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# Supply Chain Management Performance Improvement in Automotive Industry: A Comprehensive Review

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**Abstract.** Industrial management focuses on designing and managing industrial systems that effectively utilize people, resources, and energy. In today's competitive landscape, companies are increasingly adopting scientific methods to enhance customer satisfaction and improve the quality of goods and services. To achieve this, businesses must not only retain their clients but also foster loyalty. The manufacturing sector, in particular, has excelled in consumer satisfaction. Despite the longstanding emphasis on product design as a key factor influencing process design in operations management literature, the direct and indirect impacts of product design on process and supply chain activities have received less attention. This review article investigates supply chain management in the manufacturing industry of developing countries, with a focus on India. India's automobile industry has made significant strides by adopting new technologies and global best practices. However, there is a pressing need for OEM channel partners to implement more effective and pragmatic supply chain strategies. This article examines the critical role of industrial computing in sectors such as aerospace, automotive, and electronics within the Indian automotive supply chain, covering aspects from raw material allocation to production and delivery. The study contributes to the operations management literature by providing an in-depth analysis of the manufacturing industry's interaction with lean practices. It offers a detailed implementation process and analytical framework to guide future research and managerial strategies for enhancing supply chain capabilities in a global, dynamic environment. This research provides a foundation for industrial managers to understand practice interrelationships, thereby improving the likelihood of successful supply chain management implementation.

**Keywords:** Aerospace, Automotive, Electronics, Industry Management, Lean Manufacturing, Manufacturing, Production, Quality, Supply Chain Management.

## 1. INTRODUCTION

Management is the process of creating and maintaining an internal environment in which individuals working in groups can function efficiently and effectively to achieve group objectives. Industrial management has evolved into a discipline of engineering that enables the design of management systems and their integration with people and their activities to maximise resource utilisation. It is a method for organising and managing an organization's operational activities. Industrial management is concerned with the design, building, management, and application of scientific and engineering principles to improve all aspects of the industrial infrastructure and operations [Obradović et al., 2021]. The core role of industrial management is management, and it is primarily concerned with the design of systems. The competitive landscape of manufacturing industries has changed dramatically as a result of global rivalry. Firms must set strategic goals that, if met, will give them a competitive advantage in the marketplace. Industrial Management is still widely exploited in manufacturing plants and industries today. In today's world of cutthroat competition at all levels of operations, a business should manufacture goods and services with the needs and satisfaction of the potential client in mind. Manufacturing and industrial production managers are in charge of the production process's labour, materials, and mechanical or technological logistics [Molka-Danielsen et al., 2018].

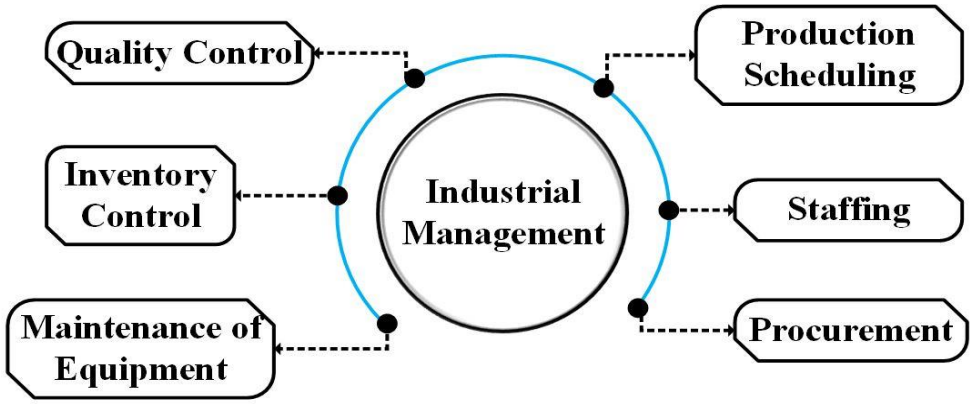


**Figure 1:** Industrial Management

Production scheduling, staffing, equipment procurement and maintenance, quality control, inventory control, and coordination of factory operations with those of other departments are some of the common areas of responsibility on the production floor which is depicted in Figure 1. The deployment and manipulation of human resources, financial resources, technology resources, and natural resources are all part of resourcing. Industrial management is concerned with people in the industry, besides materials and energy, to increase production. A person in charge of industrial management is required in every organisation. Productivity measures can be looked at in aggregate (over the entire economy) or by industry to examine changes in labour growth, wage levels, and


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technology advancement.

### 1.1. Applications of Industrial Management

Industrial management enables any industry vertical to grow at a quicker rate by maximising output at the lowest possible cost and maximising resource use. The use and scope of industrial management were first limited to the manufacturing industry. Construction and transportation, farm operations, air-line operations and maintenance, public utilities, and government and military operations are all examples of non-manufacturing activity. The goal should be to produce items at the lowest possible cost while ensuring the highest level of customer satisfaction. The following section is where Industrial Management is served [https://www.coursehero.com/file/83652188/APPLICATIONS-OF-INDUSTRIAL-MANAGEMENTdocx/]

**Design and Development:** The marketing function, in numerous fields of engineering, such as plant engineering, manufacturing, and engineering, including production engineering, play an important role in product design and development. If the production design is poor from a production standpoint, it may necessitate significant changes to the manufacturing process in terms of equipment, materials, and manpower. If the design is good, production costs may be low enough to boost a company's profit margins significantly. The importance of good and effective product design is fast becoming apparent, and companies who are successful in a competitive market try to utilise design aspects that lower production costs or develop product features that appeal to a wider market.

**Plant Layout and Material Handling:** The physical layout of industrial components and the equipment utilised to handle materials throughout the manufacturing process has a significant impact on production costs. For the given situation, the material handling system and plant structure should be the most efficient.

**Method Study and Work Measurement:** The link between the production of goods and services and the input of human and material resources is investigated using method study and measuring techniques. It is possible to accurately measure and control the labour component if the material, including scrap and waste, can be accurately monitored and controlled. The challenges of assessing labour efficiency are more challenging than measuring the material economy, but they are not insurmountable. The measurement should attempt to determine the most appropriate manner of completing various operations in a production system to maximise resource utilisation and the man-machine relationship to boost productivity. However, higher productivity and total production line efficiency are the most important aims for practically all manufacturing businesses.

### 1.2. Role of Manufacturing Sectors in Industrial Management

Any industrialised country's manufacturing sector has played a critical part in its growth and development. Manufacturing is at the forefront of rising and developing economies' economic growth strategies. Manufacturing's percentage of GDP is thus a primary indicator of the sector's importance in a country's economy. Furthermore, the traditional stages of development of any country, from primary to secondary to tertiary, determine the different stages of manufacturing growth, from low to peak and then declining, though there are still variations in the growth trajectory as the development process may pursue different routes for economic progress of individual countries [Kumar et al., 2019]. Manufacturing accounts for 14 percent of India's GDP in recent years. Comparable figures for advanced and developed countries such as Germany, the United States, South Korea, and Japan are 19%, 11%, 25%, and 21%, respectively. The corresponding percentages for emerging and developing countries like China, Turkey, Indonesia, Russia, and Brazil are 27 percent, 19 percent, 20 percent, 13 percent, and 9 percent, respectively, while low-income countries have an 8 percent share. Production has increased by 4.3 percent in developing and emerging industrial economies, however with greater volatility over time. Industrialized economies, on the other hand, have been growing at a steady rate of 3.2 percent since the first quarter of 2021, surpassing their pre-pandemic output levels.

**Table 1:** Leading Countries on Manufacturing Output.

| Country | Manufacturing Output (USD in billions) | Percent of National Output | Percent of Global Manufacturing |
|---|---|---|---|
| China | $2,010 | 27% | 20% |
| United States | 1,867 | 12 | 18 |
| Japan | 1,063 | 19 | 10 |
| Germany | 700 | 23 | 7 |
| South Korea | 372 | 29 | 4 |
| India | 298 | 16 | 3 |
| France | 274 | 11 | 3 |
| Italy | 264 | 16 | 3 |

China accounted for 28 percent of global manufacturing output in 2018, according to figures provided by the United Nations Statistics Division. Leading countries of manufacturing output in the year 2018 are stated in table 1. This locates China more than a 10 % point ahead of the United States, which had the world's largest manufacturing sector until China surpassed it in 2010. Manufacturing production in the Americas (of which the United States represents 72 percent) will expand by 4.6 percent in 2022. Asia, except for India, has fared the best in terms of manufacturing during the pandemic. Manufacturing is expected to expand by 7% in 2022, while machinery is expected to grow by 6.5 percent. The footwear business, as a manufacturing sector, uses a variety of

materials, goods, and resources to create a wide range of products. Consequently, in the domain of coordinated research, the sustainable growth of the manufacturing sector becomes an essential concern for academia, business, and government [Govindan et al., 2020]. More crucially, developing instructional material suitable for educating the future generation of engineers and scientists, and also retraining the current workforce, has become critical. Mechanical manufacturing is the foundation of any manufacturing industry. As a result, the purpose of this study is to scrutinize and identify risk issues with their impact on the performance of a corporation based on Indian mechanical industries.

