectors are struggling to build strategies to succeed in the current competition brought on by the growing globalisation of industry. Supply Chain Management has been a critical methodology, representing a

corresponding image to address problems linked to procurement, consumer demand and distribution. The benefits of practising Supply Chain Management can be seen in the form of a more substantial business relationship with vendors, improved inventory delivery, decreased shipment times, minimised running costs and increased customer loyalty. The supply chain should be handled correctly to make the distribution chain more successful and increase its profitability.

Sectors now predict that they can depend on productive distribution networks or networks performed in a world market or a networked economy. The paradigms of modern governance, the idea of corporate partnerships, reach beyond the conventional industry's borders and aim to coordinate the whole phase of the corporate through many businesses' production chain. The future is a time of supply chain management in which companies and business entities could not stand alone, but adapt to the ever-changing global economy by creating a supply chain infrastructure to build a value distribution system.

The supply chain system is a dynamic system consisting of many integrated subsystems; the supply, operating characteristics, and synergy of the numerous subsystems significantly affect the supply chain system's overall performance. Depending on the development of an evaluation system for the supply chain system success of the manufacturing sector, it creates a DEA CCRo evaluation model: first, uses DEA to measure weights input variable layer, then uses DEA to assess the relative efficiency of each output variable; and finally, calculates the total efficiency values of each manufacturing enterprise supply chain system to be evaluated. The model approach takes full account of the DEA method's benefits; achieves a fusion of subjective and empirical, and follows the current supply chain system; the analysis outcomes are more systematic. This study verifies the rationality and usefulness of the approach by means of an example of verification, which makes the decision-making mechanism relevant to the supply chain system more logical and comprehensive.

While measuring the effectiveness of Supply Chain, it was observed that there was no shortfall in starting two years 2010 and 2011. The data envelopment study indicates that remaining industries functioned in accordance with the plan with appropriate

performance. Castings, Forgings & Fasteners, the cement production market, Non-ferrous metals, the garment-textile industry and the Auto Ancillary industry. The other five supply chain sectors run efficiently and reliably over the two years. Over the years, there are considerable effort and reliability in the supply chain for specific industries. The automotive, automotive, casting, fittings, cement and tyre manufacturing sectors did not work effectively, but the cable and tyre manufacturing sectors are also reputed to be one of the most productive and most influential supply chains. The only period in which the supply chain records slack is in 2017, 2018 and 2015, 2019. The remaining six years in business is an illustration of an approximately stable supply chain. In Bearing Manufacturing, textile and textile weaving industries, the supply chain worked well in the six years from ten years of research. The least successful supply chain was identified by the Castings, Forgings & Fasteners market. The most vigorous years for the above industries are 2010, 2011, 2017 and 2019.

Companies' effectiveness relies very much on their ability to plan and develop their supply chain management strategy to make the most market where economic dynamics are complex. The competitive edge is the potential of a company to establish a defensible role over its rivals. It provides skills that allow a company to distinguish itself from its rivals and make critical management decisions. Suggesting, establishing and justifying a multi-dimensional, operational metric of the Supply Chain Management Output Construction and demonstrating its usefulness in improving organisational performance and competitive advantage, this analysis provides Supply Chain Management managers with a valuable method for evaluating the comprehensiveness of their existing Supply Chain Management operations.

Building an efficient model for decision-making in the value chain and organisational performance, the supply chain of a Manufacturing Sector must consider how its activities and decisions contribute to the company's performance of the supply chain components. It can then evaluate the effect of its different behaviour, and the components would affect the efficiency of the supply chain. This will help make sure that perhaps the supply chain department makes and executes recommendations that are respected by the company’s top management.

Decision making at a critical factor in managing the supply chain is often a significant

element in the Supply Chain's performance. The effect of transport and the relation between the different primary performance metrics play a crucial role in decision-making. While measuring the impact of the transport on key Indicators, the linear regression equation indicates that the Average Collection Period and the Working Capital Turnover Ratio have a significant association with the Transport component in all industries except three sectors each. Eventually, the transport variable did not significantly affect the said variable in the following sectors: Castings, Forgings & Fasteners Industry, Non-Ferrous Metals Sector, Textiles – Texturizing Sector and Cement Sector. While Debtors Turnover Ratio, Inventory Turnover Ratio and Return on Investment denote a substantial partnership with the four industries' transport component. Two industries Auto Ancillaries and Non-Ferrous Metals are associated with the significant effect of transport on variables. The Degree of inventory is the least efficient variable and has no significant effects on transport. Although Net Sales are the only variable that significantly affects the transport variable in both industries. Castings, Forgings & Fasteners Business, Cement Sector and Non-Ferrous Metals Industry implies that the four variables out of the seven variables indicate a significant association between transport and other independent variables. In conclusion, the Cable Manufacturing Industry, Textiles Texturizing Sector, Tire Manufacturing Sector and Textiles Weaving sector has the least transport component. Just the two-variable Inventory Conversion Period and Net Sales show a significant connection to the transport variables.

