Evaluating the Impact of Demand Forecasting, Warehouse Management, and Supply Chain Visibility Tools on Operational Efficiency in the UK Automotive Industry

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ABSTRACT

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Keywords: Demand Forecasting, Warehouse Management System, Supply Chain Management, Production Planning, Operational Efficiency, UK Automotive Industry, Thematic Analysis, Supply Chain Visibility Tools, Inventory Management, Supply Chain Efficiency.

The purpose of this research is to examine the applicability of Demand Forecasting, Warehouse Management Systems (WMS) and Supply Chain Visibility (SCV) tools toward raising the level of performance in the UK automotive industry. In a highly competitive and dynamic business environment, supply chain management has emerged as one of the most strategic factors to address by leveraging innovative digital technologies. In line with the objectives of the research, the method choice involves a qualitative, secondary data type of research where the data analysis is based on thematic analysis of the findings from the published academic articles, cases and industry reports. Research conducted shows that accurate demand forecasting increases inventory and production planning and control, while WMS helps in warehouse organization, automation and inventory accuracy. SCV tools help in live monitoring, enhanced risk control and management and evidence-based decision making. However, the research also reveals some risks, such as the integration of legacy systems, high costs of implementing block chain solutions and cybersecurity risks. The study thus shows that each tool is beneficial on its own, but when implemented in combination, the greatest benefits are realized. It underscores the necessity of being prepared, aligned and committed to the digital agenda. It advances the field's knowledge of supply chain digitalization and provides recommendations for automotive companies that want to appeal to consumers in a rapidly changing environment.

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ABBREVIATIONS

Abbreviation	Full Form
AI	Artificial Intelligence
DF	Demand Forecasting
ERP	Enterprise Resource Planning
JIT	Just-In-Time
KPI	Key Performance Indicator
ML	Machine Learning
ROI	Return on Investment
SC	Supply Chain
SCM	Supply Chain Management
SCV	Supply Chain Visibility
SMEs	Small and Medium-sized Enterprises
UK	United Kingdom
WMS	Warehouse Management System

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1 Introduction

In today's world of constant technological advancement, businesses compete not on product quality or price but on speed, flexibility and adaptability. Nowhere is this more evident than in the UK automotive industry, a vital contributor to economic development that depends on integrated supply chains, stringent manufacturing tolerances and efficient logistics. Zenghelis et al. (2024) reported that the automotive industry generated £77 billion of revenue in 2023 for the UK economy, proving its significance in industrial production and employment. Nevertheless, increasing market fluctuations, globalization and changing consumer preferences in the current world make traditional supply chain management inadequate to handle today's issues (Brownlow, 2022). According to Mubarak and Khan (2024), issues like production and supply chain disruptions, prolonged lead times and increasing logistics costs make it mandatory for organizations to adopt more efficient and flexible solutions based on data and technology. A moment's delay in ordering or availability of the wrong product could lead to millions lost in sales and lost competitiveness in the market, making the ability to predict disruptions, manage stocks and make decisions in real-time a necessity.

To overcome these challenges, automotive firms are implementing sophisticated digital solutions like demand forecasting, warehouse management systems (WMS) and supply chain visibility (SCV) for efficiency, cost and responsiveness. Demand forecasting helps manufacturers to match production with the market demand to avoid the risks of stock-outs and over-production (Niaz, 2022). The incorporation of artificial intelligence and machine learning in the forecasts improves the forecasting of consumer demand and the supply chain disruptions, making it easier for firms to be prepared (Liu and Panagiotakos, 2022). , WMS enhances the increase in automation of the warehouse, storage and logistic coordination, which leads to a smooth and efficient material flow and minimize wastage (Mocan, 2020). Other SCV tools also strengthen real-time monitoring, predictive analysis and suppliers' cooperation and help firms monitor shipments, minimize losses and gain visibility of the supply chain (Holloway, 2024). Altogether, these technologies are transforming the UK automotive supply chain through enhancing the productivity of the supply chain, widening business flexibility and enhancing operational sustainability (Ahmed et al., 2021).

Nevertheless, some obstacles prevent the large-scale implementation of demand forecasting, WMS and SCV tools. According to Venkatraman (2016), some of the major challenges that many firms

face include high implementation costs, system integration issues and the rigidity of traditional workforce structures, especially among SMEs. Furthermore, the existing IT infrastructure is incompatible with new cloud-based supply chain technologies, which demand reconfiguration and capital (Rosenkranz et al., 2024). Moreover, since the application of technology in business organizations has grown rapidly, risks such as leakage of data, hacking and interruptions in business operations can occur (Perwej et al., 2021). These challenges reveal that there is a growing necessity for better approaches with technology adoption so that the implementation of technology is comprehensible, cost-effective and appropriate to the industry (Gupta and Agarwal, 2024).

Despite the availability of literature about the impact of demand forecasting, WMS and SCV tools on operations, there is limited literature that explores the synergistic impact of all the three elements in the context of the UK automotive industry (Upadhyay et al., 2021). This study therefore aims at filling this gap by assessing the relationship between these technologies and their impact on inventory control, production planning and supply chain processes. Therefore, this research provides useful suggestions and potential regarding SCMs adoption and their implications for the organization's competitiveness and sustainability of the UK auto industry for auto manufacturers, government officials and supply chain managers.

1.1 Background

The UK automotive industry is an influential sector of the UK economy, which in 2023 produced around £77 billion in revenues and makes up 3% of the gross domestic product (GDP) (Zenghelis et al., 2024). This is a rather integrated sector where manufacturers, suppliers, logistic service providers and retailers are involved and must work cohesively to satisfy customer needs and regulatory compliance. Due to the globalization of the supply chain and the advances in technology, operational efficiency is a key success factor in the automotive industry. Companies in this industry have to keep on improving their supply chain management, inventory management and production planning to remain competitive. Nevertheless, the following issues remain constant and cause inefficiencies in managing inventory, work schedules and logistics (Pal, 2023). These lead to such negative effects as production inefficiencies, which contribute to high costs, long lead times and supply chain disruptions that can harm a company's strategic positioning. In the recent past, there have been increased pressures on the automotive industry from the external

environment such as economic factors, geopolitics, environmental issues and the market. The Brexit transition also brought new barriers to trade and challenges to the supply chains of automotive components, which caused disruptions. Likewise, COVID-19 revealed gaps in the supply chain systems and there is a need for better and more flexible supply chain systems (Moinuddin, Usman and Khan, 2024). Moreover, the semiconductor shortage that started in 2021 has had a lasting impact on automotive production as several car manufacturers have had difficulties in production and delivery timelines (Temitope, 2023). Therefore, to minimize these risks, firms have shifted to adopting technological solutions like demand forecasting, WMS and SCV tools.

Technology has played a significant role in changing the supply chain, inventory and logistics of the automotive industry. The integration of digital technologies in supply chain management has allowed organizations to increase transparency, improve resource utilization and eliminate some of the constraints in the supply chain (Minashkina, 2024). Among these solutions, demand forecasting, warehouse management systems (WMS) and supply chain visibility (SCV) tools have become popular since they enhance efficiency in operations and decision-making (Niaz, 2022). The technologies used in demand forecasting help in anticipating the market trends to match the production cycles to the demand cycles. The automotive industry is one of the industries that are sensitive to the demand side because the production of automobiles depends on the economic factors, fuel prices, technological developments and changes in the preferences of the buyers, as noted by Mubarik and Khan (2024). Inaccurate forecasts can create excess inventory or stock-outs, both of which are costly to the business and unsatisfactory to the customers. The adoption of AI, ML and PA in demand forecasting models has improved the accuracy of demand estimates to support better decision-making processes among manufacturers (Liu and Panagiotakos, 2022). Furthermore, AI models use sales, market and other trends to make real-time forecasts that are useful for short-term production and inventory planning (Zaman et al., 2023).

Similarly, WMS or Warehouse Management System is useful in managing the storage of inventory, minimizing time and improving the order picking systems. It uses traditional ways of handling goods normally through manual operations in the warehouse, poor space management and no proper tracking of the inventory hence slowing the flow of the supply chain (Shanmugamani and Mohamad, 2023). WMS has made it possible to have an actual control over

the stock, automatic ordering of the stock and even make analytical predictions for proper storage (Richards and Grinsted, 2024). Besides, robots and IoT smart warehouses have played a significant role in improving inventory management as a measure of reducing cost and increasing flexibility (Wicki, 2020). Some of the current market leaders in the automotive industry, such Jaguar Land Rover UK and Nissan UK currently use AI WMS to increase efficiency, cut expenses and improve the accuracy of its inventories (Vaka, 2024). In addition to demand forecasting and warehouse management, supply chain visibility (SCV) solution have become essential for automotive organization to enhance the visibility and flexibility of the supply chain (Ahmed et al., 2021). SCV tools employ real-time tracking, data analysis and cloud technologies to provide perfect track of inventory, supplier and logistical flow (Baah et al., 2021). Blockchain, GPS and AI have made supply chain tracking possible and helped firms analyse issues and opportunities for improvement to suppliers (Sharma, 2023). SCV tools enhance operational visibility and enable the firm to address market dynamics, production issues and transportation challenges on time (Camur, Ravi and Saleh, 2024).

However, the application of demand forecasting, WMS and SCV tools has operational advantages, but its implementation has drawbacks regarding cost, integration with other systems and employees. The first one is the high capital investment needed to implement technological solutions in organizations (Ali et al., 2024). Several automotive companies, especially SMEs, suffer from financial challenges that do not allow them to invest in AI-based forecasting models, automatic warehouses and real-time SCV systems (Kamble et al., 2023). Moreover, legacy system integration issues arise in implementing new supply chain technologies because most firms still use old ERP systems that do not interconnect with new cloud-based supply chain applications (Hugos, 2024). One of the most significant barriers is the resistance to change from employees, especially at those industries that have applied manual processes and conventional inventory management practices for several years (Rosenkranz et al., 2024). The change of WMS to an automated system and the use of AI-based forecasting models entail a change in organizational culture, training and adaptation of human resources (Walchshofer et al., 2023). Some of the key challenges include operational disruption during the adoption phase due to the time taken to retrain employees to use new digital platforms (Chen, Wang and Li, 2023). Also, there are issues of cybersecurity threats in the digital supply chains since automotive firms are embracing the use of

cloud computing, AI and IoT systems (Hammi et al., 2023). Hacking attacks on supply chain networks, inventory data and logistics applications cause data leakage, system interferences and operational and financial losses (Menghwar and Daood, 2021). The use of digital solutions has been on the rise among firms and this has raised the need for strong cybersecurity frameworks and measures against risks (Gupta and Agarwal, 2024).

While the use of demand forecasting, WMS and SCV tools is on the rise in the UK automotive industry, there is a dearth of studies on the combined effect on operational efficiency. However, there is a dearth of extensive works that focus on the combined impact of these technologies on the overall supply chain performance (Upadhyay et al., 2021). In addition, the current literature mainly addresses the general context of global automotive supply chains while providing limited information about supply chain challenges in UK automotive manufacturers (De Ruyter et al., 2020). This research will seek to fill this gap by assessing the synergistic application of these tools in inventory control, production scheduling and supply chain transparency in the automotive industry in the UK. Thus, filling these gaps, this study will be beneficial for industry practitioners, policymakers and supply chain managers and consultants interested in improving efficiency, minimizing waste and increasing competitiveness in the context of the UK automotive sector.

1.2 Problem Statement

The recognition of the improvement brought about by technology is useful for the modernization of automotive companies in the UK (Brownlow, 2022). However, De Martini (2021) stated, that operational issues continue to be a problem. It was noted that inventory management is a challenge that affects many manufacturers and which results in reduced output and higher expenses. Temitope (2023) established that more than half of the manufacturers face inventory problems. In addition, SCV tools are not optimally integrated into business systems and there is insufficient training of the employees. Such issues indicate the need for a systematic assessment of the relationships between demand forecasting, WMS and SCV tools to establish their impact on the efficiency of operations in the UK automotive sector.

1.3 Research Gap

Although global literature supports the use of demand forecasting, WMS, and SCV tools in improving supply chain performance, there is limited empirical research examining their combined impact in the UK context particularly within the automotive logistics sector. Most studies isolate these tools rather than exploring their interdependencies or cumulative effect on key operational metrics such as order accuracy, inventory turnover, fulfillment speed, and responsiveness to market changes. Furthermore, research tailored to the UK's distinct regulatory, infrastructural, and cultural environment remains scarce. This study seeks to bridge that gap by evaluating these tools collectively, providing practical insights relevant to UK-based logistics and warehouse operations.

1.4 Research Aim and Objectives

To achieve the research aim, the following objectives are outlined:

1. To analyze the impact of demand forecasting on inventory management and production planning.
2. To investigate how warehouse management systems, improve operational bottlenecks.
3. To assess the contribution of supply chain visibility tools to decision making and responsiveness on the supply chain activities from end to end viewpoint.

