ROLE OF HUMAN CAPITAL IN DIGITALISED & SUSTAINABILITY ORIENTED SUPPLY CHAINS

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Dedication

I dedicate my dissertation work to my lovely family, friends including my office colleagues and my mentors.

A special thanks to my Life partner Mamta who has always encouraged me to pursue my dreams and taken the additional responsibilities which allowed me to devote my time towards research requirements. Lots of Love to my lovely Daughters Shaanvi & Takshvi and my younger Sisters Indrani & Shubhangi who were always my biggest cheer leaders. A special feeling of Gratitude to my parents who made be capable so that I could fulfill my professional aspirations.

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ABSTRACT

ROLE OF HUMAN CAPITAL IN DIGITALISED & SUSTAINABILITY ORIENTED SUPPLY CHAINS

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Research Purpose: The objective of this study is to investigate the relationship between supply chains, human capital management, and to show how human capital management functions in supply chains that are digital and sustainability focused. It aims to understand how digital transformation in supply chains is influenced by human capital and how this digitalization can contribute to or hinder sustainability efforts.

Methodology: This study was based on a mixed method (Including both qualitative and quantitative data collection) approach. For the purpose of quantitative data collection, primary data collection technique was used, including a questionnaire survey of 330 respondents. On the other hand, the qualitative data was collected through existing literatures, books, journal articles etc. Collected quantitative data was analysed using SPSS (Statistical Packages for Social Sciences) software, employing various statistical techniques such as correlation and regression.

Results: The findings indicated that human capital plays a critical role in the successful integration of digital technologies within supply chains. Digital literacy and employee

engagement were found to be significant factors in enhancing digitalization efforts, leading to improved supply chain efficiency and resilience. Additionally, the study revealed that digitalization and sustainability are increasingly interconnected, with digital tools offering both opportunities for more sustainable operations and challenges, such as increased energy consumption.

Conclusions: The study establishes that digitisation of supply chain requires and unlocks competitive advantage and sustainability when supported by robust human capital management. This is because every industry has factors that define it and makes it different from the others, which requires industry-specific solutions to the problems of digitalization and sustainability. Companies that invest time in the continuous education of their employees and align themselves to needs of the sector to be in are well placed in achieving sectoral competitive advantages and environmental objectives. The study also underlines the necessity of continuing the further research of human capital, digitalization, and sustainability concerns in supply chain relationships, particularly, considering the development of new technologies and customers' changing preferences.

Keywords: Supply chain, human capital, human capital management, sustainability, digital transformation, digitalization, digital literacy, employee engagement.

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LIST OF ABBREVIATIONS

Abbreviations	**Full Form**
SCM	Supply Chain Management
SCI	Supply Chain Integration
ICT	Information and Communication Technology
DSN	Digital Supply Network
CSR	Corporate Social Responsibility
MDGs	Millennium Development Goals
IoT	Internet of Things
KBV	Knowledge-Based View
AI	Artificial Intelligence
HCM	Human Capital Management
CSCRM	Cyber Supply Chain Risk Management
ERM	Enterprise Risk Management
BCM	Business Continuity Management
RBV	Resource-Based View

CHAPTER I:

INTRODUCTION

1.1 Introduction

In scholarly writing, the phrase " A senior counsel at Booz Allen first used the term "Supply Chain Management (SCM)" in 1982. Lummus and Vokurka (1999) The expression "supply chain" means "Every single step that go into getting a product from a supplier to a final consumer, such as order entry, customer delivery, channel shipping, business and assembly, inventory management, and warehousing, as well as the information systems needed to monitor these processes." In order to improve the long-term performance of individual businesses as well as the supply network as a whole, the concept of supply chain was expanded by avoiding disciplinary boundaries and addressing more general concerns as "the systematic, strategic organisation of the conventional business activities and the strategies used within a specific organisation and among enterprises." The field of supply chain research has expanded throughout time. SCM is on the CEO's agenda because it is now a component of the overall business strategy. Capable top-level leadership is necessary for modern SCM. It doesn't seem like there are many benefits to employing SCM when supply chains are managed using fragmented components like purchasing, shipping, distribution, and stock. This prevents advancements in lowering the overall expenses to customers. The topic of supply chain study has grown, and academics are paying greater attention to various components. The differentiation between the initiative's operational efficacy and its conformity to the business plan of the company. Supply chain initiatives aimed just at cost reduction and efficiency enhancement will not be sufficient to distinguish a firm from its rivals over the long run unless they are included into the company's overall business strategy. The competitor would find it difficult to

implement a comparable supply chain approach. An organisation must therefore choose which set of duties to prioritise. on the Supply Chain segment to develop the business's strategic position and add value (Khan, Haleem and Khan, (2018); Mentzer *et al.,* (2001); Lummus and Vokurka, (1999)).