## 2. SUPPLY CHAIN MANAGEMENT PROCESS

From raw materials extraction to customer purchase, Supply Chain Management (SCM) encompasses all actions required to get the right product into the hands of the appropriate consumer in the right quantity and at the right time. Planning and forecasting, purchasing, product assembly, transporting, storage, distribution, sales, and customer support are all part of the SCM process. SCM professionals are active in every aspect of the company process to gain a long-term competitive advantage by designing and delivering goods that are better, faster, and less expensive. Professionals in supply chain management work for a variety of enterprises, including manufacturers, merchants, transportation companies, third-party logistics companies, government agencies, and service companies [Khan and Yu, 2019]. SCM graduates are sought by companies in all sectors of the business from all around the world. Purchasing, logistics, new product development, global sourcing and procurement, quality management, inventory control or traffic analysis, operations, and supplier relationship management are all areas where a supply chain expert could work. Today's global business climate is characterised by competitive pressures and intelligent clients who undertake inventive and prompt responses. Understanding and optimising company processes are critical to success, which is why supply chain experts are in high demand.

Furthermore, supply chain sustainability, which encompasses environmental, social, and legal concerns, plus sustainable procurement and the closely related concept of corporate social responsibility, which assesses a company's impact on the environment and social well-being, are major concerns for today's businesses [Zimon et al., 2020]. Sustainable supply chain management (SSCM) encompasses all operations that contribute to lowering product carbon footprints and improving ecological, environmental, and social well-being. Supply chains have taken sustainability as a concept, which has now grown into the theory and practice of sustainable supply chains (Dubey *et al.*, 2017). One of these is the ecological modernization hypothesis, which states the monetary benefits of taking ecological factors into account. Although sustainable supply chain management was developed to address environmental and social challenges, it has the potential to provide considerable long-term benefits to the company. To maintain track of their supply chains and create resilient and sustainable supply chains (SSCM) for the future, the company can avoid or minimise these difficulties. Many firms in India have continuous SSCM processes; nevertheless, there are few studies in the literature that look into firm financial performance and its relationship with supply chain sustainability, particularly in developing countries.

### 2.1. Requirement of Supply Chain Management in the Manufacturing Industry

In industrial supply chain management, time and money are two elements that are critical to the operation's success. Though this remark applies to many other businesses as well, in the manufacturing industry, spending the time and money properly is very vital. Depending on the size of the operation and the severity of the error, a single blunder or setback can cost a corporation thousands or even millions of dollars. Manufacturers must simplify their supply chain management (SCM), or the processes that help them make their supply chains as efficient as possible, to avoid these costly or time-consuming errors. Manufacturers can also use SCM systems to collaborate with the engineers who design their products, allowing for more efficient communication and production. The most essential portion of the industry is the production and manufacturing sectors [Javaid et al., 2021]. Electronics, Aircraft Production, Automobiles, Chemical, Petrochemical Production, Computers, Consumer Electronics, Electrical Equipment, Heavy Machinery, and Refined Petroleum Products are the subsectors of this sector. Mechanical parts, which are mostly made of metallic pieces, are found in the majority of industrial equipment. Wear and corrosion are the key life-limiting concerns for equipment. Corrosion prevention is primarily reliant on maintenance painting. Manufacturing companies, notably vehicle manufacturers, have long recognised the value of these systems, as they must maintain cost control at all stages to remain competitive. The process of supply chain management in the manufacturing industry is illustrated in Figure 2.

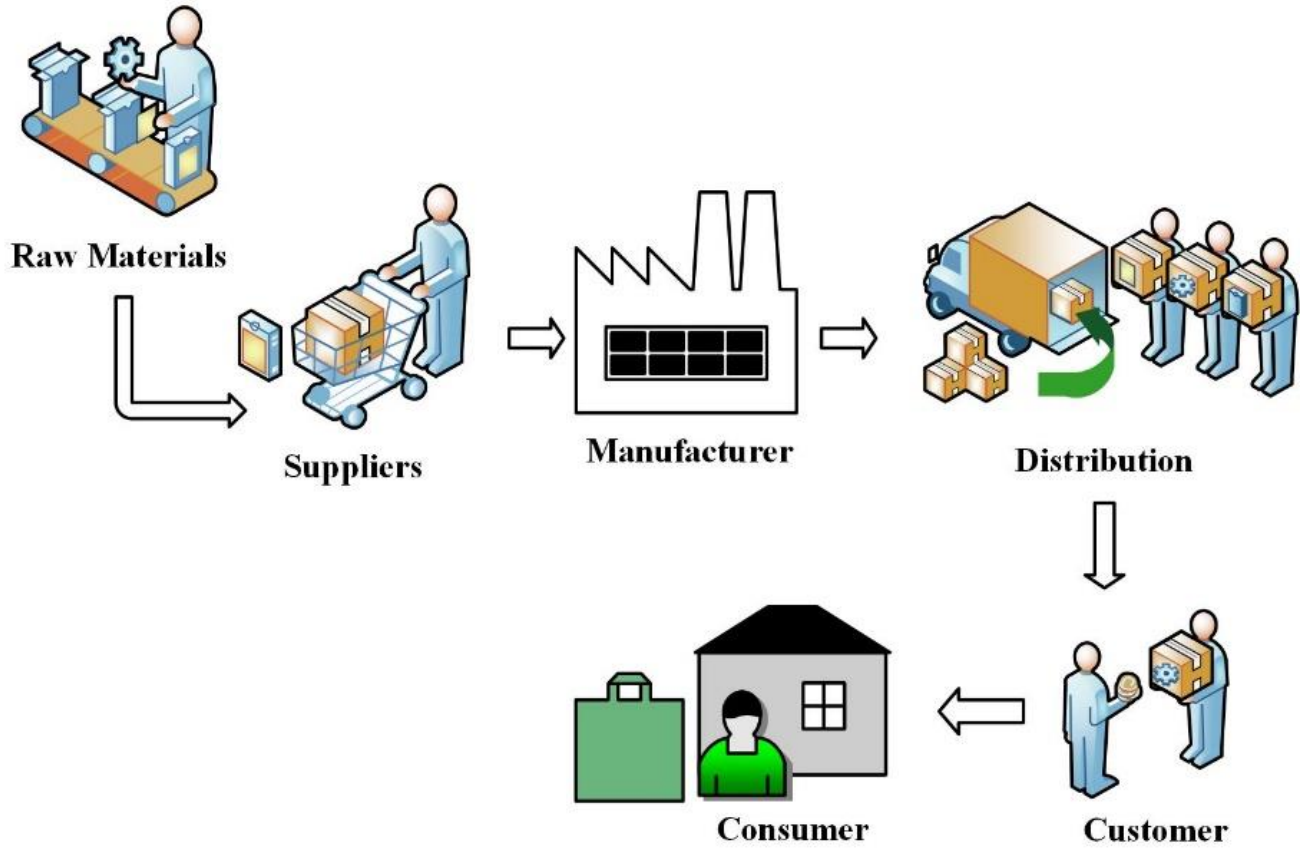


**Figure 2:** Supply Chain Management in Manufacturing Industry.

Manufacturing enterprises are currently facing new issues as a result of global markets, higher competition, and prolonged SCs. In the pursuit of operational excellence, the need to minimise waste, embrace new technology, improve supplier/customer interactions, better manage inventories, comply with regulations, and be more cost-effective is becoming more apparent. The effect of an SC disruption will have varying amounts of impact on each member of the SC due to the extensive linkages among its components. If the disruption is not handled immediately, it will cause some production activities to terminate. Any well-functioning firm needs an efficient supply chain, but supply chain management in the manufacturing industry is even more vital [Lengyel et al., 2021]. Supply chains can connect data or ideas, connect people through communication systems, or focus on the production of a real product. The end goal of any supply chain, though, is a happy consumer.