1.5 Research Questions

This research seeks to answer the following questions:

1. How does demand forecasting affect inventory management and production planning in the UK automotive industry?
2. What is the impact of warehouse management systems on improving operational bottlenecks?
3. How do supply chain visibility tools contribute to decision making and responsiveness the supply chain activities from end to end?

1.6 Research Rationale

These technologies are now embraced as strategic tools that can significantly transform the automotive industry and enhance overall operating efficiency through the application of Demand Forecast, Warehouse management System (WMS) and Supply Chain Visibility (SCV) tools (Minashkina, 2024). These technologies envision solving some of the major problems including inventory control problems, congestion of production lines and poor decision-making. Nevertheless, their application across the industry continues to expand, but their practical usage is highly unpredictable. Issues like inadequate implementation strategies, poor integration with other systems and lack of organizational readiness can be blamed for these discrepancies and further research is needed on this issue (Liu and Panagiotakos, 2022). This is an interesting case for looking at how these tools might be optimised further and tuned to provide the kinds of data required by the particular needs of automotive industry in the UK. The industry is strategic for the national economy and this research therefore seeks to offer practical information on key considerations of sustainability and operational excellence to industry players in light of the current global trends (Siefan et al., 2024). This work aims at arming the manufacturers and supply chain managers with the right information that will enable them increase competitiveness, build market robustness and effectively address the emerging market demands.

1.7 Ethical Considerations

The use of secondary data does not pose a high level of ethical questions as it involves dealing directly with respondents, as it is common with primary research that requires consent and the disguise of identities. Moreover, several important ethical considerations still need to be met so that the research would meet the highest ethical standards of academic research (Glendinning, 2022). First, the suitability of the secondary data source needs to be carefully examined so as not to base decisions on wrong or biased information (Kumar and Adil, 2024). This involves sourcing data from such publications and analyses as those from the government, industry and peer-reviewed publications. However, before using secondary data, several factors must be considered and some of them include. The interpretation of secondary data must be done objectively and without any bias or misrepresentation of facts or selective reporting to create a certain given attitude (Karunarathna et al., 2024). Information collected from these sources will be treated as

confidential and will only be used in the course of this research. The results will be reported honestly so that they will encompass the essence of the work and the sources. Therefore, the study aims at comply with the principles of ethical practices to meet validity, reliability and accountability and generate meaningful and ethically acceptable conclusions to the field of research.

1.8 Dissertation Outline

This dissertation is organized into five chapters, each serving a specific purpose in exploring the impact of demand forecasting, Warehouse Management Systems (WMS) and Supply Chain Visibility (SCV) tools on operational efficiency in the UK automotive industry. Chapter One provides an overview of the research background, outlines the problem statement and sets out the research aim, objectives and questions. It also presents the rationale for the study and discusses ethical considerations related to the use of secondary data. Chapter Two reviews relevant literature, beginning with a theoretical framework such as the Resource-Based View or Systems Theory, followed by an examination of existing studies on demand forecasting, WMS and SCV tools. It concludes by identifying a clear literature gap. Chapter Three describes the methodological approach, explaining the interpretivist philosophy, qualitative design and the use of secondary data sources. It also outlines the data analysis techniques and reinforces ethical practices. Chapter Four presents and discusses the findings, analyzing how each tool influences efficiency and linking insights to theory and literature. Finally, Chapter Five summarizes the research outcomes, offers practical recommendations for stakeholders, highlights the academic and industry contributions of the study and acknowledges its limitations while suggesting areas for future research.

2 Literature review

2.1 Theoretical Framework

The selection of the right theory is very crucial in any SCM research because the theory adopted will determine the direction, which a research will take, as well as the outcome of the research. The choice of theory provides a helpful background as to how several factors apply to operational effectiveness in aiding the assessment of technological enablers in a supply chain. The two major theories that have been employed in the SCM research are the Resource-Based View (RBV) and the Systems Theory (Shibin et al., 2020). These frameworks offer various approaches in developing a better understanding of how technology can be effectively applied in improving the operations. RBV is from the belief that firms must utilize resources within it such as technology and human capital for competitive advantage (Collins, 2022) On the other hand, System theory concerns with how several components of a system are related and how the joint efficiency of all these components can lead to better performance (Sony and Naik, 2020). In this study, these theories will be employed to evaluate the role that the tools like demand forecast, WMS and SCV play in the context of the UK automotive industry.

2.1.1 Resource-Based View (RBV)

The Resource-Based View (RBV) is a popular theory in the strategic management field aimed at explaining the role of resources for a firm to gain competitive advantage. RBV, in contrast, states that an organization's ability to outcompete rivals in the long run requires the use of valuable, rare, inimitable and perishable resources. According to RBV, organizations should develop capabilities that are a source of competitive advantage and difficult for competitors to imitate which are the VRIN capabilities (Zvarimwa & Zimuto, 2022). These may be tangible such as equipment, machinery, buildings, intangible such as cash, inventories and equipment, or human such as skilled labor, knowledge base and goodwill. In the context of SCM, RBV has been widely used to evaluate how resources and technological assets improve operations and organizational performance. Several theorists have stated that organizations that adopt sophisticated supply chain technologies like demand forecasting systems, WMS and SCV have a competitive advantage over organizations that use traditional management approaches (Zaman et al., 2023). These are resourceful technologies that help in the proper management of inventories, efficient management of logistics

and supply chain. For example, Antoni, Jieand Abareshi (2020) argue that SCV tools help to monitor inventory and products' movement in real-time, allowing firms to prevent disruptions. Likewise, the demand forecasting systems enhance firms' capacity to match production plans with customer demand, thus avoiding stock outs and overstocking (Hao, 2024). As VRIN framework highlighted the resources that are inimitable, the organizations which are able to integrate and customize these technologies into their operations gain a competitive advantage which is hard for rivals to imitate.

Some scholars have pointed out that the success of supply chain technologies depends on the fit between the technologies and the organization. As Saqib and Satar (2021) have pointed out, firms in industries with fluctuating demand and extensive supply chain systems, like the automotive industry, need to invest in internal technology and human capital to effectively harness these technologies. This research reveals that the adoption of advanced technologies within a supply chain can only bring the expected benefits when integrated and when there is development of skills to accompany the technologies. On the other hand, the organizations that have integrated digital solutions into the supply chain processes can enhance the efficiency of the processes, reduce costs and increase customer satisfaction, thus strengthening their market position. According to the literature on RBV in supply chain management, firms need to make efforts in continuously innovating, training employees and re-engineering their processes to make the best out of their resources (Zaman et al., 2023).

The second area of concern in relation to RBV in the context of supply chain management is the relationship between technological capabilities and operational flexibility. Companies that use the conventional inventory management systems face issues such as long cycle time, poor forecasting of demand and poor coordination of logistics (Antoni, Jie and Abareshi, 2020). On the other hand, the firms that implement the SCV tools can improve the visibility of their supply chain networks and can adapt to the disruptions and changes in the production schedule in real time (Hao, 2024). This agility is especially crucial in the context of the UK automotive industry where organizations face challenges in dealing with suppliers, customers and production processes. Lack of real-time visibility and predictive analytics can lead to more operational inefficiencies, financial losses and unsatisfied customers. Therefore, RBV offers a solid theoretical framework for explaining how

firms in the UK automotive sector can leverage supply chain technologies as valuable, rare, inimitable and organization-specific resources to improve competitiveness.

Thus, besides technological factors, human factors and organizational culture also have a great influence on the effectiveness of resources deployment. Even though the WMS and demand forecasting systems give firms the insights in an automatic way, the success of these systems depends on how the employees understand and respond to those insights (Sugiarno and Novita, 2022). Zvarimwa and Zimuto (2022) established that organizations possessing skilled human capital and a robust culture of technology utilization realize higher returns on technology investments than organizations that neglect to train employees and transform organizational culture. The RBV perspective also highlights the need to not only acquire superior technologies but also to manage the firm in a way that optimizes the technologies that are available to the employees.

From the point of view of strategic management, RBV emphasizes the need to develop resources as opposed to building on existing capabilities. The UK automotive sector is in transition with changes taking place in the current decade due to digitalization, change in regulations and market forces (Saqib and Satar, 2021). Those organizations that do not change the allocation of internal resources and IT support to supply chain management may be overtaken by competitors who apply advanced supply chain solutions. According to Zaman et al. (2023), firms that adopted technological integration in supply chain management have higher performance than the firms that still use traditional methods. This supports the RBV theory that points to the fact that firms need to develop new and better resources in order to sustain their competitive advantage in dynamic industries.

When analyzing this study using RBV, it is clear that demand forecasting, WMS and SCV tools are not just tools of operations but they are strategic resources that UK automotive firms have to employ in order to increase the efficiency of the supply chain, minimize risks of operations and improve financial performance. This research therefore contributes to understanding how firms can harness these technologies to enhance their competitiveness in the current complex and evolving business environment. The study shall also contribute to the existing literature by showing how RBV may be applied to supply chain digitalization and supply useful insights and a

framework to firms who wish to effectively leverage their internal resources for better performance and supply chain resilience.

2.1.2 Systems Theory

The Systems Theory is one of the core concepts in organizational and management sciences that deals with the interaction of various elements to form a coherent whole that is aimed at achieving a particular goal. While the RBV approach considers resources within an organization as the sources of competitive advantage, the Systems Theory is a more complex approach that recognizes an organization as a system where changes in one part affect the other components (Crawford, 2020). The basis of this theory lies in the concept that all systems are made of a number of sub-systems and for an efficient operation all these sub-systems must work in harmony. In the context of SCM, Systems Theory is quite appropriate because SCM networks are complex systems that involve procurement, manufacturing, inventory management and distribution. The interdependence of the links in the supply chain means that any problem in one link has an impact on the rest of the links making system wide improvement more important than the improvement of specific links.

According to Systems Theory SCM emphasizes the integration of different aspects of supply chain. It is in contrast to the linear supply chain approach that focuses on individual activities, a systemic perspective acknowledges the dynamic interconnectivity between suppliers, producers, logistics service providers and retailers (Jadoun, 2024). According to Alabi et al. (2022), information flow is the most crucial factor to support supply chain connectivity, which enhances timely information exchange and decision-making processes as well as resources management. This correlates well with demand forecasting, WMS and SCV since these technologies enable the flow of information between the nodes to be efficient and effective to avoid disruption of the supply chain. This interdependency of the supply chain elements implies that any disruption in demand forecasting will lead to a corresponding problem in production planning, warehouse management and distribution, all of which are detrimental to the performance of a business.

The systems-based approach to supply chain optimization reveals that the application of technology should not be seen as a standalone but as a set of tools that can support the supply chain optimization process (Moinuddin, Usman and Khan, 2024). For instance, demand forecasting tools

offer actual-time data and forecasts that enable organizations to match inventory and production strategies to the expected consumer demand. In the case of failure to produce accurate forecasts, it may lead to stock-out situations or overstocking, which affects the downstream activities (Ivanov and Dolgui, 2021). Like in WMS, inventory control is a function that helps in the management of warehouse and storage of goods in the right quantity and at the right time. SCV tools complement this integrated system by increasing supply chain visibility, tracking the shipment and improving information sharing between the suppliers, manufacturers and distributors (Alabi et al., 2022). The integration of these technological tools enhances coordination, accelerates decision making and increases the flow of operations in the supply chain.

According to several authors, it is possible to achieve suboptimal outcomes in supply chain management if a systemic approach is not taken despite the technological developments. According to Jadoun (2024), if a firm adopts demand forecasting technologies but at the same time fails to enhance warehouse management and supply chain visibility, then the firm will be inefficient due to the fragmented decision-making system. For instance, if a firm has accurate demand forecasting but it does not have efficient means of tracking the inventory in the warehouse then it will lack the right products in the right place hence takes long time and incurs high handling costs. Similarly, organizations that have adopted WMS but have not incorporated supply chain visibility solutions face issues of inaccurate stock status and logistics because they lack visibility of the supplier's performance and incoming stocks (Crawford, 2020). This is an implication that the implementation of one technological solution without the support of other tools hinders the overall functionality of the entire system, support the argument that Systems Theory can be useful in shaping the framework for the adoption of supply chain technology.

The application of Systems Theory does not only lie in the functioning of SCM as a system but also as a capacity to manage risks and develop resilience. The global supply chain is highly unpredictable and the changes in the economy, politics and other aspects can lead to critical disruptions that affect the business continuity (Ivanov and Dolgui, 2021). The COVID-19 pandemic showed how a disruption in one link of the supply chain, for instance, closure of factories in China affected other links, leading to stock-outs, longer lead times and higher costs (Moinuddin, Usman and Khan, 2024). The challenges that emerged in the supply chain included the ability to promptly alter sourcing, production and inventory distribution and the firms that had put in place integrated systems of supply chain management with real-time data sharing had an advantage in

managing these difficulties. This underlines the fact that supply chain resilience is not about the individual company competence but about the overall system flexibility and integration, which reiterates the key assumption of Systems Theory stating that organizations should be viewed as complex systems.