It can be said that the concept and management of the supply chain is undoubtedly an approach which can strengthen the business method in manufacturing sectors. Especially considering that supply chain management has to maximise the productivity and efficiency of manufacturing sectors, it is essential to consider the components of the chain and its function in the overall success of the supply chain. It is also worth mentioning that the effective execution of the Supply Chain Management concept relies fundamentally on a well-identified relation between the company plan and the consumer’s value. The research model intended to offer an adequate demonstration of the possibilities for using the modelling and simulation process in manufacturing enterprises.

The established relation of the various performance indicators also discussed. It can be concluded that the two performance measures of the Supply Chain Average Collection Period and the Inventory Conversion Period are positively associated with contingent variable net sales in all 10 Sectors. Multiple regression study also reveals the Auto ancillary industries, Castings, Forging & Fasteners, Cement Manufacturing Industry, Non-Ferrous Metals Business, Textiles –Texturising Sector has the strong relation with the transport and has the significant impact on the net sale. The transport indicator tends to be a set of ideal indicators that positively correlate to the business's real production, i.e. Net Sales. Debtors Turnover ratio reveals a strong correlation with net revenues in all industries excluding Cement Production and Textiles Texturising. Return on investment is a metric that has a substantial connection to net profits of just 5 industries. One industry is favourably linked to net revenue. The degree of inventory and the turnover ratio indicator is the least important variables.

The supply chain may be formed between different entities (manufacturing, commercial and financial organisations, service industries) and between separate roles or operations. Due to their diverse relationships, participants of the supply chain may maximise their income by exchanging knowledge and collaborating, i.e., maintaining cooperation with each other to fulfil the particular processes' goals. Moreover a favourable connection between transportation costs and net sales is also signified in the study. The cable manufacturing sector and the tyre manufacturing sector both have productive supply chain and that productive supply chain is due to the positive relationship between Transport and Net sales. The Castings, Forgings & Fasteners sector is least successful, but there is still a good relationship between transport and net sales. Transportation and net profits were strongly favourable in the following sectors: Auto-Ancillaries, Aerospace, Bearings, Cable, Castings, Welding & Fasteners. The square value of r ranges from.802 to.947. Textiles Texturising and Textiles Weaving business often have a positive partnership between the variables.

This research has a variety of managerial implications. First, it provides SCM managers with an adequate formula for measuring supply chain performance effectiveness and the latest aspects of supply chain management practices that have already been established. Results also suggest that supply chain management

activities can significantly impact the productivity of the supply chain.

The final critical analysis of the thesis was provided in this chapter. The key aims and central findings and the significant contribution of the systematic method were examined, and the strengths of the study were discussed. Suggestions and possible ranges for prospective research have also been defined. Study on Supply Chain Performance Measurement Variables provided fresh insights on approaches and concepts undeveloped in the Supply Chain Performance Measurement Literature. The decision-making phase and the supply chain macro processes methods have been objectively evaluated after they have been combined to build the groundwork for empirical work. The findings offered fresh perspectives and observations on the study of supply chain value measurement in relation to performance measurement variables and effectiveness in India's manufacturing sector.

6.5 Future Scope

The present study's goal was to evaluate the performance and measure the effectiveness of Supply Chain that affect organisational performance. It is just a general analysis. Despite its narrow reach and lack of study in any specific variables or dimensions, the researcher provides scope for further review in the following fields.

Supply Chain Management The factors responsible for affecting operational efficiency are involved but not stagnant. They are subjective to adjust from time to time, from sector to sector. Study on supply chain management factors should also be performed if and when appropriate. Studies can be performed independently and in-depth, taking into consideration any specific form of business. Further studies could repeat this analysis with a broad sample and broader representation of the service industries. The present research is restricted to just 10 Indian manufacturing sectors. It may also be applied to various other fields. The comparative analysis may also be carried out between the companies in two different states. As this study is restricted

only to supply chain issues, competencies, and procedures on organisational performance, more research can be examined by considering climate dynamics, political impact, and fiscal policy changes as aspects of supply chain management performance. Other statistical methods can also be explored, which give more accurate results.

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