### 2.2. Product Design Characteristics and Supply Chain Complexity

While manufacturing processes are still significantly reliant on the sort of production they perform, the supply chain is equally reliant on the processes that deliver the product to the supply chain. Manufacturing processes have been defined as being heavily influenced by both product development and supplier network efficiency, making product, process, and supply chain link predictable and circular. Companies must decide the best strategy to meet consumer expectations when constructing the supply chain. Companies have recently realised that changing the design of products and processes to better suit customer requests is a key component of improving supply chains. For decades, operations management literature has emphasised the importance of product design as a primary predictor of process design, but the direct and indirect effects of product design on process and supply chain activities have become less attention. The work by Prem Chhetri *et al* [Chhetri et al., 2021] examines the alignment of supply chain complexity with product demand and design characteristics and formulates effective supply chain alignment techniques. A taxonomy is proposed based on the findings to give a reference frame for practitioners to develop appropriate alignment techniques to manage or mitigate risk associated with expanding supply chain complexity. Xufeng (Rax) Yao *et al* [Yao and Askin, 2019] deal with the complications that arise across the complete life cycle of different product kinds, from product design to sourcing, production, marketing, and recycling. Melek Akn Ateş *et al* [Akın Ateş et al., 2022] analyse the relationship between supply chain complexity and corporate performance. While the majority of evidence from prior studies indicates that supply chain complexity is harmful to firm performance, the findings show that while supply chain complexity is averse to operational success, it is beneficial to innovation and financial performance.

Judit Monostori *et al* [Monostori, 2021] measures for characterising both structural and operational robustness/complexity of supply chains are offered to balance these characteristics and compare different supply chain configurations in a trustworthy fashion. Mohit Goswami *et al* [Goswami et al., 2021] develop an analytical methodology for identifying product design concepts that are associated with lower supply chain risks, which is usually a result of both technical and commercialization concerns. Hugo *et al* [DeCampos et al., 2022] examine

how the number of products a focal firm produces, the number of suppliers it uses, and the number of customers it sells affect its financial performance (ROA and ROS). To understand the significance of product complexity in shaping the interaction between upstream supply chain visibility (resources and capabilities) and the social, environmental, and economic performance dimensions, Rameshwar Dubey *et al* [Dubey et al., 2020] use a contingent resource-based view theory perspective.

### 2.3. Trends in Supply Chain Management

Supply chains are efficient networks of businesses that participate in a certain product or service value chain (Stevenson, 2007). Through market processes, contracts, and partnership agreements, firms in a supply chain coordinate and share benefits, resulting in increased efficiency for all parties. In today's difficult economy, the struggle between huge firms has long been extended to supply chain actors. Several significant themes in supply chain management have emerged during the last several decades. According to supply chain academic David Simchi-Levi, it was just-in-time production in the 1980s, supply chain collaboration and the outsourcing of logistics activities in the 1990s, and internet application in the 2000s (Hopkins, 2010). The supply chain design will become more important than ever in the future to total organisational performance and efficiency, and it has obtained a lot of attention in the literature. Six major issues in the competitive global market have impacted supply chain design for many multinational corporations (MNCs) over the last several years [Park and Lee, 2021]. Among the changes are:

- Globalization that produces longer and longer lead times in production
- Reduced product and transportation costs lead to firms taking advantage of economies of scale by shipping huge quantities of products from overseas, resulting in higher logistics costs and big inventories.
- A long and geographically diverse supply chain that is vulnerable to a variety of challenges and risks
- Significant increases in labour costs in developing countries (for example, 20% in China vs. 3% in the United States), reducing labour cost savings in these growing organisations over time.
- As rules change, firms must consider the number of carbon emissions produced by their supply chains, causing them to focus on green supply chains and long-term sustainability.
- Commodity price volatility (e.g., coal, gold, oil, steel) leads to market shifts in commodity procurement (long-term vs. short-term commitment).

## 3. DEVELOPMENT OF SUPPLY CHAIN MANAGEMENT IN VARIOUS MANUFACTURING SECTORS

Nearly all of the physical items and systems around the world are designed, developed, and constructed using fundamental principles. Automobiles, machines in all types of manufacturing units, and machinery used in building construction, road construction, agriculture, and so on are examples of these devices. Aircraft, vehicles, chemicals, clothes, computers, consumer electronics, electrical equipment, furniture, heavy machinery, refined petroleum products, ships, steel, and tools and dies are among the most important manufacturing industries. Automobile production, electronics manufacturing, and aerospace industry manufacturing involve hundreds of parts from a variety of suppliers; supply chain management is a vital aspect of the industry's operations management and a critical factor in the automakers' success or survival.

### 3.1. Electronic Parts Manufacturing Industry Supply Chain Management

Many firms employ Electronic Manufacturing Services (EMS) vendors as a strategic method to minimise time to market, cut costs, improve quality, and boost customer satisfaction. Prior to the 1980s, EMS were mostly employed to save labour costs and increase manufacturing capacities. All board designs, components, and testing were provided by EMS customers [Valverde and Saadé, 2015]. Due to the rapid growth of electronic manufacturing in the 1980s, EMS providers expanded their services to include not only consignment but also complete turnkey services such as product design, materials management, final assembly, and, in certain cases, after-sale services. EMS providers manufacture about 60% of all products for the computer and consumer products industries. Automotive, communications, medical, and office equipment are among the other industries that use EMS. Production of electronic products supply chain management in EMS is depicted in Figure 3.

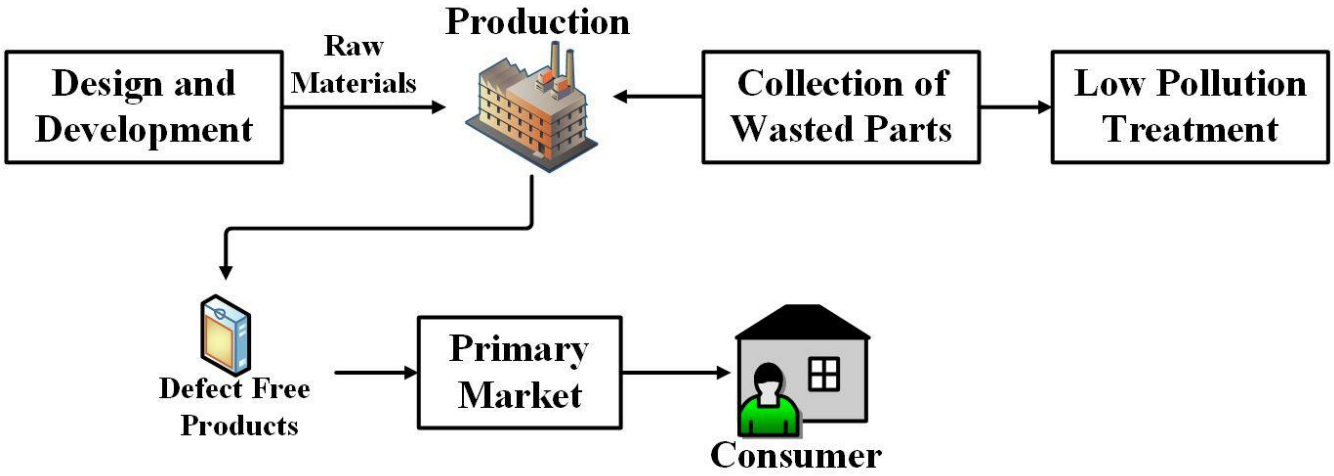


**Figure 3:** Electronics Products Supply Chain Management.

In the example of the electronics sector in India, Rakesh R. Menon *et al* [Menon and Ravi, 2021] identify and analyse the main challenges to sustainability implementation. The Interpretive Structural Modeling (ISM) methodology is worked to determine the hierarchical structure and interrelationships among these barriers. The PSO inventory strategy was established by Ajay Singh Yadav *et al* [Yadav et al., 2020] for resellers of electronic component warehouses in the electronic supply chain. This technique is often managed to assess the efficacy of administrative strategies. The proposed artificial bee colony (PSO) algorithm uses current stock to find the best product at the moment of the order. Ramesh KT *et al* [Ramesh and Sarmah, 2020] examine the impact of systematic supply risk management (SRM) on buyer business performance, with a particular focus on the Indian electronics industry. Mohd Shahril Abu Hanifah *et al* [Shahril Abu Hanifah and Ismail, 2020] sought to establish the prevalence of fatigue among shift employees in Malaysia's electronics manufacturing industry and to explore the factors that contribute to fatigue. Intervention programmes may help to lower the risk of fatigue and its consequences. Sherif Barrad *et al* [Barrad and Valverde, 2020] study the impact of e-supply chain management systems on the operations and business models of the electronics manufacturing services (EMS) industry in North America. To establish the influence of e-SCM on their major supply chain operations and business models, a causal and descriptive research study was undertaken based on a survey administered to 36 persons in EMS organisations.