The use of systems theory in supply chain technology adoption has also been discussed in a number of industry contexts and has shown the efficiency of the theory in explaining the enhancement of organizational performance. Crawford (2020) explored how Systems Theory was used in the pharmaceutical industry where disruptions in the supply chain lead to scarcity of essential drugs. Through implementing an integrated supply chain visibility system, the pharmaceutical firms were able to track the shipments around the world, control production in real-time and manage the relationships with other logistics partners to avoid significant interruptions and shortages in the availability of life-saving drugs. Likewise, Ivanov and Dolgui (2021) revealed that WMS and demand forecasting tools improved inventory management, cut down on unnecessary stock and satisfied customers in the electronics industry. These studies indicate that it is possible to achieve optimal results from technology adoption in various industries, thus supporting the use of Systems Theory to explain supply chain improvement initiatives.

The importance of Systems Theory in the context of the UK automotive industry can be explained by the fact that this sector is characterized by extensive supply chain networks, JIT strategies and fluctuating consumer demands (Moinuddin, Usman and Khan, 2024). Since there are many players in the automotive supply chain including the direct suppliers, logistics providers and manufacturing plants, it is crucial for the firms to have the integrated solutions to manage the supply chain materials, production and distribution. In this research, Systems Theory is adopted as the theoretical framework for analyzing the relation between demand forecasting, WMS and SCV tools in the context of a supply chain environment. It will be seen that these technologies are not individual applications but a handling system that enables firms to link them and instead offer optimum approaches to supply chain management, thus improving efficiency and costs and hence leading to better competitive advantage.

This is also in concordance with the modern industry trends where companies are moving away from the traditional established supply chain structures to lean and dynamic supply chain structures that are tightly integrated with digital elements such that they offer instant interactive and dynamic supply chain networks for decision making and optimization. Thus, due to the application of digital

transformations, the free and efficient transfer of data within the SC is maintained, enhancing the responsiveness and reliability of the business SC network while securing a competitive advantage. The outcomes of this study will thus be useful to the UK automotive firms in the way they implement demand forecasting, WMS and SCV tools in the supply chain networks towards better operational effectiveness, lower vulnerability and enhanced sustainable business performance.

2.1.3 Comparative Analysis: RBV vs Systems Theory

RBV holds useful lessons on how technology enhances the effectiveness of supply chain, even as Systems Theory equally provides useful lessons on the same subject (Huang et al., 2023). However, each of them focuses on different prospects of the supply chain. RBV takes a view inside the firm by stressing on technological capability as the source of competitive advantage through better information processing and resource deployment. On the other hand, Systems theory incorporates the concept of supply chain integration by analyzing the linkages between the supply chain components and the need to optimize the performance of the entire system (Browning et al., 2023). Although RBV is valuable for identifying how firms can utilize technological resources, such as demand forecasting, WMS and SCV tools for performance improvement, systems theory offers a broader view of how these tools can affect the overall effectiveness of supply chains (Odeyinka and Omoegun, 2023). Relating to the issue of the UK automotive industry, both concepts are applicable. RBV can assist in evaluating how the technology, as an internal resource, can be applied in improving the operation capabilities of firms (Abdulkadir, 2023). However, Systems Theory is more suitable for this research because it enables an understanding of how demand forecasting, WMS and SCV tools can be integrated into a coherent system that fine-tunes performance all along the supply chain. Since most of these tools are employed in synergy with other tools to tackle various issues within the supply chain, Systems Theory offers broader perspectives on how their applications affect the overall supply chain operation (Manzoor et al., 2022). By comparing the Resource-Based View and Systems Theory, it can be realized that both of the theories offer useful insights regarding the contribution of technologies in improving operations inside supply chains. However, System Theory is more suitable for this study as it provides a structure to analyses numerous elements that are involved in supply chain relationships (Zampou et al., 2022). Through the use of Systems Theory, this work will examine how demand forecasting, WMS and SCV tools can be combined into a systemic model to obtain efficiency gains in the UK automotive industry. This theoretical perspective will inform the study discovering

how these technologies may be implemented towards improving supply chain functionality and performance.

2.2 Literature based Insights and Evidence

2.2.1 Enhancing Demand Forecasting with Advanced Technologies

One of the highly significant aspects in the automotive industry's supply chain is demand forecasting as it affects the inventory levels, production plans and organizational performance (Gonçalves et al., 2021). Demand forecasts, therefore, help automotive firms match supply with demand, which reduces both stock out situations and overstock situations. This helps in getting the right product mix in the right quantity, time and this eliminates the cost of holding on unsold stocks and cost of delayed production (Halilovic, 2022). In the context of the UK automotive industry, demand forecasting technologies are applied to supply chain information flows to support JIT inventory control as a way of increasing organizational performance. This view is strongly supported in recent empirical literature that highlights the role of technology-driven forecasting in aligning supply with dynamic demand conditions. New technologies in the field of data analysis and artificial intelligence have helped the improvement of demand forecasting methods. AI and big data analytics have helped automotive firms to manage a significant number of data and improve the supply chain responsiveness (Bag et al., 2023). It is for this reason that several predictive models for demand are more useful in the current markets by using machine learning algorithms to analyses sales data, related factors, or current economical and other marketing conditions. These technological advancements have helped organizations to minimize the use of conventional forecasting tools and thus enhance their capacity to predict change in demand and fashion the operations of the enterprise in accordance with the change (Ren, Chan and Siqin, 2020). Multiple studies have empirically validated this shift toward data-driven forecasting in the UK automotive sector. There are several examples on how demand forecasting can be implemented and has proved useful for automotive firms in the UK. For instance, Al-Toubi (2024) described how a major automotive maker in the UK was able to reduce its overall inventory excess by 15% and incipient shortages by 10% having adopted demand forecasting tools based on ML. Gonçalves et al. (2021) provided another example of the implementation of ADF for a UK automotive firm that enhanced supply chain demand planning for higher production and distribution synchronization and subsequently decreased lead time. However, demand forecasting is not

without its challenges. The first problem lies in the uncertainty of demand forecasting that may be unstable because of the shifting of consumers' preferences and unexpected impacts of the economic crisis, catastrophes, or political conflicts (Etemad, 2020). Such risks and limitations are also frequently reported in empirical case studies, particularly to market volatility. In addition, many times planned and actual demand may not match and as a result, the company may end-up with no stock or excess stock. This issue is made worse by the fact that the field of automotive is very much unpredictable due to shifting consumer trends. The third task is to incorporate demand forecasting tools with the existing supply chain applications and infrastructure along with the need for major investments in software and employee education (Islam et al., 2024). Nevertheless, challenges such as forecast inaccuracy are addressed in demand forecasting tools to improve supply chain systems. They are integrated with the warehouse management system (WMSs) and supply chain visibility (SCV) tools to make a more integrated and adaptive supply chain. Existing research suggests that this integration significantly improves supply chain responsiveness, although legacy systems can pose notable technical barriers. However, the integration process can be challenging, especially for the firms operating with legacy systems. To achieve the integration seamlessly, it is necessary to have a strong framework, team cooperation of IT and related workers and the organizational culture of constant enhancements.

2.2.2 Streamlining inventory and Fulfillment with Warehouse Management Systems (WMS)

Warehouse Management Systems (WMS) are crucial for managing inventory, optimizing warehouse operations and improving overall supply chain efficiency in the automotive industry (Mrabti et al., 2024). WMS technologies assist the firms in cutting costs through increasing inventory accuracy, shortening lead times and optimizing order fulfillment (Shanmugamani and Mohamad, 2023). These systems aid in minimizing stock levels, arranging spaces in the warehouses efficiently and the overall picking and packing to ensure that the products such as parts and components are available when required. WMS have potential to minimize the role of human error and enhance operational visibility and this makes productivity and operational efficiency to improve (Deepali, Monika and Dharmendra, 2024). It also may help WMS to minimize operation bottlenecks because all inventory processes are automatized. For example, WMS reduce stock variance and delay in order fulfilment by minimizing manual stock count.

Empirical evidence from the literature, particularly case studies in the UK automotive sector, supports these operational improvements associated with WMS adoption. These studies highlight measurable benefits such as improved picking accuracy, order throughput and inventory turnover resulting from WMS integration. Furthermore, Richards and Grinsted (2024) found that implementing WMS in a UK automotive facility reduced picking errors by 20% and improved throughput by 15%, contributing to a more agile supply chain. Moreover, Wicki (2020) shows that WMS implementation led to a 10% reduction in order fulfillment time and a 12% increase in inventory turnover, demonstrating the significant impact of WMS on operational performance. However, adopting WMS presents challenges, particularly in integrating new systems with existing legacy systems, which can be costly and time-consuming (Axelsson and Aslin, 2022). The initial investment required for software, hardware and training, coupled with staff resistance to change, can delay the full realization of WMS benefits. These challenges are also commonly cited across empirical research, emphasizing the need for strategic change management and adequate resource allocation during WMS implementation. Despite these challenges, successful implementations, such as Jaguar Land Rover's WMS system, have shown the potential for optimising operations. The system enabled inventory management optimization and reduced operating costs but faced integration and staff training challenges (Vaka, 2024).

2.2.3 Enabling Real Time Control through Supply Chain Visibility Tools

Supply Chain Visibility (SCV) tools are vital for improving the transparency and tracking of goods throughout the supply chain (Ahmed et al., 2021). These tools allow tracking of status and location of products to help stakeholders to track the movement of material from suppliers, through production centers to customers. SCV tools use sensors or GPS, barcodes or RFID to inform inventory status, shipment position, or any impending interruptions and thus improve the supply chain's flexibility (Ashfaq, 2022). A number of empirical studies have confirmed these functionalities in practical settings, particularly within the UK automotive sector. The use of SCV tools makes an organization's operations more efficient in decision making, coordination and managing risks. Real-time tracking used in operations management enables businesses to know the areas that are behind timelines and suppliers who are underperforming, as well as situations that require an organization's intervention (Sharma, 2023). By managing uncertainty, SCV tools help the managers to be prepared for any issue likely to arise. Moreover, enhance organizational

processes. For instance, SCV tools enable organizations to change the pace of manufacturing or re-assign delivery paths to keep off time (Dolgui, Sgarbossa and Simonetto, 2022). The use of information systems and technology enhances the flow of communication between the suppliers, manufacturers and distributors hence reducing cases of misunderstandings and hence minimum time is taken on such issues. SCV tools also enhance risk management because firms can use them to track disruptions, for example, transportation delay or strike and make plans for it. These outcomes have been documented across several case studies, validating the effectiveness of SCV implementation in reducing supply chain uncertainties. Literature has presented substantial evidence that SCV tools improve supply chain effectiveness. In a study by Guo et al. (2024), it was established that the tools enhance the accuracy of inventory and the flexibility of operations. In a large automotive firm in the UK, SCV tools cut lead times by a fourth and Stock out rates by an equivalent quarter. SCV tools also contribute to improving the efficiency of suppliers by giving firms current information on quality and delivery of the supplied products so that any problems arising from the suppliers can be dealt with immediately (Siagian, Tarigan and Jie, 2021). The use of SCV tools reflects Toyota's successful application of the real-time tracking and monitoring of stocks. In this way, through SCV Toyota improves its JIT inventory system by determining the location of the part to be delivered at the precise time needed. This visibility minimizes the number of days such products remain in the pipeline and the overall warehousing expenses (Camur, Ravi and Saleh, 2024).

SCV tools are also applied to improve the supply chain coordination of BMW with the supplier and assembly plants for quicker and cheaper production (Wissuwa and Durach, 2023). However, the use of tools in implementing SCV has its drawbacks. Data accuracy is critical since inaccuracy of tracking can harm the decision-making process. SCV tools can also be integrated with other supply chain management systems and this can be challenging for firms that have old systems. Empirical evidence also highlights these limitations, particularly in small and medium enterprises where technological integration and funding are major constraints. It can be seen that integration is a function that demands planning, significant funds to be committed and staff development. In addition, the process of using SCV tools on a global scale proves difficult and could prove to be a challenge to small suppliers or manufacturers that may not have adequate capital to employ or support such systems (Hendrawan et al., 2024).