### 3.2. Automobile Industry Supply Chain Management

Automotive Supply Chain is a type of supply chain management that focuses on the automotive industry. This is linked to complete cycle chain management, which begins with the delivery of raw materials from suppliers and ends with the distribution of items to customers. The automotive supply chain, which manufactures automobiles, trucks, and other vehicles, is one of the world's most complicated. It's also getting more global, only to the electronics industry in terms of global suppliers, manufacturers, and other third parties. Globalization adds a level of complexity to the automotive supply chain that requires vehicle manufacturers and brands to come up with realistic solutions. Globalization isn't the only thing causing problems for auto suppliers and manufacturers. The vehicle supplies chain network for raw materials, parts, and finished autos is impacted by changes in production methods, consumer demands, and new, disruptive developments. Automotive supply chain managers must decrease costs, optimise manufacturing and distribution, and ensure that components and products reach the correct organisations at the right time due to both internal and external influences.

The automobile industry has been forced to optimise its supply chains by the demanding and competitive environment (Zhu & Zhang, 2018) [Ren et al., 2019]. The automobile industry has evolved to be a substantial contributor to the global economy, with over 95 million vehicles produced each year (International Labour Organization, 2020). Approximately 20 million automobiles are produced in Europe, and the automotive industry, directly and indirectly, employs 14.6 million people, accounting for 6.7 percent of European employment (European Automobile Manufacturers Association, 2020). According to the European Automobile Manufacturers Association, the European automotive industry directly generates 11.5 percent of manufacturing jobs and 7% of total GDP in Europe [Pavlínek, 2017]. Sweden is one of the countries where the automobile industry is at the top of the list of important economic sectors (BilSweden, 2021). The automotive industry is the country's major source of exports, accounting for 15% of all items exported. Manufacturing accounts for 13% of the total value created.

### 3.3. Aerospace Industry Supply Chain Management

In terms of market structure and production system, the aerospace industry is one of the most international. The aviation sector has offered innovative solutions to develop its goods through aircraft development projects. The importance of the partners involved in the development projects for the next generation of aircraft is growing. For big enterprises in the business, supply chain management has become a critical issue. The supply

and administration of design and production are the most complicated aspects of this sector. These issues have grown increasingly sophisticated worldwide in the recent decade. The introduction of new technology, moreover expansion and compliance needs, have complicated supply chain management (Mayer, 2014). It is also critical to maintain effective communication throughout the programme stages to define requirements and demands. Claude Serfati *et al* [Serfati and Sauviat, 2019] demonstrate the profound changes in the strategies of major French automotive and aeronautical TNCs, particularly in the administration of their R&D, in relation to the appeal of IA to financial investors. The kinds of AM technologies that are routinely utilised to create metallic parts are described by Shahir Mohd Yusuf *et al* [Mohd Yusuf et al., 2019]. The evolution of metal additive manufacturing in the aerospace sector from prototyping to manufacturing propulsion systems and structural components is also discussed. When suppliers build joint ties with the buyer's competitors, Ulrich Schmelzle *et al* [Schmelzle and Mukandwal, 2022] explored the performance effects. The data is analysed using an unrelated regression approach (SUR), which is followed by endogeneity checks of the empirical findings. To maximise the SCP, Hao Wang *et al* [Wang et al., 2019] combine a multi-agent simulation model with a reinforcement learning-based dynamic inventory replenishment method. An aerospace manufacturing case study was adopted to demonstrate the method. Rakesh K. Mudgal *et al* [Mudgal et al., 2009] suggested the supply chain management (SCM) methods affecting customer responsiveness, and their findings have been experimentally validated using a conceptual framework. The responses were analysed using structural equation modelling (SEM) and bivariate regression on a sample of 433 employees from ten Indian automobile and aerospace manufacturing companies.

## 4. SUPPLY CHAIN MANAGEMENT IN THE INDIAN MANUFACTURING INDUSTRY

In several business industries, India has proven to be a reliable partner. India, with a population of over 1.3 billion people, has the workforce and resources to quickly ascend the list of top manufacturing countries in the coming years. Although India is primarily recognised for its IT labour support or customer service centres, the country's manufacturing output was $412 billion in 2018. India's manufacturing industry is expected to develop as corporations diversify their portfolios as they expand globally. The manufacturing sector is an important part of the country's industrial progress, as it contributes to the country's economic development and employability. Indian manufacturing businesses, on the other hand, are quickly expanding in the worldwide market. In recent years, the Indian automobile sector has developed and demonstrated extraordinary growth potential. This has been made feasible primarily as the Indian middle class's living standards have improved and their disposable income has increased. The government of India's liberalisation initiatives, such as lowering import tariffs and fine-tuning banking laws, have also played a key part in propelling the Indian automotive industry to new heights. India is the fourth largest and fastest expanding passenger car market in Asia, the second-largest two-wheeler market, and the largest three-wheeler market in the world, according to the Automotive Components Manufacturers Association (ACMA) [Nagamani and Muthusamy, 2018].

**Table 2:** Acquisitions Made by Indian Auto Companies

| Company | Acquisitions Made |
|---|---|
| TATA Motors | Daewoo commercial vehicle plant, S. Korea, Ford U.K. |
| Bharat Forge | Scottish stamping ltd., Scotland<br>Fedral Forge, USA, Imatra Kilsta AB, Sweden,<br>Aluminium technik, Germany |
| Mahindra and Mahindra | Sar Auto products ltd., Jianglang Motor company, China |
| Sundram Fastners | Cramlington Forge, UK, Greenfield plant, China, Precision forging, UK |
| TVS Group | CJ components in the UK, RBI auto parts, Malaysia |

The enhanced performance of the auto components segment has made the export boom in the vehicle sector conceivable. The acquisition made by Indian auto companies is stated in table 2. The top rung manufacturers in the component sector made a frantic attempt to overcome the low domestic market in the late 1990s by tapping the export market and improving quality and competitive potential. Exports also resulted in increased profit margins. According to the ACMA, component exports surpassed the US$1.8 billion mark in 2005. By 2010, it is predicted to be worth $6 billion, and by 2015, it will be worth $25 billion. Acquisitions like these shield corporations against demand changes in different parts of the world. To maintain competitiveness and provide a competitive advantage over other vehicle manufacturers, Indian automobile industries include sustainability into their supply chain processes. Implementation practises in the automobile industry have been explored from many perspectives in previous studies, but none of them has offered more significant approaches. Sachin B. Khot *et al* [Khot and Thiagarajan, 2019] assess the role of supply chain management in India's automobile industry. The overall findings gained from a review of refined articles state that, in nations like India, sufficient management commitment is required for supply chain sustainability and resilience, rather than government rules and regulations. During the lockdown, Tapas Kumar Biswas *et al* [Biswas and Das, 2020] identified five major supply chain bottlenecks for Indian manufacturing sectors, including a shortage of manpower, local law enforcement, lack of transportation, scarcity of raw materials, and a lack of financial flow. Anilkumar Elavanakattu Narayanan *et al* [Narayanan et al., 2018] identify, model, analyse and prioritise barriers to implementing sustainable practices in the rubber goods manufacturing industry in Kerala, India. Analysis of the relationship between 'lean' and 'agile' (leagile) methods by Kaliyan Mathiyazhagan *et al* [Mathiyazhagan et al., 2021] aspects to be a concrete strategy to become more sustainable, particularly in a rising country like India.

### 4.1. Effects of Improving Supply Chain Quality Management in Manufacturing

One tendency in the industry to address these risks is to shift the focus away from cost and toward supply chain resilience and continuity by utilising diverse sources and maintaining some safety stock (Zhang, 2018). Globalization of supply chains in the automobile sector and other industries has resulted in advantages such as lower costs, greater access to a wider range of suppliers, and a larger worldwide market (Kremer, 2020). Supply chain risk management (SCRM) has emerged as a countermeasure to hazards that may have a detrimental impact on the supply chain. Aditya Gautam *et al* [Gautam et al., 2018] inspect the Indian automobile industry's supply chain risk management and quality issues. It was also discovered that the most crucial hazards in the modern Indian automotive supply chain environment include production problems at the supplier end, internal machine breakdowns, and raw material fluctuations. The absence of trust between diverse agents within the supply chain is now a key issue in supply networks. Better relationships can promote trust, which leads to increased flexibility, visibility, and cooperation at many stages of the supply chain. The key characteristics of risk management in the automotive supply chain in Brazil are identified by Rosangela *et al* [Vanalle et al., 2020], which evaluate enterprises in the first and second tiers. Elena Lascu *et al* [Lascu et al., 2021] identify the risks and flaws that affect the success of organisations that provide after-sales services for vehicles. Patricia Cano-Olivos *et al* [Cano-Olivos et al., 2022] provide an action plan for minimising automotive supply chain disruptions in Mexico. It does, however, assist businesses in better preparing themselves to deal with risk, particularly in changing, complex, global, and volatile environments. The surrogate mechanism was described by Liu *et al* (2020) as supervised learning, in which ensembles of decision trees were trained on historical data from SMEs' original equipment makers. After that, the proposed method was tested in a real-world supply chain, where it performed well with fewer forecast errors. Furthermore, the authors created a web-based feasibility tool that allows prediction models to be handled in real-time. Sharma *et al* (2020) did a literature review on machine learning applications for agriculture supply chain performance and sustainability. The benefits of machine learning techniques to attain sustainability in supply chain performance were highlighted in ninety-three research articles that were evaluated for review. Tufano *et al* (2020) provided a data-driven model for the automotive industry that included a machine learning method.


**Figure 4:** Quality Management in Manufacturing Industry

The degree of product quality is a particularly crucial issue for enterprises in the automotive industry, as it is also tied to safety and human life. The factors of quality management in the manufacturing industry are portrayed in Figure 4. The quality of a vehicle's ultimate product is heavily influenced by the quality of its components, which are automotive parts made by various companies. As a result, the quality of each component that makes up the finished product, which is sold directly to the customer, is critical. By addressing the issue of a large number of non-compliant products, Andrzej Pacana *et al* [Pacana and Czerwińska, 2020] streamline and

improve the production process of aluminium pistons for passenger cars. Aris Insan Waluya *et al* [Waluya et al., 2019] consider how product quality and brand image, as mediated by customer satisfaction, influence Indonesian car customers' purchasing decisions. Goran Janjic *et al* [Janjić et al., 2022] presented the quality management model for incoming components that can detect potential problems early in the component porotype generation process. On Toyota brand car buyers in Madiun, Putra Cahya Wijaya *et al* [Hussein and Yuniarinto, 2022] assess the effect of brand experience on brand loyalty both directly and indirectly through customer satisfaction and brand trust. Customer satisfaction is formulated as a linear function by Kameleh Nassiri Pirbazari *et al* [Jalilian and Pirbazari, 2021], and the study attempt to optimal pathways for customer satisfaction from Iranian automobile businesses. This model determines the highest level of customer satisfaction for each year based on the type of car and the period. In a multi-criteria framework, Shahana Althaf *et al* [Althaf and Babbitt, 2021] study the potential supply chain disruption risks in the electronics industry by applying metrics that capture supply, demand, socio-political, and environmental risks to nearly 40 metals and minerals that provide critical functionality to electronic products.

### 4.2. Data Driven Techniques for Production Effectiveness in Manufacturing

The identification and management of risk in the supply chain (SC) are one of the most critical concerns in SC management. The Fuzzy analytic hierarchy process, according to Samira Salehi Heidari *et al* [Heidari et al., 2018], is enforced to estimate the weights of the links between the PLC, OPC, and OPF in the hierarchical structure of the decision issue. In addition, to recognise the priority of ROPs in dealing with performance considerations, the fuzzy technique for order preference by similarity to the optimal solution is consumed. It's worth noting that earlier research hasn't operated a variety of criteria and options to reduce the risks associated with the PLC and OPC components of the SC under uncertain settings. Snezana Nestic *et al* [Nestic et al., 2019] present a fuzzy decision-making model for ranking production processes in the automotive industry from the perspective of quality management. Ilyas Mzougui *et al* [Mzougui et al., 2020] presented a detailed list of specific hazards relating to the automobile industry created to expand the collection of most typically evaluated risks in the SCR assessment. Second, using an integrated Multi-Criteria Decision-Making (MCDM) approach, an alternate method of computing the Risk Priority Number (RPN) is provided within the FMECA framework. The findings of a relevant case study in the automobile industry demonstrate the efficacy of this technique, which adds significant value to those businesses. Chiarini (2020) gave a presentation on how to increase a company's performance by combining Industry 4.0 technologies with quality concepts. The association between quality management principles and supply chain performance has been demonstrated in recent studies (Wankhede, 2020). The impact of supply chain and quality management strategies on a company's operational performance is examined by Hong *et al* (2018).

Ramesh K.T *et al* [Ramesh et al., 2020] propose a system for detecting distinct inbound supply-risk factors and assessing their indicators while taking into account the context. To construct the overall inbound-supply-risk score (ISRS) and prioritise the risk indicators, a hybrid multi-criteria decision-making-based DANP (DEMATEL and ANP) framework is used. In this study, R. Rajesh *et al* [Rajesh, 2020] identified a complicated decision-making dilemma encompassing twelve primary supply chain risks and twenty-one resilient risk mitigation solutions, with an archetypal focus on electronics manufacturing supply chains. In the decision-making of difficult real-world problems, a combination of the Multi-Criteria Decision Aid (MCDA) and Artificial Intelligence (AI) is becoming more common. For quantifying alternative resilient risk reduction measures, a decision support model integrating an amalgamation of grey theory and layered Analytic Network Process (ANP) was exerted. The proposed methodology was also tested in a real-world scenario using an electronics manufacturing company as a case study.

## 5. RECENT DEVELOPMENT OF PRODUCTION MANAGEMENT SYSTEM IN INDUSTRY 4.0

In the current industrial context, Industry 4.0 is rapidly evolving. Several innovative methods have been explored in industries, including smart manufacturing, artificial intelligence, the internet of things, and the cyber-physical system. These methods are chosen in the current situation since they assist industry professionals in making management systems smart and capable of dealing with problems and challenges. Real-time data from manufacturing processes can be collected using these strategies, allowing for faster and more precise decision-making. The combination of lean and smart manufacturing has emerged to meet the production difficulties encountered in operations management [Shahin et al., 2020]. In industry 4.0, smart manufacturing combined with the lean concept aids the management system in providing an intelligent decision-making system. The previous study has identified the challenges and problems in operation management, in addition to the viewpoints, problem-solving keys, and applications for Industry 4.0. Several techniques, such as smart manufacturing, the internet of things, and artificial intelligence, have been utilised to address these issues. These methods have been utilised to improve the efficacy of traditional methods. However, in Industry 4.0, the lean concept is the advanced technique with smart production. Modern firms have adopted a new supply chain concept known as Lean Supply Chain to boost their competitiveness and overall profitability. Inventory flows in a lean supply chain that enterprises have almost little inventory on hand. Supply Chain Management is costly to run, and businesses are always striving for ways to save money to increase revenues. Companies are adopting Lean tactics to improve corporate financial performance as a result of the fiercely competitive market conditions, and

they implement Lean Supply Chain Management.

### 5.1. Lean Supply Chain Management Practices in Manufacturing

Many changes are occurring in markets today, including fierce rivalry, rapid innovation, breakthroughs in manufacturing and information technology, and discriminating customers. The unpredictability associated with volatile market conditions and customer demand has raised the need for manufacturing organisations to embrace new competitive strategies that improve their capacity to respond in a timely and effective manner to a dynamic and interactive environment. These realities have prompted firms to explore innovative supply chains (SCs) that allow for the rapid transfer of high-quality products while increasing their competitiveness. The key challenge for manufacturing organisations endeavour to maintain and improve their competitiveness is to improve the efficiency and efficacy of SCs [Nimeh et al., 2018]. The Lean Manufacturing tool ensures product quality and an efficient method of production and processing.