2.3 Comparative Evaluation of Forecasting, WMS and SCV Tools

Demand forecasting, WMS and SCV tools covered in the paper are all paramount in enhancing the efficiency of the automotive supply chain (Alherimi, Saihi and Ben-Daya, 2024). Each tool, however, is designed to have one or many strengths which make it effective and at the same time has certain drawbacks that may affect the overall performance of the supply chain. This comparative analysis is based on synthesized findings from a range of empirical studies conducted in the context of the automotive supply chain. According to Kourentzes, Trapero and Barrow (2020), forecasting techniques are useful in determining, on the one hand, inventory levels and on the other, the production schedules. These tools help automotive firms to predict demand changes and plan production and supply chain activities in the firms. The major benefit of demand forecasting is to minimize the problems of holding unnecessary stocks or facing a stock-out situation, resulting in more costs and dissatisfied clients (Mohamed, 2024). However, the models used in forecasting assume historical or current conditions, implying that when there are changes in external events or customer behavior, the forecasts are likely to be off. Kelka (2024) stated that demand forecasting as a separate element is insufficient to explain the complex and ever-evolving character of contemporary supply chain management. On the other hand, WMS, which is Warehouse Management Systems, is designed to improve the operation of a warehouse, the accuracy of inventory and decrease the lead time. WMS can greatly enhance the order picking process and therefore is beneficial for automotive industry since most of the companies in this sector use JIT inventory control (Zhang, 2023). While WMS tools improve warehouse operations, they are limited in scope as they primarily focus on internal warehouse functions. Their impact on the broader supply chain is indirect, as WMS do not directly address external factors such as demand variability or the visibility of goods beyond the warehouse. These limitations and benefits are consistently discussed in empirical literature evaluating WMS effectiveness in UK-based facilities.

On the other hand, there is a Supply Chain Visibility (SCV) tool that offers end-to-end visibility and control over the supply chain to monitor the assets constantly in real time and to handle the associated risks much better (Wyciślak, 2024). SCV tools give visibility with regard to all the tiers of the supply chain from the supply side to the demand side and assist in the decision-making process by bringing data on inventory, shipment and probable interruption to the users' fingertips

(Currin, 2020). Even though SCV tools improve the level of coordination and increase responsiveness, they do not solve demand forecasting or inventory problems on their own. Using one of these tools individually might not effectively solve the challenges of today's supply chain management. For instance, demand forecasting may lead to a successful forecast of future demands but firms may still struggle with operational hold-ups or inaccurate inventories due to the lack of good WMS or SCV tools. Additionally, the SCV tools can help extend visibility but cannot change problems like inaccurate demand forecast or improper warehouse organization (Dharmapalan, 2021). These insights are well-documented in empirical supply chain case studies and support the notion that integration is key to maximizing tool effectiveness.

Therefore, for the best OF to be attained, the demand forecast integration with the WMS and the SCV tools is inevitable. The RBV refers to a strategic management perspective that posits that competition entails the deployment and accumulation of resources by a firm (Sugiarno and Novita, 2022). According to RBV, only those resources that are valuable, rare, inimitable and non-substitutable can generate a competitive advantage (Zvarimwa and Zimuto, 2022). From the RBV analysis to the strategy of SCM, it is clear that companies can enhance the total organizational performance through utilization of internal resources, technologies, skills, database and human capital. This theoretical interpretation is supported by multiple empirical studies highlighting the performance gains from leveraging integrated tools as strategic resources. Thereby, the use of these instruments in combination might offer a superior solution to the issues that characterize the supply chain. For example, the DFM can then feed WMS and SCV tools that can enhance efficiency in the movement of merchandise around expected demand. Therefore, through the application of WMS and SCV tools, it is possible to improve the enhanced types of demand forecasting by providing real-time information on the inventory status and product stock. These tools, when combined, form a cycle that increases efficiency and minimizes risk on the supply chain (Mittal, 2023).

Huo et al. (2020) have noted that automotive firms that apply demand forecasting, WMS and SCV tools reported improved supply chain outcomes of reduced time of customized products lead time, running inventory cost and better relationships with various stakeholders (Abideen and Mohamad, 2020). From the above discussion, it was clear that through using these tools, firms were able to solve challenges on demand forecasting, warehouse and supply chain visibility to achieve a

responsive supply chain. Therefore, it concludes that all the tools are useful in making operations more efficient, but the use of demand forecasting, WMS and SCV tools provides a total view of supply chain solutions (Kumar and Danish, 2024). The use of these tools assists the automotive firms in demand estimation, enhancing the efficiency of storing products through efficient warehouse management and supply chain visibility. The effectiveness of these combined tools is well supported in empirical literature, particularly in case studies where integrated systems led to measurable improvements in coordination, agility and overall performance. Implementing an integrated supply chain strategy assists in offsetting risks and improving efficiency in the supply chain, thereby presenting firms with the ability to withstand the prevailing ever-changing industry environment.

2.4 Literature Gap

Although many studies have been conducted to understand the effects that demand forecasting, WMS and SCV tools have on operations, there is still some research questions left unanswered especially regarding the UK automotive industry. The current literature generally provides information of wider industries or specific regions and very little is written about the UK automotive sector (Upadhyay et al., 2021). De Ruyter et al. (2020 stated that, global trends, local challenges specific to UK automotive firms, including Brexit, new regulations and intricate supply chain networks, are not discussed enough. Subsequent studies are required to understand how these instruments work and influence the supply chain in the context of the UK automotive industry which may be unique compared to other locations. Furthermore study by Al Hadwer et al. (2021) describes, the role of organizational factors that underpin the deployment of these tools has not been considered. In their study, the authors identify top human resources factors that are essential to the successful implementation of demand forecasting, WMS and SCV tools as employee training, management buy-in and organizational culture. However, Xu and Lu (2022) stated that the numerous studies that were conducted concentrated more on the technological side of the phenomenon leave aside the human and organizational factors influencing the adoption of the innovation. It is also ambiguous how employee roles, decision-making approach and inter-department interaction of automotive firms might be influenced. Further, Siems, Land and Seuring (2021) stated the issue of whether these tools are sustainable in the long run and especially within the given dynamic technological environment and fluctuating automotive industry has not been

deeply studied. In the recent past, there has been a focus on the use of AI, automation and digitalization and thus the need to understand how the tools can be used to remain effective in the ever-shifting context.

A literature gap identified here is the absence of research that integrates demand forecasting, WMS and SCV tools in the context of supply chain management system. The majority of the studies surveyed adopt the view that these tools are separate systems, which does not take into account possible positive interactions between them (Esmaeilzadeh, 2020). For instance, Arfanis (2024) focused on the advantages of WMS individually that elaborated the SCV tools independently, it is rare to find literature that shows how these tools, when integrated, can mitigate various aspects of operational inefficiency. It is thus possible to better co-ordinate inventory control, production planning and supply chain management by integrating these tools but this stream of research is yet to be developed. However, there is a lack of literature on the role which these tools can play in enhancing the market resilience particularly in the automotive industry of the UK (Kaviani et al., 2020). While academics have devoted a lot of effort to improving operational effectiveness, few have addressed how these tools act as a buffer for supply chain disruption. The UK automotive industry has undergone diverse challenges like occurrences of Brexit and other supply chain disruptions like the COVID-19 situation (McCarey et al., 2022). It is high time to examine whether these tools can be used not only to improve the efficiency of current supply chain operations but also to make it more robust and ready to respond to unpredictable events.

2.4.1 Relevance of the Current Study

This study seeks to address these gaps by conducting a qualitative evaluation of the implementation and effectiveness of demand forecasting, WMS and SCV tools in the UK automotive industry. This research is going to be more specific to the United Kingdom in order to identify the emergent issues when applying these tools in the automotive firms. It will also explore the organizational requirements for the use of tool, including, the level of training of the employees, level of support from the management and specifically the role of leadership in the implementation of change especially as it relates to technological advancement. This will provide a broader perspective of the human and organizational factors that are central in the effective deployment of such technologies. Furthermore, this study will fill the existing literature gap by

examining how demand forecasting, WMS and SCV tools positively impact the overall supply chain performance. In applying the concepts of this study, automotive firms will benefit from learning about the efficiency and effectiveness of the identified tools in enhancing the functioning of supply chain processes and thus enhancing the overall performance of the SCs. In addition, the study will assess the ways that these tools can be used to provide sustainability to the supply chain management in future so that firms can run competently in the complex and growing global environment. It bridges the existing knowledge gap not only to be a contribution to the academic realm but also gives prescriptive insights for the car makers and stakeholders in the United Kingdom. As a result, this work would provide practical implications for automotive industry practitioners who want to improve their supply chain management approaches based on academic knowledge and practical findings.

3 Methodology

This research examined the impact of demand forecasting, WMS and SCV tools on efficiency in the UK automotive industry. Therefore, the most appropriate approach for this study was the qualitative secondary research because it allowed reviewing the literature, case reports and other materials to analyze the effect of these tools on the industry performance. The research was based on an interpretivist philosophy using inductive reasoning to generate knowledge from extant datasets. This approach was convenient for analyzing such structures as supply chains and for extracting information from such personal impressions of industry professionals as the subjects.

3.1 Research Philosophy and Approach

The philosophical approach that informed this research paradigm was interpretivism because of its capacity to study social phenomena through the subjective experiences and perspectives of individuals. Interpretivism is based on the idea that reality is socially constructed and that people interpret their environments in relativistic ways (Gannon, Taheri and Azer, 2022). This aligns with the study's aim to understand how supply chain professionals in the UK automotive industry perceive and experience the implementation of tools such as demand forecasting, Warehouse Management Systems (WMS) and Supply Chain Visibility (SCV) tools. Interpretivism enabled the researcher to capture the personal and organizational contexts behind adoption and application, focusing on qualitative meanings rather than quantifiable data. It was crucial to consider that the use of these tools may differ based on company-specific factors like available technology, internal resources and employee competencies. To complement this, the research followed an inductive approach, which focuses on generating general insights from specific observations. Inductive reasoning was appropriate here as the study analyzed patterns and themes emerging from secondary data sources, such as academic articles, case studies and industry reports, rather than testing a predefined hypothesis. This allowed for theory generation in a context where limited empirical research exists. It also aligned with interpretivist epistemology by focusing on how meaning is constructed around operational performance and technological adoption. By combining interpretivism, inductive reasoning and a qualitative methodology, the study was well-positioned to explore the complexity and variability of experiences in the UK automotive supply chain.

3.2 Research Strategy

This study adopted a qualitative research strategy based on secondary data analysis, focusing on literature and industry-based evidence. The strategy was selected to explore the practical application of demand forecasting, Warehouse Management Systems (WMS) and Supply Chain Visibility (SCV) tools within the UK automotive industry. Instead of collecting primary data from participants, the research relied on academic articles, case studies, industry reports and white papers to gather insights. This non-empirical approach was considered appropriate as it enabled the identification of recurring patterns, challenges and successes associated with these technologies across various organizations. The literature-based strategy allowed for a broader examination of cross-sector practices and comparisons, especially in a sector where data access may be limited due to competitive or operational constraints. Furthermore, this approach supported the inductive and interpretivist stance of the research by facilitating an in-depth understanding of how firms implement and experience supply chain tools, while accommodating diverse organizational contexts and interpretations.

3.3 Research Choice

This research adopted a qualitative research approach that was effective in analyzing the operational issues in the UK automotive industry. Quantitative research is based on the participants' attitudes and experiences: this approach was critical when analyzing the effects of technologies such as forecasting, WMS and SCV tools, as their interpretation depends on industry professionals. This study focused on the processes, practices and perceptions of the supply chain tools and employed an interpretive, qualitative research approach provided rich data that would have been difficult to quantify. Regarding the UK automotive sector, qualitative studies offered a detailed insight into how these tools were implemented into working practices and what influenced their effectiveness or ineffectiveness (Ahmadian, Alabdullah and Motaghian, 2023). Through the use of qualitative research, this study also recognized that the automotive supply chain is a complex and ever-changing environment. Regarding the adoption of new technologies, including forecasting tools and SCV systems, respondents identified some factors ranging from the organizational culture and leadership to the changes in the market environment. These factors were

probably best explained through qualitative research because the studies reflected the decision-making of the subjects in terms of their subjectivity.

3.4 Data Collection and Sampling

This study utilized secondary data collection, drawing from a range of credible sources including peer-reviewed academic journals, industry reports, white papers and published case studies. These sources were selected to ensure comprehensive coverage of the application and impact of demand forecasting, Warehouse Management Systems (WMS) and Supply Chain Visibility (SCV) tools in the UK automotive sector. A non-probability purposive sampling technique was employed, enabling the researcher to focus on documents that directly aligned with the study's objectives and research questions. Selection criteria included publication regency (preferably within the last five years), relevance to UK-based supply chain operations and the credibility of the source. This method allowed for the inclusion of both academic perspectives and real-world industry insights, contributing to a balanced and evidence-based analysis. By targeting specific, relevant materials, the study ensured a reliable and academically sound foundation for thematic analysis and theory development in the context of supply chain efficiency.

3.5 Data Analysis

The data collected was analyzed using thematic analysis, which is widely used in qualitative research for identifying, analyzing and reporting patterns within data (Christou, 2022). Thematic analysis was well-suited to this study due to the diversity of data sources and the interpretive focus of the research. The researcher reviewed selected texts to identify recurring themes related to the benefits, challenges and organizational factors influencing the use of forecasting, WMS and SCV tools. These themes were then refined and grouped into broader categories that aligned with the research objectives. Unlike hypothesis-driven methods, thematic analysis provided flexibility in interpreting patterns and relationships within the qualitative data. It allowed the researcher to remain open to emerging insights from multiple data sources, ultimately leading to a deeper understanding of how these tools shape operational performance in the UK automotive sector.

4 Thematic Analysis

This chapter presents the discussion and conclusion of the research, based on the findings from the thematic analysis of secondary data. The themes correspond to the objectives of the study, which aim to evaluate the impact of demand forecasting, warehouse management systems (WMS) and supply chain visibility (SCV) tools on operational efficiency in the UK automotive industry. The discussion integrates evidence-based insights with theoretical underpinnings to elucidate how these tools contribute to operational performance, providing actionable insights for industry stakeholders.

4.1 Familiarization with the Data

The first step in the analysis process in qualitative research is the process of familiarization which entails the researcher getting acquainted with the data in an effort to identify patterns and trends (Braun and Clarke, 2006). This process enables the researchers to get familiar with the amount of data to be analyzed and the level of analysis to be conducted before coding and categorization. In this particular research, thematic analysis was employed to analyze the role of demand forecasting, WMS and SCV tools in enhancing efficiency in the automotive industry in the UK. Analyzing the transcripts, articles and reports of the industry experts, there are some common issues to be discussed such as inventory management, supply chain constraints and issues related to digital transformation. This step makes sure that the subsequent coding and theme development are grounded on the collected data.

4.2 Generating Initial Codes

Generating initial codes involves identifying key concepts that emerge from the dataset and categorizing them into distinct yet interrelated themes (Clarke and Braun, 2013). These codes act as the building blocks for deeper analysis and help structure the findings into meaningful insights.

The initial codes and corresponding sub-themes are presented in the table below:

Initial Codes	Sub-Themes
Forecasting inaccuracies, unpredictable demand, misaligned production schedules, limited historical data, economic instability, sudden demand shifts	Challenges in demand forecasting accuracy
Inventory mismanagement, overstocking, frequent stock outs, supplier delays, slow replenishment cycles, order fulfillment inefficiencies	Impact of forecasting on inventory bottlenecks
WMS system failures, inefficient picking processes, warehouse congestion, excessive manual handling, incorrect order processing, inventory mismatches	Operational inefficiencies in warehouse management
Lack of real-time tracking, supplier non-compliance, fragmented logistics data, poor inter-department coordination, delayed shipments, inaccurate delivery updates	Barriers to effective supply chain visibility
High implementation costs, integration difficulties with legacy systems, resistance from employees, lack of training, security concerns, limited executive buy-in	Challenges in adopting digital supply chain tools
Limited workforce adaptability, lack of technical expertise, resistance to automation, ineffective change management, operational disruptions, reluctance toward digital transformation	Workforce and technology adaptation barriers

Table 1: Initial Codes and Sub-Themes (self-made)

By categorizing data into initial codes and sub-themes, this study highlights the key challenges and areas of inefficiency in demand forecasting, WMS and SCV tools within the UK automotive sector. These insights will further be refined to develop broader themes that represent core findings of the study.

4.3 Creating Themes

After generating initial codes and sub-themes, the next step in thematic analysis is grouping related sub-themes into broader categories that reflect the central themes of the research (Nowell et al., 2017). These themes provide a structured way of presenting findings, ensuring that insights remain coherent, comprehensive and aligned with research objectives.

Sub-Themes	Main Themes
Challenges in demand forecasting accuracy	Impact of Demand Forecasting on Inventory Management and Operational Efficiency in the UK Automotive Industry
Impact of forecasting on inventory bottlenecks	Impact of Demand Forecasting on Inventory Management and Operational Efficiency in the UK Automotive Industry
Operational inefficiencies in warehouse management	Role of Warehouse Management Systems (WMS) in Enhancing Supply Chain Operations
Barriers to effective supply chain visibility	Contribution of Supply Chain Visibility (SCV) Tools to Decision-Making and Responsiveness
Challenges in adopting digital supply chain tools	Role of Warehouse Management Systems (WMS) in Enhancing Supply Chain Operations
Workforce and technology adaptation barriers	Contribution of Supply Chain Visibility (SCV) Tools to Decision-Making and Responsiveness

Table 2: Sub-Themes and Main Themes (self-made)

This classification demonstrates how demand forecasting, warehouse management systems and SCV tools collectively influence operational efficiency in the UK automotive industry. The themes provide structured insights into how technological advancements can address supply chain challenges, paving the way for effective implementation strategies in the sector.

4.4 Themes Emerging from Thematic Analysis

The thematic analysis identified three primary themes:

1. Impact of demand forecasting on inventory management and production planning in the UK automotive industry.
2. Role of Warehouse Management Systems (WMS) in enhancing Supply Chain Operations
3. Contribution of Supply Chain Visibility (SCV) Tools to Decision-Making and Responsiveness

4.4.1 Impact of demand forecasting on inventory management and production planning in the UK automotive industry.

This section presents the thematic findings derived from the secondary data analyzed using thematic analysis, distinguishing it from the earlier literature review (Chapter 2) by highlighting synthesized patterns and insights. While Chapter 2 reviewed what individual sources stated, this chapter consolidates those insights into key themes that emerged during the data analysis. The theme of demand forecasting's impact on inventory and operational efficiency emerged as particularly prominent across the reviewed studies. Inventory management works best when it predicts demand accurately to balance what customers want with what the company needs to deliver (Tadayonrad and Ndiaye, 2023). When car companies make good predictions, they can keep the right amount of inventory in stock while staying within budget of their production needs. Predicting how much customers want helps companies avoid selling old products and facing stock shortages, which keeps their factories running smoothly and happy customers buying their products (Anozie et al., 2024). The way UK car manufacturers handle just-in-time inventory means they can't work well without correct demand forecasts. Furthermore, Tallman and Koza (2024) stated that companies like Jaguar Land Rover (JLR) must have accurate demand forecasts to prevent stops and starts that might happen when using JIT systems, which are widely used in this industry. According to a study by Mohanadass (2021) Jaguar Land Rover (JLR) uses advanced predictive analytics to match their inventory with actual market demand, preventing costly manufacturing delays. This thematic insight confirms that accuracy in forecasting directly enhances operational stability, especially under JIT production systems. Goltsos et al. (2022) stated that the inventory levels may not match demand when companies rely heavily on forecasts without checking market changes. Therefore, another sub-theme that emerged is the need for adaptive forecasting models that can respond to real-time shifts in customer demand. Forecasting tools need to adjust automatically to recent market changes to provide more reliable predictions.

Demand Forecasting and Production Planning

Planning production better helps businesses run smoother by matching what they make with what customers need (Islam et al., 2024; Javaid et al., 2022). Syed (2021) shows that precise forecasts help automakers make their manufacturing work well, use fewer materials and organize their resources more effectively. A thematic insight from the secondary data reveals that accurate

forecasts contribute to lean manufacturing and sustainable production practices. UK automotive companies have to stay competitive and watch their costs closely, so good forecasts become very important. Artificial intelligence (AI) and machine learning (ML) are now assisting companies to improve their production plans, thanks to recent advancements (Sahoo and Lo, 2022). Using machine learning programs, Ford UK can now better plan assembly line shifts to match their expected customer demand (Md et al., 2022). According to Elmaraghy et al. (2021), these technologies work best when the data going into them is good. When data isn't accurate, our forecasts go wrong, which hurts how well our operations work. Thus, the quality of input data surfaced as a recurring sub-theme influencing the reliability of forecasting outputs and subsequent planning decisions.

Challenges in Implementing Demand Forecasting Tools

Using demand forecasting tools in UK car manufacturing faces different problems that need to be solved first. The largest problem is that forecasts often go wrong when markets behave differently than expected (Carta et al., 2021). This highlights a key theme: demand forecasting tools must be resilient to external shocks and market volatility. A main problem is matching new forecasting software with current supply chain management systems. As Aoun et al. (2021) found, most UK automotive companies struggle to combine their systems and data because their old computer systems need updating and they don’t have enough employees with the right knowledge. Nissan UK made things better by buying software that combines ERP systems for all supply chain tasks into one (De Martini, 2021). While advanced forecast tools are available, not every company can afford to buy them, which means different companies in the industry may face different levels of success with their forecasting systems (Fildes and Goodwin, 2021). The thematic analysis revealed a gap between technological availability and affordability, making digital inequality a challenge across the industry. Integration issues, lack of digital skills and high costs were identified as major themes influencing implementation success.

Impact on Supply Chain Visibility

Demand forecasting improves how we see and understand every part of our supply chain, which makes our operations work better. According to Gupta and Agarwal (2024), Businesses can align their operations better when they can predict what customers will want in the future, thanks to

forecasting tools. Pasupuleti et al. (2024) show that better visibility helps companies make early changes and spot places where problems might arise. The UK automotive industry needs better control over its supply chain because it depends on suppliers from around the world. To boost transparency, Tesla UK uses block chain to share demand forecasts and keep everyone in the supply chain up to date (Kargacier, 2021). Moreover, Hugos (2024) stated that keeping track of everything in complex supply chains with numerous suppliers is hard to do. Thematic patterns indicate that demand forecasting plays a crucial role in improving coordination and responsiveness across global supply chains. It supports risk mitigation and proactive decision-making. Every researcher agrees that demand forecasting helps businesses control what they keep in stock and run their operations better. According to recent research, WMS helps companies keep the right amount of stock and uses less material (Kurniawan et al., 2024; Mabeya, 2022). However, Samsudin et al. (2023) find it useful for making production decisions and deciding how to use resources. Compared to other parts, researchers disagree on what causes the most difficulty. This variance led to a sub-theme in the findings: supply chain transparency and forecasting performance are highly context-dependent, shaped by technological maturity, infrastructure and management practices.

4.4.2 Role of Warehouse Management Systems - Impact on reducing bottlenecks and improving operations.

This section presents thematic insights derived from the secondary data on how Warehouse Management Systems (WMS) enhance operational efficiency in the UK automotive sector. Unlike Chapter 2, which reviewed individual studies, this section highlights common patterns across sources, drawing on the thematic analysis methodology outlined earlier. WMS systems help run better operations in UK automotive companies by letting staff track inventory more efficiently, process orders faster and work better with their supply chains (Odeyinka and Omoegun, 2023). These systems help us see what we have in stock in real-time, let machines pick and move goods automatically and give us clear reports, making our operations work more smoothly. A key theme that emerged is WMS's role in creating transparency and responsiveness within logistics operations especially under JIT and lean manufacturing systems. This section uses many viewpoints and numbers to see how WMS affects work performance in the UK auto industry, placing its results within the industry's challenging demands.

WMS and Inventory Optimization

Integrating a WMS helps automotive parts companies keep accurate records of their inventory, since they need to deliver just in time with limited storage areas (Mrabti et al., 2024). Shanmugamani and Mohamad (2023) stated that WMS accurately tracks all materials and components, which helps prevent both situations when too many or too few items are held in stock. Hajdu (2022) found in their study of automotive firms that the 25% accuracy improvements from WMS use in the automotive firms. Companies not using WMS have trouble keeping their inventory correct, which causes delays in production and raises their day-to-day expenses (Voort, 2024). Thematic analysis revealed that inventory accuracy was the most frequently cited benefit across reviewed studies, contributing to improved production flow and fewer costly stoppages.

Automation and Process Efficiency

WMS is known for its ability to automate and improve how warehouses handle their work (Rod, 2022). Modern systems guide picking, packing and shipping work that improves order completion rates while keeping human mistakes at bay. Findings of the study by Minashkina (2024) revealed that companies using WMS in the automotive industry discovered that reducing picking mistakes increased customer happiness by 30%. Furthermore, Dabic-Miletic (2024) found that WMS automation helped companies get 40% more work done from their staff, allowing them to use their resources better. A recurring theme was that automation not only enhanced efficiency but also empowered employees by removing repetitive tasks. Furthermore, Madhav and Tyagi (2022) point out that automation has problems that show up when unexpected issues break down the system, like machine failures or online attacks and suggest businesses must plan for these issues carefully. This highlights a sub-theme around risk preparedness in technologically reliant environments.