The application of the lean SC strategy has become a trend in the worldwide market and is one of the most common tactics used by manufacturers. The notion of LSCM was first discovered as an integral feature of the Just in time delivery system in the Japanese automobile industry (Shingo, 1988). The success of Japanese automobile companies piqued the curiosity of western scholars who wanted to learn more about the procedures required to attain manufacturing excellence. The logistics activities cost the manufacturing industry in the United States roughly 30% of the overall cost of the product. The success of LSCM is determined not only by top management decisions but also by the execution technique and the involvement of employees in the implementing company. Matteo Rossini *et al* [Rossini et al., 2021] carry out research on the link between LA and operational performance through the integration of Lean principles and Industry 4.0 technologies. The study employs a multi-stage empirical method and data from over 200 manufacturing companies; one representative from each of the companies was asked to complete a survey on Lean practises and Industry 4.0 technology bundles, with productivity, delivery, inventory, and quality as performance indicators. This study by B. Logesh *et al* [Logesh and Balaji, 2021] analyses the relationship between lean waste and the impact of such waste on green practices. This demonstrates that by reducing lean wastes during production, negative effects on the environment may be decreased, and so green manufacturing can be achieved. Samuel *et al* [Samuel et al., 2021] highlight the use of lean and quality tools for continuous improvement in non-automated electronic repair sectors. To eliminate bottlenecks affecting quality and productivity, two layers of the repair bay procedure were adopted.

The automobile industry's strong competition has prompted corporations to streamline their supply chains and operations, as well as implement Lean thinking. To cut inventory costs, the lean method focuses on decreasing waste, non-value-adding operations, and redundancies (Rossi, 2021). Just-in-time delivery, outsourcing parts of production to emerging countries, and single-sourcing are all ways for streamlining supply chains. Just-in-time provides for low inventories, outsourcing to emerging countries allows for reduced labour costs and allows the organisation to focus on core competencies like R&D, marketing, and design, and single-sourcing allows for order scalability and scale economies. Noelia Garcia-Buendia *et al* [Garcia-Buendia et al., 2021] discussed how Lean Supply Chain Management (LSCM) research has progressed from 1996 to 2018, identifying the main challenges investigated and potential trends. Matteo Trabucco *et al* [Bolcato et al., 2020] explore COVID-19 affects company sustainability by examining performance and organisations might respond to pandemic issues by implementing ad hoc lean SC techniques and investing in digital technologies. This also inspects whether business sustainability, digitalization through mobile apps, AI systems, Big Data, and Machine Learning, helps firms to be more resilient. Varun Tripathi *et al* [Tripathi et al., 2022] propose a framework for cleaner production management in Industry 4.0, based on lean and smart manufacturing.

### 5.2. Comparison Survey Study of Modelling Techniques of Lean Principles in Supply Chain Management

Lean manufacturing is a production process based on an ideology of maximising productivity while simultaneously minimising waste within a manufacturing operation. Lean manufacturing involves completely a lot of techniques and principles, with the suitable ultimate goal: to minimize waste and non-value-added activities at each service or production process to attain the most satisfaction for the consumer. Table 3 elucidates the survey study of lean in the manufacturing industry.

**Table 3:** Comparison Survey Study of Modelling Techniques of Lean in Industry.

| Year | Author | Objective | Tool of Analysis | Level of Analysis | Findings |
|---|---|---|---|---|---|
| 2020 | Rohit Kumar Singh *et al* [Kumar Singh and Modgil, 2020] | Identifying effective performance techniques using a multi-criteria decision-making approach | DEMATEL and fuzzy-VIKOR | Automotive Supply Chain | Assist decision-makers in devising an appropriate strategy for identifying important behaviours that have an impact on the lean supply chain. |
| 2021 | Raed El-Khalil *et al* [El-Khalil and Nader, 2021] | The impact of lean manufacturing, supply chain practices, and sustainability practices on operational performance measures. | Just-In-Time (JIT), 5S, seven wastes, and Kanban | Case Study | When supply chain strategies were combined with sustainability, operational performance improved significantly. |
| 2021 | Naveen Kumar *et al* [Kumar et al., 2021] | Highlights the unique performance measures of sustained lean manufacturing and discusses the value of performance measures (SLM) | Hypothesis testing | Automobile Industry | For the Indian automobile industry, the key initiatives and verticals of SLM are effectively defined. |
| 2022 | Rajeev Rathi *et al* [Rathi et al., 2022] | Using Lean Six Sigma approaches, identify the many types of impediments. | 31 Importance-indexed and CIMTC Lean Six Sigma Barrier (LSSB) | Automobile Industry | According to a CIMTC study, LSSB-4 and LSSB-3 posed a threat to the majority of Indian manufacturing enterprises. |
| 2022 | Prateek Guleria *et al* [Guleria et al., 2022] | Using the six sigma DMAIC tool, reduce faults after eliminating process variation. | There are 33 different types of axles for different vehicles. | Case Study | The lead time was shortened from 12 to 11 days. |

## 6. MULTIPLE ANALYSIS METHOD OF MANUFACTURING INDUSTRY SUPPLY CHAIN MANAGEMENT

A case study is a detailed examination of an uncontrolled environment provided by a corporation or in an academic setting. It's usually exploited to describe something, generate an idea, or test a theory. To compare and evaluate a situation, a case study can focus on one company or numerous companies. It is also feasible to research multiple processes inside a single firm or a single process that is common across the entire industry. Case studies employ a variety of research approaches, including interviews, surveys, and experimental analyses. Validation and acceptance of research credentials are aided by these strategies. In this case study, three approaches of investigation are used: (1) review and analyse of accessible records of preceding manufacturing variations (2) in-depth interviews, and (3) a survey.

### 6.1. Case Analysis with Data Collection Phase

Sudhir D Shivankar *et al* [Shivankar and Deivanathan, 2021] conducted a case study at an automobile firm to better understand how product design changes are perceived in the manufacturing environment. The case study takes place at Tire 1 Company (called ABC Company to protect the company's identity), a supplier of automobile components to OEMs. Figure 5 illustrates the OEM approaches of the industry. The findings of the case study bring attention to the concerns raised, which range from raw material planning to the disposition of modified parts, as well as the requirement for change prediction in the implementation phase across functions and the whole automotive supply chain.