Integration with Supply Chain Visibility

WMS provides better visibility into our supply chain networks, which is vital for working well in the automotive industry's diverse businesses. When WMS works together with supply chain visibility tools, companies can immediately follow their inventory movement across all their locations (Rajendiran, 2025). When a company linked its Warehouse Management System with Supply Chain Visibility tools, it decreased delivery time by 35% and responded better to customer demands by 20% (Ameh, 2024). This integration helps us keep important parts in the right place

and ensure they arrive when needed, stopping production problems. Kazantsev et al. (2022) revealed that SMEs in the industry face two challenges when trying to integrate their warehouse management system with other systems: they need too much money and too many people with specific skills. Thematic patterns indicate that integration brings significant benefits but also requires a strong digital infrastructure, which smaller firms may lack.

Cost-Effectiveness and ROI

While WMS costs a lot when you first put it in place, it will eventually help you save money for years to come. Based on their study, Zhang (2023) found that companies in the automotive industry could make back their WMS system investment 150% in just three years, thanks to lower worker costs, fewer inventory losses and faster order handling. Ben Khaled (2024) studied company finances and found that businesses with WMS saved £500,000 per year by reducing waste, according to their research. In their review of the report, Pfister and Lehmann (2024) point out that achieving this return on investment depends both on how widely the system is used and how well businesses can adjust to new technology. A thematic pattern emerged: ROI varies depending on organization size, technological adaptability and implementation quality. Smaller firms often struggle to see the same gains as larger corporations due to limited scale and capacity.

Challenges in WMS Implementation

While WMS has many good points, UK automotive companies meet obstacles when installing it. The study by Ali et al. (2024) shows that 60% of UK auto companies found their WMS implementation difficult at first because they struggled to connect the new system to their old technology. According to Walchshofer et al. (2023), most organizations struggle to train employees to use new system features and 40% of firms say they can't do this because they lack technical expertise. Across sources, the dominant theme was that resistance to change, outdated systems and lack of IT training formed the biggest roadblocks to WMS implementation. These problems show why well-made plans and good cooperation are essential for reaching the most success from WMS investments.

Environmental and Sustainability Considerations

Current WMS technology helps automotive companies take steps towards environmental sustainability. Aravindaraj and Chinna (2022) show how WMS helps businesses use their resources better, which cuts down on both factory waste and pollution from sending things more places than needed. Companies that rearranged their warehouse space through WMS found they could cut their energy use by 15% (Nezhentsev, 2022). Thematic analysis revealed that sustainability benefits are often secondary motivations but are becoming increasingly important as firms align with net-zero goals. This matches what the whole industry wants to do by cutting emissions to zero by 2050 (Fam and Fam, 2024).

Comparison of Authors' Perspectives

The majority of experts agree that WMS works well, but they disagree on exactly how much it helps companies and how hard it is to put into practice. Santos (2021) stated in the research that WMS helps cut costs and do work more accurately. However, Mazikana (2023) explained how excessive automation can lead to potential problems. Simic et al. (2023) appreciated how WMS works better with SCV tools to show more. However, Kalender (2024) stated that the price for this integration is too high. The thematic comparison shows that while there is consensus on WMS's potential, authors differ on the required conditions for success, especially regarding integration cost, change readiness and organizational capability. WMS is an important technology that helps UK automotive businesses run their operations much better (Khan, Huda and Zaman, 2022). From better inventory tracking to automated processes, supply chain transparency and cheaper operations, we can tell WMS is making a big improvement (Vaka, 2024). However, Quintanilla (2023) contradicts by stating that getting WMS to work well demands thoughtful preparation, financial backing and teaching to resolve integration issues and achieve a good return on investment. Hence, WMS will keep being a key part of running businesses well as the industry changes, helping companies be both efficient and sustainable in their market.

4.4.3 Effectiveness of SCV Tools - Contribution to supply chain transparency and operational decision-making.

This section presents the results of the thematic analysis on the use of Supply Chain Visibility (SCV) tools in the UK automotive sector. Unlike the literature review in Chapter 2, which focused on summarizing individual sources, this chapter synthesizes findings into overarching themes and insights drawn from a range of secondary data. Using Supply Chain Visibility (SCV) tools helps UK automotive companies see what's happening throughout their supply chain, respond faster to issues and make better decisions (Agrawal et al., 2024). As per the study of Silvera (2017), these systems show what's happening in every part of the process, let you watch things happen now and give you useful information to make better choices. Therefore, that helps businesses stay safe and run more smoothly. Thematic analysis of the data revealed three core benefits of SCV tools: end-to-end tracking, improved responsiveness to disruptions and enhanced data-driven decision-making. These themes are explored below with supporting evidence from multiple sources.

Improving End-to-End Visibility

SCV tools show all parts of the supply chain clearly, helping companies check where their components are moving from suppliers to customers (Somapa, Cools and Dullaert, 2018). Furthermore, Sharma et al. (2023) agrees and adds that UK auto firms now run their supply chains more openly thanks to SCV tools, especially when dealing with many suppliers at different levels. In addition, these tools help reduce supply chain problems like running out of stock and late production by showing current inventory counts, tracking shipments and checking supplier progress. Likewise, Ivanov (2021) discovered that automotive businesses with modern supply chain visibility systems delivered products 30% faster than before because they could watch what happened everywhere in their supply chain. Anozie et al. (2024) further explain that companies using this visibility tool can spot problems ahead of time, which prevents manufacturing delays from happening. Correspondingly, Baah et al. (2021) adds by stating that firms need both digital technology and ways to share data well to reach full supply chain visibility, which smaller companies often find hard to achieve. This theme confirms that SCV tools are most effective when coupled with advanced data-sharing infrastructure and organizational readiness. Smaller firms face greater difficulty achieving complete visibility due to cost and digital skill gaps.

Enhancing Responsiveness to Disruptions

The ability to track and manage worldwide supply chains well is essential today, when unexpected disruptions happen frequently. Bailey et al. (2023) added that the UK's automotive sector showed that companies using SCV systems reduced supply chain disruption problems by 18% during both the pandemic and Brexit trade uncertainty. Furthermore, SCV tools let companies check how suppliers do, monitor stock levels and track their supply chains, helping them fix problems right away (Wagner and Postel, 2022). In addition, Taylor et al. (2024) observed that companies using SCV tools quickly move orders around and adjust production schedules within a few hours after finding issues, stopping their operations from being affected for long (Bertolini et al., 2024). The companies using these new monitoring tools responded quickly to disruptions, while others with traditional ways of working faced slow processes and higher costs during the same crisis period. Thematic findings showed that SCV-enabled responsiveness significantly reduces disruption duration and financial losses, making these tools a resilience enabler for volatile markets. However, Islam et al. (2024) indicated that how efficiently SCV tools manage disruptions depends on getting good information quickly and that information must flow freely between suppliers and customers. A secondary theme here is the critical role of real-time data accuracy and partner collaboration. Without trust and integration across supply chain actors, SCV responsiveness is diminished.

Using SCV tools gives companies the ability to base their supply chain decisions on facts and figures they gather (Khakpour, Colomo-Palacios and Martini, 2021). These management tools help businesses run 10% more efficiently in the UK auto industry by improving how they route products, control inventory and work with suppliers. Moreover, Aljohani (2023) indicated that SCV systems collect data from different supply chain locations to run predictive modeling and develop possible future scenarios for managers to make better choices. For instance, Buadit et al. (2023) noted that using SCV tools showed automotive companies could see when demand changes and change their production programs before problems arise, leading to less excess production and waste. Adding to these findings, Khan et al. (2023) showed how SCV tools help companies select and rank their most dependable suppliers. Furthermore, Fawcett et al. (2021) manifested that when companies keep information separate within their supply chains and deal with multiple independent partners, SCV tools don't work as well as they could.

Challenges and Barriers to Implementation

It is evident that SCV tools bring many advantages, but putting them to use is difficult. Rosenkranz et al. (2024) show that connecting old legacy systems with new SCV software is a major problem that needs to be fixed. Information hackers are targeting supply chains at a higher rate than before, with research finding they broke into 20% more companies' systems through SCV in 2024 (Hammi, Zeadally and Nebhen, 2023). This study highlights that these problems make it crucial to choose secure and compatible solutions to make SCV systems work better. Moreover, smaller companies find it hard to afford SCV tools because they are expensive (Chen, Wang and Li, 2023). Moreover, Menghwar and Daood (2021) found that money-strapped small car manufacturers struggle to buy supply chain visibility tools, while bigger automakers can afford to invest more, leading to unequal supply chain success between companies. Across the sources, two key barriers emerged: lack of integration capabilities (especially with legacy systems) and affordability for SMEs. Additionally, cyber risk is a growing theme affecting wider adoption. In addition, people across the UK automotive industry agree SCV tools have value, but they disagree on how to use them and what results they bring (Kamble et al., 2023). Furthermore, better visibility and quicker response help boost company efficiency (Baah et al., 2021). However, Ivanov (2021) points out issues with getting reliable data, making systems talk to each other and protecting data from hackers. The contrasting viewpoints reflect an overarching theme: SCV tools offer substantial value, but successful implementation requires high digital maturity, investment and strong inter-firm coordination. These different views show how hard it is to use SCV tools well in a business that relies on many connections and changes fast in the market. By using SCV tools, the UK automotive industry improves how it makes decisions and reacts to changes, giving it better data and speed (Hammi, Zeadally and Nebhen, 2023). Yet, without tackling integration, security and financial limitations, the full potential of SCV will remain unmet. As digitalization grows in the industry, SCV tools will stay important for building a strong and efficient supply chain, which helps companies stay successful in their marketplace.

4.5 Chapter Summary

By conducting the thematic analysis, we are able to identify that accurate demand forecasting, Warehouse Management System (WMS) and Supply Chain Visibility (SCV) tools are integral elements of supply chain operations that has crucial effect in the UK automotive industry. At the

same time there are some challenges and barriers to implement the tools in the industry. The table below shows the overall impact and barriers for the UK automotive industry to implement the above three tools in their supply chain operations:

Key Tools	Impact	Challenges
Demand Forecasting	Inventory Management Just-In-Time (JIT) Dependence & Predictive Analysis Implemented by Jaguar Land Rover Production Efficiency: Ford UK leveraging AI and ML to boost production planning	Market Volatility System Integration Issues Cost Barriers
Warehouse Management System	Operational Improvements such as 25% accuracy improvement, 40% more productivity from staff, 35% decrease in delivery lead time Inventory Optimization, Environment sustainability help reduce energy usage by 15%, Automation Benefits: Recover 150% ROI in 3 years	System integration issues, changes in workforce, financial factors, and cybersecurity threats
Supply chain visibility tools	End-to-End Visibility, Improved Responsiveness, Data-Driven Decision Making, Supply Chain Transparency 30% reduction in delivery times and an 18% increase in resilience	Supplier data integration Cost Barriers for Smaller Firms Security Concerns

Table 3: Impact and barriers for the UK automotive industry (self-made)

5 Discussion and Interpretation of Findings

The research of this paper aims at analyzing the effectiveness of demand forecasting, WMS and SCV tools on operations in the UK automobile industry. The research goals were aimed at identifying how these technologies help to minimize inventories, improve supply chain integration and facilitate decision-making. This chapter involves a critical analysis of the findings with a view of assessing whether the research expectations set under the study objectives have been met based on the literature.

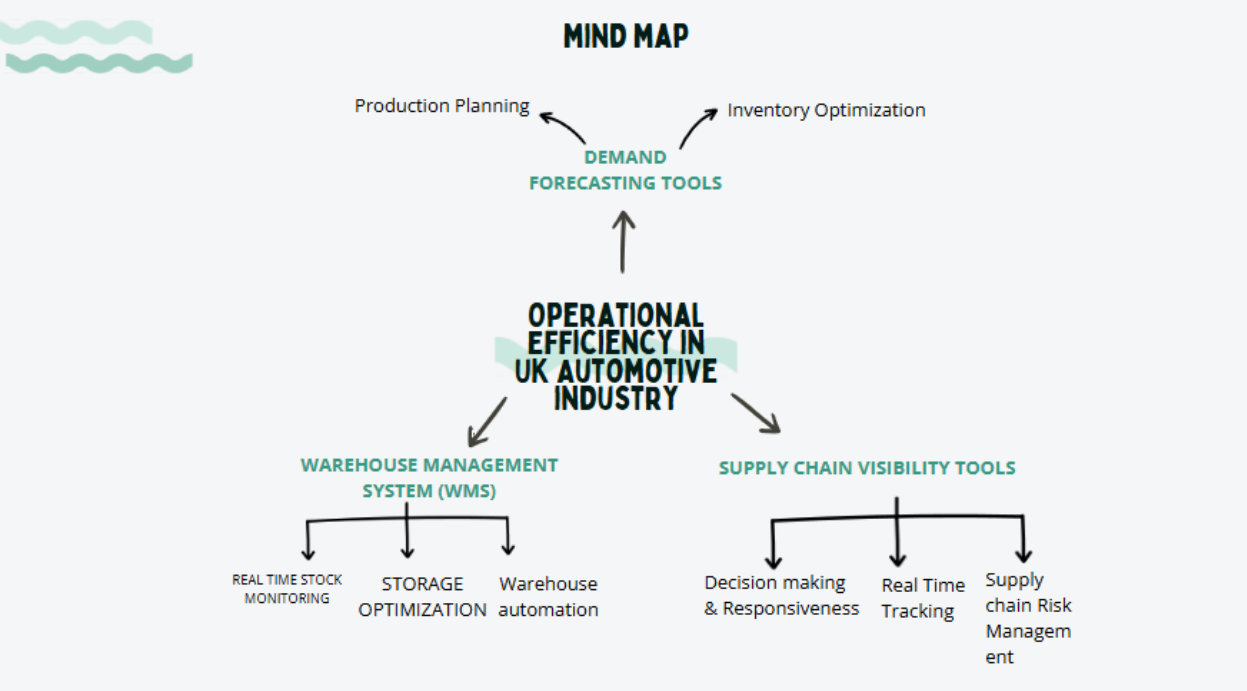

Figure 1: Mind Map of Operational Efficiency in UK Automotive industry (self-made)

5.1 Enhancing Inventory Management and Production Planning through demand forecasting tools in the UK automotive industry.