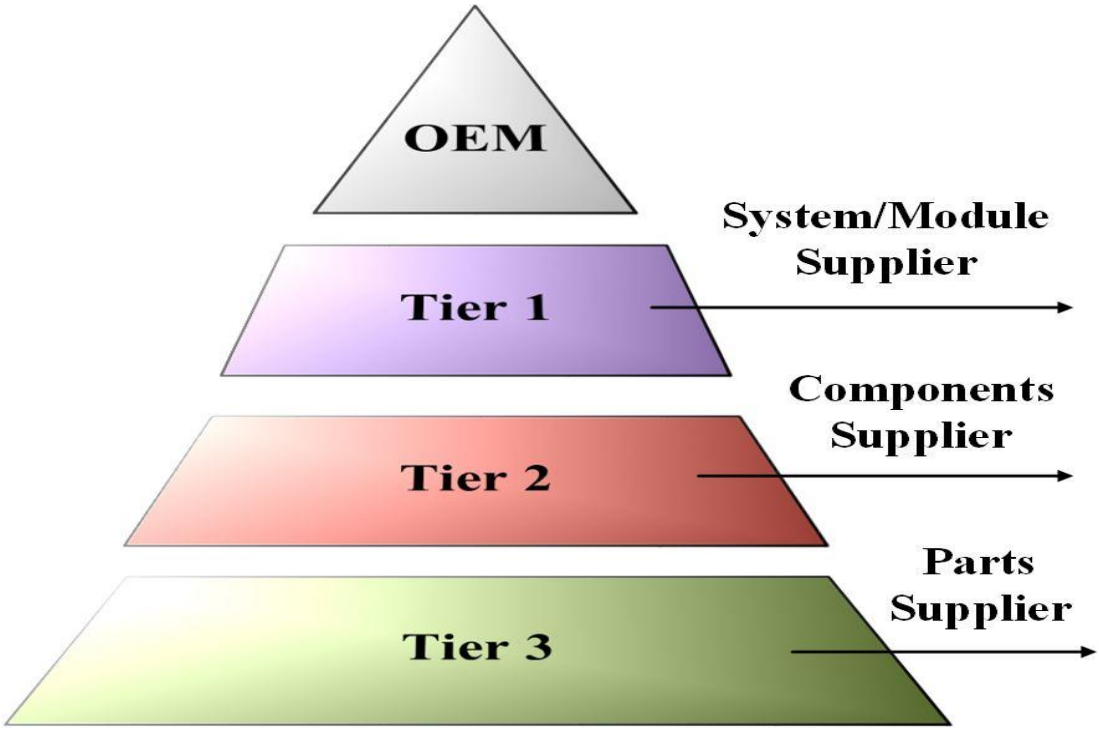


**Figure 5:** OEM Approaches on Tier 1-3.

Atif Saleem Butt *et al* [Butt, 2022] employed a multiple case study methodology to conduct 36 semi-structured interviews with senior executives from nine different companies that produce, procure, or distribute items from China and other heavily impacted South Asian countries (Pakistan, Sri Lanka, India). Using a paradoxical perspective, Axel Georg Zehendner *et al* [Zehendner et al., 2021] initiate an investigation sustainability tensions in electronics SC situations and management solutions. Companies and third-party organisations are applied as embedded units of analysis in a single case study on the electronics SC, which is conducted using semi-structured interviews and publicly available data. The impact of the COVID-19 pandemic-induced supply chain disruptions (SCDs) on the Indian automotive industry was studied by Tapas Sudan *et al* [Sudan and Taggar, 2022]. This was demonstrated through a case study of Maruti Suzuki India Limited (MSIL), which controls approximately half of the Indian automotive market, and included mitigation techniques and the SCDs recovery model. Abdullah Yldzbas *et al* [Yıldızbaşı et al., 2021] suggested the example of firms in the Turkish automobile industry to assess their social sustainability. The case study for assessing Turkey's social sustainability will allow for tremendous progress. To address a sustainable supplier selection and order allocation problem, Hossein Beiki *et al* [Beiki et al., 2021] proposed a linguistic entropy weight method (LEWM) and a multi-objective programming (MOP) method. A real case study of vehicle production is used to demonstrate the applicability of the proposed strategy.

The basis of the Toyota Production System, according to Khakimova Shakhnoza *et al* [Хакимова and Умарходжаева, 2021], is Kaizen: waste reduction and uncompromising concentration on consistently high quality through a continuous improvement process. The findings show how Toyota may use its production system to gain a competitive edge across its entire supply chain. To acquire a clear perspective of the company's actions, the data-gathering technique was to observe and take notes at the same time. To investigate the differences in core competencies and platform strategies, Malagihal *et al* [Malagihal, 2021] utilise a benchmarking technique to compare Tata Motors' passenger car segment performance to that of a similar overseas passenger vehicle manufacturer. Nathania Astria *et al* [Astria et al., 2021] presented a system dynamics approach to model a major private company's supply chain system, which can be simulated under government regulations affecting the palm oil sector and supply chain performance. Amine Belhadi *et al* [Belhadi et al., 2021] employed a sequential mixed-method approach to assess resilience, combining Time-to-Recovery (TTR) and Financial Impact (FI) analysis. In the second step, undertake an empirical survey with 145 companies to assess short-term SCRes reaction methods. This conducted semi-structured interviews with supply chain executives from the automotive and airline industries in the third phase to better identify long-term SCRes response strategies. To improve quality management and reduce the risk of product recalls, Yibin Zhang *et al* [Zhang et al., 2022] presented a holistic supply chain quality management framework based on the interaction between supply chain quality system integration, supply chain relationship quality, and quality performance. The study employs survey data from Chinese makers of consumer electronics, food, autos, pharmaceuticals, and toys to empirically test this concept. A qualitative, applied, and exploratory field research of a Brazilian automaker was conducted by Gabriela Costa Dias *et al* [Dias et al., 2020].

### 6.2. Questionnaire Development Phase

The review article devised a questionnaire after identifying experts to validate the identified probable SC risk factors. The questionnaire is based on the literature review's findings of potential risk variables that are critical to the manufacturing business. The impact of lean manufacturing, supply chain practices, and sustainability practices on operational performance measures is examined by Raed El-Khalil *et al* [Raed et al., 2020]. Based on existing literature and practitioner comments, a survey questionnaire was constructed and delivered to 94 American and European automotive factories. In the context of Chinese manufacturing supply chains, Kumar *et al* [Kumar et al., 2018] determine the role and influence of supply and manufacturing risk management on business performance. A two-phased multi-method approach was used, with semi-structured interviews following a survey questionnaire sent to practitioners in Chinese industrial supply chains. Mia Delic *et al* [Delic and Eyers, 2020] present a conceptual framework for examining the linkages between Additive Manufacturing adoption, flexibility, and performance in the context of supply chains. The study is based on a quantitative approach, with 124 medium- and large-sized European Union car manufacturing enterprises participating in a questionnaire survey. Partially least square structural equation modelling (PLS-SEM) is used to test the hypothesised relationships. Wenbin Ni *et al* [Ni and Sun, 2019] present an integrative approach to understanding how supply chain management affects business performance. The information was gathered in the fall of 2013. The original English version of the IMSS questionnaire was used to create the Chinese version. Due to multiple missing data on questions linked to the issue of interest, 23 cases were removed from the study.

The study by Deepak Mathivathanan *et al* [Mathivathanan et al., 2018] aims to provide a deeper understanding of the interconnected influences across SSCM processes, with a focus on the automobile industry. The study provides a framework model for evaluating the automobile industry's SSCM practises in the rising economy of India, based on the Decision Making Trial and Evaluation Laboratory technique. This discovered inter influences and the prominence of the highlighted practises using a questionnaire survey of the above-mentioned stakeholders. To establish a sustained competitive advantage, Dubey *et al* [Dubey et al., 2018] exploring when and how firms create agility, flexibility, and alignment as separate supply chain attributes. The study used a pre-tested questionnaire to collect 351 usable responses to test the research hypotheses. Debadyuti Das *et al* [Das, 2018] discover the adoption of sustainable supply chain management (SSCM) methods among manufacturing and process-based organisations in India, and their influence on organisational performance across all three sustainability dimensions. A questionnaire was distributed in both offline and online formats to elicit responses from potential respondents. Sourabh Kumar *et al* [Kumar and Barua, 2022] conduct inquires on the petroleum industry's supply chain concerns and build Total Interpretive Structural Models (TISM) of the corporations' and consumers' perspectives on the problems. The questionnaire was discussed with the 114-member decision-making panel, which included specialists from energy firms and government officials. Academics, along with retail entrepreneurs. From the perspective of a client, Kostas Stylidis *et al* [Stylidis et al., 2020] examined qualities. Such knowledge can help improve the efficiency of design processes throughout the early stages of product development. In conjunction with China Euro Vehicle, this technique was tested on 144 respondents who represented the customer's target group.

## 7. IMPLEMENTATION PROCESS IN SUPPLY CHAIN MANAGEMENT

SCM (supply chain management software) is used to control the production of a product from raw materials to the numerous manufacturing and distribution processes till it reaches the consumer. The target of good supply chain management is to keep stocks low while ensuring that product flow is optimised throughout the network. Supply chain management encompasses all aspects of a product's vertical management, from raw material extraction to consumer sale. While this is simpler with a single, vertically organised firm, in most circumstances, numerous organisations are engaged in the product's life cycle, making the process more difficult to manage [Bianchi et al., 2022]. Different Enterprise Resource Planning (ERP) systems are used by manufacturing organisations to assist in the administration of supply chains, sales and distribution, inventories, finance, logistics, and operations, including production and maintenance. ERP systems are also connected with Business Change Management. SAP, Oracle, Infor, SYSPRO, EPICOR, PLEX, Acumatica, Tally, and Horizon ERP are some of the most widely used ERP systems on the market. SAP and PLEX are instances of cloud ERP systems. Despite the fact that many companies have suggested and analysed cloud manufacturing models, manufacturers still find it difficult to implement advanced technology, combine fragmented business intelligence, and collaborate across organisational boundaries.

### 7.1 Cloud-Based Software in Supply Chain Analytics

Cloud-based solutions, also known as Software-as-a-Service (SaaS), can be a cost-effective solution for enterprises, providing real-time analytics and the capacity to swiftly scale up or down. They get regular updates and are serviced by vendors, accordingly it won't need a specialised IT department to keep them up to date. Many companies now provide cloud-based services entirely or in addition to on-site implementation as more of the world's corporate activity migrates online. Aerospace, Electronics, Retail, Pharmaceutical, Food and Beverage, Distribution, and Furniture are just a few of the industries that are already using this comprehensive platform.

These are based on four separate OEM car models in India, Brazil, and Russia. To handle overall operations, including ECM, ABC Company uses PLEX, a Cloud ERP platform. The PLEX smart manufacturing platform connects people, technologies, and equipment to deliver a holistic perspective of the manufacturing industry. The

PLEX smart manufacturing platform can track and analyse data. In the last year, the average change for the door module has been around 100. Changes occur throughout the 'Introduction and Growth' stage of the product life cycle, which lasts for three years after the product is introduced to the market. Faisel Mohamed Elbahri *et al* [Elbahri et al., 2019] provide a comprehensive analysis of the various cloud ERP (Enterprise Resource Planning) systems, also guidance and recommendations for their implementation. SAP, Microsoft Dynamics 365, and Oracle ERP Cloud are the three systems that will be examined. The function of cloud-based solutions in their primary sourcing application is analysed by Prathamesh Sapale *et al* [Sapale, 2018]. This study scrutinize that cloud-based technology can help enhance the supply chain in the oil and gas industry by executing supply-chain transactions, managing supplier relationships, and controlling business processes. Olakunle Jayeola *et al* [Jayeola et al., 2020] study the interrelationships between major contextual elements of cloud ERP adoption and the strategic implications of such adoption in a holistic manner. The utilisation of software packages (SP) aimed at the supply chain management (SCM) sector is investigated by Neelesh Haulder *et al* [Haulder et al., 2019]. The goal is to examine and categorise the various software features provided by various SCM-SPs currently on the market. ERP gathers data from all of a company's functions, providing a holistic view of the complete operation. ERP systems can track supply, requests, scheduling, finished inventory goods, and other essential information needed by management to operate the entire company. Inside a manufacturing organisation, R. Chopra *et al* [Chopra et al., 2019] synchronise activities and processes [Tarun Kumar Kotteda et al., 2022; Tarun Kumar Kotteda et al., 2021].

## 8. CURRENT PROBLEM DEFINITION AND MOTIVATION

The automotive supply chain is one of the most complex supply chains in the world, which has become a multi-national relationship between many suppliers and builders. Nowadays, a car's parts come from several different countries, are assembled in different countries, get shipped to different countries, and are sold in different countries. Conversely, it's not just more digitalization and globalization. Changes in the manufacturing process, consumer demands, how people want to experience services and products, and disruptive trends in the manufacturing landscape have all impacted the automotive supply chain. Meanwhile, in this complex process that moves raw materials from dealerships to the hands of consumers around the world, the automotive supply chain faces many unique challenges. These are only a few of the instances, Poor Visibility of Automotive Parts-81% of the automotive industry is concerned about visibility in the supply chain. Because a car's many parts are either manufactured in-house or sourced from a third-party manufacturer, a lack of visibility can cause significant delays, inventory shortages, and revenue loss. Environmental disruptions, import and export deals, and a global health crisis are just a few of the factors. This can affect a manufacturing plant's ability to operate, source raw materials, and deliver inventory on time. Consumer trends and preferences determine the demand for vehicles. When consumers change what they want or how they want to receive their products, the automotive supply chain needs to make significant shifts to accommodate. Automotive manufacturers have high fixed and variable costs that include machinery, staffing, R&D, suppliers, materials, and shipping. Without high visibility of expenses, it will be hard to determine accurate price points and profit margins. Proper quality inspections ensure that vehicles meet production guidelines and are in excellent condition when they reach the hands of consumers. Lack of auditing can lead to failures and recalls which damage reputation and profit loss.

### 8.1 Challenges Faced By Previous Study

The above work presents various studies and research findings related to supply chain management, quality management, and manufacturing in different industries, particularly the automotive sector. While the research offers valuable insights and contributions to the field, several challenges and limitations can be identified [Ghavidast et al. 2024; Hen et al. 2024]. Many of the studies are based on specific case studies or data from a limited number of companies or industries. As a result, the findings may not be easily generalizable to other contexts or industries. Some studies have relatively small sample sizes, which may limit the statistical power and generalizability of the results. Larger and more diverse samples would enhance the reliability of the findings. While some studies discuss the implementation of specific methodologies or techniques, there is a lack of direct comparisons with alternative approaches or existing state-of-the-art methods. The studies mentioned briefly touch on the integration of artificial intelligence (AI) and Industry 4.0 technologies, but there is a need for more in-depth analysis and investigation of their impact on supply chain and manufacturing management. Many of the studies focus on cross-sectional data or short-term observations. Longitudinal studies that track the changes and effects over an extended period would provide more robust insights into the dynamics of supply chain and manufacturing management. Some studies rely on self-reported data, which can be prone to bias and may not accurately reflect the actual practices or performance. Incorporating objective data sources and validation methods would strengthen the research. The majority of the studies seem to be concentrated in specific regions, such as India and certain parts of Europe. A broader geographical representation would provide a more comprehensive understanding of global supply chain and manufacturing challenges. There is a need for a unified framework or standardized metrics to assess and compare the effectiveness and performance of different supply chain and manufacturing management strategies. While the research discusses various methodologies and practices, there is limited exploration of the challenges and barriers that companies face in implementing these strategies and technologies.

## 9. CONTRIBUTION OF THE STUDY

The automotive sector is currently facing several issues. In terms of cost and functionality, the automotive market has become increasingly demanding. Each manufacturing organisation strives to improve product quality while sticking to a certain production management strategy. Establishing inventory levels across the supply chain in such a way that the intended objectives, such as supply chain efficacy and responsiveness, can be realised, is scientifically difficult. The vehicle supplies chain network for raw materials, parts, and finished autos is influenced by changes in production methods, consumer demands, and new, disruptive developments. Automotive supply chain managers must decrease costs, optimise manufacturing and distribution, and ensure that components and products reach the correct organisations at the right time due to both internal and external influences. Unaddressed risks in automobile manufacturing operations can result in missed production targets, safety issues, and vehicle recalls. Supply chain efficiency management as it stands now is unable to properly control the risk posed by inefficient supply chain management. The main purpose of the study is to improve product quality in the automotive industry to improve supply chain management efficiency.

## 10. CONCLUSION AND FUTURE SCOPE

Environmentally conscious companies may improve their reputation by managing their supply chains. The relationship between supply chain management methods and business reputation, on the other hand, has received minimal attention in study. The influence of each approach engaged in the adoption of supply chain management on reputation is examined in this review article through a longitudinal and quantitative study of risk and quality in diverse manufacturing industries. SCM relies heavily on quality management. Firms must build a good quality management system in their supply chain to ensure a continuous flow of products and information to compete in the global market. Automobile manufacturers have difficult hurdles in improving vehicle quality and shortening the time it takes to produce new products. These demands put a lot of pressure on the PD process to improve customer satisfaction (CS), increase company effectiveness, and generate higher-quality goods with fewer resources and in less time. The quality of business processes has a significant impact on long-term competitive success and development, particularly in the automotive industry. Ninety research publications were chosen for assessment, with the benefits of combining machine learning with lean methodologies to improve supply chain performance sustainability being highlighted. In the manufacturing industry, smart manufacturing implementation with the lean concept aids the management system in providing an intelligent decision-making system. Aside from that, there will be a smooth production flow, increased productivity, lower production costs, employee involvement, order documentation, inventory reduction, and breakdown with greater intra and interconnectivity to make faster decisions. The overall findings gained from a review of refined papers say that, in nations like India, sufficient management commitment is required for supply chain sustainability and resilience, rather than government rules and regulations. The findings of this study will contribute to a better understanding of how effective organisational learning can boost industrial performance. Future expectations in the US have risen to their second-highest level in nearly six years, owing to improved supply conditions, and have risen marginally in the Eurozone and Asia excluding Japan and China. The latter experienced a significant drop in expectations for the coming year.

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