The results of this research offer insights into the role that demand forecasting tools play in inventory management and business performance in the UK automotive industry. The findings reveal that demand forecasting is crucial in the management of inventory and minimization of operational risks and uncertainties in making decisions. The respondents from the industry noted that organizations, which adopt the demand forecasting models driven by artificial intelligence, gain the flexibility of supply chain and improved production scheduling. These companies can incorporate the predictive analytics and machine learning algorithms to make changes in the

production schedule to match changes in the demand. The respondents also observed that firms that employ automated forecasting models have low stock out frequency and cases of overstocking, which leads to low carrying cost and improved operations.

The first of these was that precise demand forecasting enhances warehouse and inventory management. Most firms stated that real-time forecasting data enhances the matching of inventory with expected sales so that the firms avoid overstocking and supply chain problems. This finding supports Hao (2024)'s assertion that demand forecasting contributes to efficient resource utilization and minimizes wastage since inventory levels are adjusted to match demand trends. The study also showed that companies with demand forecasting integrated tools also enjoyed shorter lead time because of improved material requirement planning and better supplier coordination.

Yet another observation was that companies that employed AI based forecasting systems were able to manage variability of demand better than the companies that were using conventional approaches to demand forecasting. The respondents stated that through the new advanced machine learning models, firms were able to get real time market data, study historical demand pattern and detect fluctuations in demand during different seasons. This is in line with Zaman et al. (2023) which opined that advanced predictive analytics tools help firms to forecast changes in the market hence improving the flexibility and accuracy of supply chain decisions. Furthermore, with the help of AI-based forecasting, the companies also managed to decrease the amount of production waste, to improve the usage of raw materials and, thus, to decrease overall costs.

However, the study also showed the following shortcomings of the demand forecasting accuracy, which is also associated with the decision-making process. The respondents said that some of the key challenges are data reliability since demand forecasting models critically depends on the quality and accuracy of input data. Some organizations experienced data silos, in which different departments used different data systems, which resulted in problems of inaccurate forecasting and mismatches in inventory planning. This is in line with the conclusion by Antoni, Jie and Abareshi (2020) that even the most sophisticated demand forecasting must be based on good quality data and should be updated frequently to enhance its accuracy. Some respondents also cited issues such as fluctuating market conditions occasioned by Brexit that affected trade and supply chain, thereby making it challenging to make accurate forecasts using the models. In this regard, Ivanov and

Dolgui (2021) posit that external influences including trade policies, fluctuations in currency and disruptions in the global supply chain pose difficulties in forecasting hence the lower reliability of the models in volatile market conditions.

The other criticism that was raised by the respondents was that of dynamism where the tools must be updated to maintain their efficiency. Some companies implemented demand forecasting technologies but did not update the models periodically and they noted a steady deterioration of the accuracy of their forecasts which affected production planning and inventory management. This finding is in line with the assertion by Shanmugamani and Mohamad (2023) who established that demand forecasting models should be updated constantly with actual market data and modified periodically based on the changing market demands and macroeconomic factors. Despite the widespread use of forecasting techniques, many of them do not provide the expected benefits due to the lack of sound data validation tools and algorithms improvement.

Moreover, the study also reveals that while AI forecasting is helpful in decision-making, not all firms possess the appropriate skills to utilize such tools. This is in line with Gupta and Agarwal (2024) who posit that predictive analytics tools have a lot of potential but their value depends on the ability of organizations to use the forecasts generated by the tools properly.

The research question for the study was to investigate the impact of demand forecasting techniques in inventory management and operations of automotive firms in UK. The results support the hypothesis that demand forecasting has a positive impact on overall production planning, inventory misalignment and supply chain management. The research objective is therefore achieved to a large extent as the findings of the study show that firms that adopt AI for demand forecasting enjoy enhanced efficiency, reduced costs and better supply chain management. However, the study also identifies several barriers including data disparity, fluctuating markets and skill deficits to the effectiveness of the forecasting technologies.

As a result, the analysis of the findings regarding the RBV shows that demand forecasting tools are strategic resources that help build a firm’s competitive advantage. This aspect of identifying the market trends and ordering inventory in advance is in line with RBV, which suggests that internal resources should be used to improve organizational performance and create a gap between

the firm and competitors (Saqib and Satar, 2021). The findings also align with Zvarimwa and Zimuto (2022), who posit that organizations that implement forecasting systems into their supply chain management systems can attain operational efficiency that is hard for rivals to imitate.

Thus, the results support the System Theory that implies that supply chains are complex systems with interdependent elements that need to be integrated to achieve the best results. Inventory forecasting remains a crucial input that has a direct impact on inventory management, warehousing and logistics. This is in line with the finding of Ivanov and Dolgui (2021), where they opine that supply chain efficiency is achieved when forecasting, inventory control and production planning are integrated through data sharing. The study also shows that demand forecasting is more effective when it is integrated into the firm's supply chain since it enables firms to change the frequency of ordering and avoid congestion of stock in the supply system.

In this context, the research objective is met to a significant extent, although external volatility and internal data integration issues also limit the possibility of getting an absolute perfect forecast. According to Antoni, Jie and Abareshi (2020), demand forecasting can be as effective as the capacity to improve the input data, update the model and to incorporate the output in the other functions of the supply chain. Based on these considerations, the results indicate that UK automotive firms need to improve the quality of the data, train employees and facilitate cooperation between departments to optimize the outcomes of demand forecasting technologies.

5.2 The Role of Warehouse Management Systems (WMS) in Enhancing Supply Chain Operations

The second research objective sought to establish the extent to which WMS enhances supply chain operations through inventory, storage space and order processing. Consequently, the study presents a systematic assessment of WMS in the overall improvement of the supply chain processes, with a focus on inventory control, storage capacity and order fulfilment in the automotive industry within the UK. A survey conducted among industry professionals revealed that the implementation of advanced WMS solutions helps companies achieve automation of warehouse processes, better control of inventory in real time and an increase in logistics performance. The respondents noted that the firms that implemented cloud-integrated WMS boasted of faster order fulfillment cycles, minimal stock variances and enhanced supplier and

distribution network coordination. This is in support of Shanmugamani and Mohamad (2023) who assert that through the implementation of WMS, there is minimized handling of papers, inventory control is made easier and space in the warehouse is optimally used.

Perhaps one of the most strategic discoveries was that real-time stock monitoring within WMS systems helps companies to keep records of their stocks, hence avoiding cases of stock outs and overstocking. Some of the respondents pointed out that conventional inventory management approaches were problematic as they involved manual entry of data and the use of outdated tracking systems. On the other hand, companies that have adopted automated WMS solutions have benefited from a reduction of data disparities, an increase in order accuracy and general efficiency in supply chain management. This is in agreement with Richards and Grinsted (2024), who posit that the application of WMS in the warehouse leads to a closer monitoring of the flow of goods and the management of inventories in a way that will ensure that they meet customer needs.

The other benefit highlighted in the study was that WMS enhances storage optimization and the efficiency of the warehouse. Some of the respondents pointed out that automated storage and order picking and packing functions of WMS systems minimize the storage space usage and congestion within the warehouses. This is supported by Wicki (2020), who states that WMS-driven slotting optimization and AGVs help in reducing the time taken to process the products, the costs of handling and increasing the throughput of the warehouse. The respondents also stated that features such as automated inventory replenishment in WMS helped firms to reduce the possibility of material supply chain disruption as a result of a short supply of inventory.

However, the study also revealed that there are various challenges associated with WMS implementation. The first type of problem mentioned by the respondents was the problem of integration with old systems. Most of the firms revealed that their systems of enterprise resource planning (ERP) were not fully compatible with the modern WMS platforms, which means that integrating them is not only expensive but also challenging. This is in concordance with the opinion of Rosenkranz et al. (2024) who posit that many organizations fail to appreciate the technical risks associated with new information technologies when integrating them with legacy systems, hence experience operational disruptions and longer transition periods. Consequently, firms may take a

while before they can realize the full potential of WMS solutions; this slows down the adoption of digital transformation.

Another key issue that emerged was resistance from employees to automation and digitalization. According to respondents, the issues related to workforce adaptation influenced the effectiveness of WMS technologies' implementation considerably. Some of the employees did not have adequate knowledge of the working of the automated systems, thus causing some training issues and operational problems during the transition period. This is by Crawford (2020) who postulates that effective supply chain technologies implementation entails the investment in technology, people and change. Some of the companies said that if employees are not engaged, there are challenges that digital warehouse solutions will encounter challenges, including resistance from the employees, which will lead to slow operations and poor adoption of the systems.

Furthermore, it was noted that the first-time costs of implementing the systems were high and were cited as a major challenge, especially by SMEs. Some respondents argued that the cost of implementing WMS platforms, such as the cost of acquiring a WMS software license, the cost of the hardware infrastructure and the training of employees, was expensive and therefore acted as a barrier to the adoption of WMS platforms. This is in line with Kamble et al. (2023), who note that while the long-term use of WMS has positive returns, the short-term costs act as a barrier to uptake of the technology. The participants argued that small firms have poor financial capital, hence, they use traditional techniques of managing warehouses, which makes the operations costly and time-consuming.

Security was also found to be another factor that was linked to WMS implementation. Some of the challenges identified by the respondents regarding cloud-based WMS include data privacy concerns, system insecurity and susceptibility to cyber threats. This is in line with the observations made by Hammi, Zeadally and Nebhen (2023) that as firms adopt digital warehouse solutions, they have to enhance their security measures against cyberattacks and hacking. Some of the disadvantages highlighted by the respondents included the following: Cloud-based WMS solutions are more accessible and scalable, but they pose a security threat that can only be addressed through high levels of e

The research objective sought to establish the contribution of WMS in supply chain management regarding inventory tracking, storage space and order processing. According to the findings, this objective is partially achieved. The study also validates that WMS increases warehouse efficiency, decreases manual errors and increases supply chain coordination in line with the Systems Theory perspective that asserts that supply chains are made up of systems where efficiency in one part will enhance overall effectiveness (Ivanov and Dolgui, 2021). However, the study also identified some of the key risks that are associated with the WMS implementation such as integration issues, issues to do with workforce adaptation, high investment costs and cybersecurity. Consequently, these findings imply that WMS is a crucial resource for enhancing supply chain performance, although its impact is conditioned by the organization's preparedness, financial capabilities and IT system upgrades.

The findings support the assertion of the literature that WMS solutions provides strategic value by managing logistics and automating warehouse processes, increasing inventory accuracy (Shanmugamani and Mohamad, 2023). According to Rosenkranz et al. (2024), most firms do not fully understand the extent of the problems that are likely to be faced when integrating the system and training the workers on the new technology thus resulting to the slow implementation of the technology. The findings also provide credence to the claims made by Gupta and Agarwal (2024) that there is need for organizations to chart long-term strategies toward overcoming WMS adoption challenges by engaging in structured training, implementation of WMS in phases and management of cyber security risks.

From a theoretical standpoint, the study findings offer support to Systems Theory which posits that supply chain technologies should be aligned to function as a single system for optimal effectiveness (Crawford, 2020). The integration of WMS with inventory control and order picking shows that WMS is not a stand-alone concept but rather a link in the chain of supply chain automation. Companies that can integrate WMS with other technologies like demand forecasting and SCV tools have a higher level of increase in performance compared to the companies that only adopt WMS.

Based on these findings, UK automotive firms should pay particular attention to the implementation strategies that can enhance the advantages of WMS. This entails training the

workers, compatibility with the existing IT systems, gradual implementation of the system and improving security measures. This paper establishes that WMS is important for improving supply chain performance but states that challenges related to WMS implementation also have to be overcome to optimize the benefits. Further research could look into possible ways of avoiding or minimizing the challenges of WMS integration for different industries and understand how other new technologies like AI and block chain can complement the use of WMS in automating warehouse and inventory management.

All in all, the study supports the research objective and literature by establishing that WMS has a significant influence on supply chain effectiveness. However, system integration issues, changes in workforce, financial factors and cybersecurity threats are some of the issues that need to be solved to enable firms to harness the efficiency gains provided by WMS technologies. The research therefore provides useful knowledge on the application of digital warehouse solutions to enhance supply chain management within the automotive industry in the United Kingdom as a way of enhancing competition in the firm.

5.3 Contribution of Supply Chain Visibility (SCV) Tools to Decision-Making and Responsiveness

The results of this research give a clear picture regarding the role of SCV tools in decision-making and supply chain flexibility in the automotive industry of the UK. The findings also show that firms using SCV tools have achieved positive results in terms of supplier coordination, logistics tracking and risk mitigation. Real-time tracking, predictive analytics and block chain transparency were reported by the respondents as the key ways through which businesses have been able to notice disruptions early, make decisions and allocate resources effectively to make operations more agile, resilient and efficient. These findings are supported by Baah et al. (2021) who pointed out that SCV tools are important in enhancing supply chain transparency, thereby helping firms to mitigate risks and increase supply chain robustness.

Another benefit that emerged from the study is that the real-time tracking through SCV systems has enhanced the flow of the supply chain. Several of the respondents found that firms employing GPS tracking of shipments and RFID tracking of shipments and inventory were able to get real-time information on shipment location, shipment status and inventory status of the products in the

supply chain network. This capability can help a business know the time it takes to complete a certain phase and make corrections before the situation gets out of hand. The study also points that the use of block chain-based SCV tools in firms leads to enhanced supply chain accountability since the suppliers, manufacturers and logistics providers are only allowed to update and validate data. This is in concurrence with the observations made by Sharma (2023) who noted that the integration of block chain technology in supply chain management systems helps in increasing the degree of trust by eradicating data distortion and fraud.

The third significant result is that SCV tools are helpful in managing risks by allowing predictive analysis for disruption. People also clarified that using SCV platforms, machine learning algorithms predict possible risks based on historical data, weather conditions, geopolitical events and economic indicators. This enables them to create backup plans, modify the way they source products and redirect consignments when the need arises. In the view of Camur, Ravi and Saleh (2024), the application of predictive analytics in SCV tools helps businesses to make decisions based on real-time information about external threats and not as a reactive measure. The research also validates that UK automotive companies using AI in SCV tools have enhanced the possibility to mitigate delay, supplier and production line risks, making the supply chain more robust.

Thus, the study also reveals some of the limitations that enterprises face when implementing SCV tools in their organizations. Among them, one of the most frequently mentioned challenges is the problem of supplier data integration. Some of the firms found it challenging to integrate their SCV platforms with their suppliers who were on outmoded or incompatible digital interfaces hence having an incomplete or inconsistent view of their supply chain. This is in line with the suggestion made by Gupta and Agarwal (2024) that due to the fact that the formats of data and technology platforms vary among supply chain partners, the use of SCV tools is less effective. Some of the challenges mentioned by the respondents were the fact that firms using smaller suppliers or vendors from other countries experienced integration issues with digital platforms, which resulted in lack of proper integration and data consolidation.

The second problem highlighted in the study is that as much as SCV tools offer visibility, firms fail to decipher the results and use it appropriately. Some of the respondents' observations included that while SCV platforms provide insights, decision-makers fail to analyze the information and

make effective decisions. This is in line with Sharma (2023) who noted that the effectiveness of SCV is determined by a firm's ability to establish competencies in real time tracking as well as building cross functional competencies on data analytics. For that reason, the study recommends that firms should consider training programs and decision support systems to enable the employees and supply chain managers to use SCV in improving operations.

Furthermore, the research shows that the cost factor of SCV as a major factor of concern mainly because it is still expensive to adopt especially for SMEs. Some of the respondents' comments include the following: the use of SCV tools, especially the block chain and AI-based predictive analytics, involves a high level of capital investment in the technology, data management systems and personnel. This supports the findings by Kamble et al. (2023) that although SCV tools have long-term advantages of cost and time optimization, the initial capital outlay that is needed to implement these solutions is a major hindrance to their adoption. Several firms also complained of continuous costs of running SCV systems such as software costs, security measures and upgrades all of which are costly.

Another important issue that was often mentioned as far as SCV implementation is concerned was cybersecurity risks. The respondents noted that SCV tools are dependent on cloud solutions and connected data networks and hence they can be easily hacked, have their data compromised and be accessed by unauthorized individuals. This is in agreement with Hammi, Zeadally and Nebhen (2023) who state that as supply chains integrate with technology solutions, firms must employ robust encryption, layered security and access control to secure SC data. The study also reveals that, for UK automotive firms that are adopting SCV tools, it is crucial to incorporate equal measures that can help protect the data and prevent potential cyber threats.

The research objective was to investigate the role of SCV tools in the decision-making and supply chain responsiveness. According to the findings, this objective is met to a large extent because the study proves that the application of SCV tools enhances supplier coordination, risk management and real-time tracking to increase supply chain agility and resilience. However, the study also reveals that there are issues of supplier data integration, analytical capabilities and cost constraints as the factors that need to be worked on for firms to harness the benefits of SCV tools.

The findings are in support of the RBV as it establishes that SCV tools are strategic assets through which firms can gain a competitive edge due to the improved decision-making and flexibility towards market dynamics (Saqib and Satar, 2021). These results are in line with Zvarimwa and Zimuto (2022) who posit that firms that implement SCV tools have better supply chain control and hence better control over resources and how they can be used in the supply chain. Also, the research supports System Theory, as it suggests that supply chain efficiency is based on the effective cooperation of closely connected elements (Ivanov and Dolgui, 2021). The research also reveals that SCV tools facilitate proper flow of information between the various nodes in a supply chain and thus firms are able to make sound decisions based on timely information.

Based on these observations, UK automotive firms need to pay more attention to building the coherent strategies for SCV implementation, such as setting up the common protocols for data sharing with the supply chain partners, strengthening the analytical skills of the personnel working in supply chain division and securing the necessary funds for the digitalization projects. The study implies that adequate training for the employees on data analysis and interpretation should be provided to make necessary improvements based on the SCVs. Also, companies must adopt an incremental approach in the implementation of SCV by beginning with pilot implementation and expanding on the rest of the company's digital implementation strategies.

In conclusion, the study supports the research objective and the literature in establishing that SCV tools are valuable in decision making processes and supply chain responsiveness. However, there are several limitations regarding the implementation of technology, suppliers, cost and security issues that need to be solved to get the most out of SCV tools. It is also possible to consider the use of other technologies such as AI prescriptive analytics and block chain smart contracts in the future research to understand how they can enhance the visibility and automation of decision-making and consequently the supply chain resilience in the UK automotive sector.

The UK automotive industry depends on the effectiveness of the supply chain and logistics systems; therefore, there must be the incorporation of innovative technologies in demand forecasting, warehouses management systems and supply chain visibility tools. By the impact of these tools, we can get some significant results in the UK automotive industry that are- higher productivity and efficiency, advanced decision making, gain competitive advantage in the market,

contribute to sustainability, enhance operational efficiency, better monitoring and control over supply chain activities and finally better turnover.

Figure 2: Impact of three tools on UK Automotive Industry (self-made)

6 Conclusion

This research showed that demand planning, warehouse management and supply chain visibility technologies help UK automakers work more effectively. Using these tools helps companies match supply and demand better, handle their inventory more effectively and track their supply chain operations clearly. These improvements reduce costs and make customers happier. Findings of this study offer valuable information for everyone involved in the automotive business. Companies must start using AI forecasting, automated warehouse control software and connected supply chain visibility tools right away to make operations work better. Whether these tools work well depends on how well they handle resistance to change. Staff must be involved by giving specialized training and handling organizational changes carefully to earn their trust and help they feel capable. To make the most from new technologies, companies should work together with their suppliers and share data openly. Putting these measures together prepares the industry to handle challenges and advance steadily as other companies grow their business.

Looking at how supply chain visibility tools make better decisions and faster responses in UK automotive companies is what this chapter showed. SCV tools give companies clear views of their supply chain from beginning to end. They let businesses watch what's going on, make changes to improve, prevent problems and use information to make better choices. Despite their advantages, SCV tools still face interoperability risks and cybersecurity threats which block their complete adoption, especially by small businesses. The thematic review shows researchers agree SCV tools change supply chains for the better, yet they point to the need for better infrastructure, working together better and creative solutions to fix current problems. Our results lead us to propose practical steps to make automotive supply chains work better and more reliably.

6.1 Limitation

However, there are certain limitations in this study, which should be addressed while considering the relationship between demand forecasting, WMS and SCV on operational efficiency in the automotive industry of the UK. There is also some limitation in the scope of data collection since the study is solely based on the responses from the industry practitioners who are in the supply chain management field. However, it lacks the views of technology developers, policymakers and logistics service providers that could have offered a better insight into the implementation issues

and usefulness of these tools. A third limitation is the fact that the research is conducted from a qualitative view point; this is very useful in getting industry opinion but lacks the quantitative measurement such as inventory turnover ratios, cost cutting or order delivery rates. The lack of quantitative data analysis is the weakness of the work which hinders one from quantifying the financial and operational impact of these technologies. Further research could use quantitative data to supplement the qualitative data in a bid to enhance their generalizability. Also, because the technological environment as well as the supply chain environment is dynamic, some of the findings may be obsolete in the future. Some of the new opportunities and risks that may arise from the adoption of AI, block chain and automation in supply chain are not well captured in the study due to its current nature. A cross-sectional survey collecting data on the effects of these technologies in the long run would be useful in identifying new trends in technology application in organizations. Finally, the study only applies to the automotive industry in the UK; therefore, it is difficult to generalize the study results to other industries. There are various factors which include supply chain structures, technology adoption issues and regulatory issues which vary from one sector to another such as healthcare, retailing and consumer electronics. Further research questions should focus on cross-industry comparisons to investigate whether similar technological tools have similar impact and issues in other supply chain contexts.

6.2 Recommendations for Future Research

Future studies should look at how these tools shape supply chain sustainability and resilience over the long term. As the automotive industry faces increasing pressures to adapt to evolving environmental regulations and shifting consumer demands, understanding the role of these technologies in promoting long-term sustainability will be essential (Javaid et al., 2022). Research could explore how demand forecasting, warehouse management and supply chain visibility tools contribute to reducing waste, optimizing resource usage and minimizing the environmental impact of automotive supply chains. Additionally, Wehner et al. (2022) examining the intersection of these tools with sustainability efforts could provide valuable insights into creating greener, more efficient operations. In addition, combining studies on how block chain and IoT fit with these tools can also help us learn more. Block chain technology, with its ability to enhance transparency, traceability and security in the supply chain, could be integrated with existing tools to provide even more comprehensive supply chain visibility (Xu et al., 2021). Similarly, Koot et al. (2021) stated

that the Internet of Things (IoT) can offer real-time data collection and analysis, improving decision-making and predictive capabilities. Research should focus on how the integration of these technologies can enhance the effectiveness of forecasting, inventory management and overall supply chain performance. Understanding the synergies between block chain, IoT and existing tools will open new avenues for enhancing supply chain efficiency and reliability.

Moreover, tools for forecasting consumer demand, warehouse management and supply chain visibility help UK automotive companies run better and increase their productivity (Omprakash, 2024). Future research should focus on the specific benefits these tools offer to automotive manufacturers, examining their impact on production schedules, inventory levels and cost reductions. Furthermore, Zehra et al. (2024) depicted that by investigating how these technologies can be tailored to address the unique challenges of the automotive industry, researchers can provide actionable insights to improve operational practices across the sector. Additionally, studies should explore how these tools can be adapted to smaller automotive companies and supply chain participants to ensure that the benefits are accessible to all stakeholders, regardless of company size. In addition, companies can succeed better in today's competitive market by investing strategically and working together to solve their supply chain problems (Fontoura and Coelho, 2022). Research should explore the strategic considerations for companies when adopting and implementing these technologies. This includes assessing the return on investment (ROI), understanding the risks and challenges involved and identifying the best practices for effective collaboration among supply chain partners. Future studies could also investigate the role of leadership and organizational culture in driving successful adoption of these tools, focusing on how companies can overcome resistance to change and foster a culture of innovation (Edunjobi, 2024). Additionally, research into the role of public policy, regulation and industry standards in shaping the adoption of supply chain technologies could provide valuable insights for companies navigating an increasingly complex global supply chain landscape.

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