. More people are realising that improving the efficacy and efficiency of the supply chain is essential to improving financial results. SCM is being used by an increasing number of companies to increase productivity. Yet, the literature on supply chain performance management lacks sufficient standard constructs for supply chains.

1.1.1 Digitalization in Supply Chains

Further research happening the adoption and implementation process in source chain management (SCM) then networks centred around electronic solutions for commerce and data transfer is necessary due to the significant advancement in innovative uses of digital and internet technology (Daneshvar Kakhki and Gargeya, 2019). supply chain integration (SCI) combines information and material movement, partner coordination, decision-making, and teamwork to streamline supply chain operations. For SCI via IT to yield the greatest benefits, resources and time are needed (Chakravorty, Dulaney and Franza, 2016). In order to enhance supply chain efficiency, SCI entails the cooperation of interorganizational and interfunctional approaches. Supply chain integration is the degree to which supply chain actors collaborate to enhance performance and efficiency (Vanpoucke, Vereecke and Muylle, 2017).

The cornerstone of information integration is the SCI process, which may be implemented in any type of business organisation . It demands attending to things like relationships, long-term resource sharing, Planning and functional domains must to be combined, and resources—particularly IT systems—should be made accessible to facilitate effective digital integration. Using cutting-edge technologies gives firms a competitive

edge through improved revenue and value creation. Digital technologies facilitate knowledge management operations and aid in the real-time movement of information. (Büyüközkan and Göçer, 2018; Wilkesmann and Wilkesmann, 2018).

SCI process operates on the tenets of open communication, cooperation, common vision, technology, and mutual trust amongst the partners. It aims at achieving accurate and timely flow of information, materials, money and processes for meeting customer requirements effectively and efficiently. The future of manufacturing depends on the creation of cyber-physical production systems, which are built on digital technology and have several networked entities. SCI can be done on both a vertical and horizontal basis by using shared or standby infrastructure. SCI can also be considered as a valuable tool for enhancing productivity and cost reduction, by effectively managing the data and information processing in real-time for prompt decision making. The movement of goods and information are the two main components of an integrated supply chain. For enhanced performance, technological innovation demands higher data management standards and expanded information accessibility. Analytics of data is useful. in the optimization of SC activities through the real-time visualisation of all of the activities (Monostori *et al.*, (2016); Scholz-Reiter, Kück and Lappe, (2014); Fayezi, Zutshi and O'Loughlin, (2017); Wilkinson *et al.*, (2019)).

Organizations may profit from appropriate integration by efficiently managing the data using powerful digital technologies and methodologies (Pappas *et al.,* 2018). Industry 4.0 is the result of mechanisation and data exchange throughout the SC brought about by the deployment of modern technologies. A highly integrated SC is now necessary due to the rapid improvements in digital technologies and the high standards set by SC partners. Research has shown that SCI through digitalization is regarded as unique of the key elements that improves source chain performance. examined how digital technology'

relationship dynamics function in supply chains and have taken into consideration the promising prospects of internet of things technologies helping producers in their production process. Information systems research has been steadily improving ended the historical few periods in a quantity of areas, including the effect, variety, and philosophical foundation of information systems. It has significantly improved over time while maintaining its strength and essential identity (Anand Jeyaraj, 2012). According to their research, businesses that use innovations in technology, like Industrial Revolution 4.0 can prosper in fiercely competitive corporate environments. They add that in order to fulfil different operational functions, the digital transformation of SC necessitates appropriate planning and organisation of activities (Boehmer *et al.*, 2020).

It is necessary to improve SC by giving supply chain restructuring based on technological innovation a higher priority than straightforward cost reduction and resource optimisation. The organisation may now supervise supply chain operations remotely thanks to the supply chain's development brought about by the digitization process. Büyüközkan and Göçer, (2018) Researchers have discovered that the use of digital technology has increased across a number of Multiple fields related to supply chains. Regarding the process of supply chain integration, there is not much consensus through digitization despite investigations into the drivers and facilitators influencing the SCI process (Hausberg *et al.*, 2019).

Using digital technology to change information in a more user-friendly way is among the biggest innovations to boost supply chain effectiveness. Business data acceptance and predictive analysis (BDPA) are positively correlated with connectivity and information interchange, with top management commitment serving as a mediating element. During their investigation, Ageron, Bentahar and Gunasekaran (2020) discovered a favourable relationship between organisational performance and supply chain

performance, as well as the application of BDPA. Verma, Mahindroo and Samalia, (2018); Ageron, Bentahar and Gunasekaran, (2020) have looked into the use of particular material systems concepts to create value. They have discovered that information systems are essential to improving SC's overall performance and have emphasised how information systems affect each of the components separately in terms of the operational and economic performance of supply chains. IT-enabled supply chain improves efficiency, competitiveness, teamwork, adaptability, and cost-cutting. The integration of all functional domains of real-time connectivity guarantees the supply chains all the way from procurement to production to delivery to final consumers. The advantages that businesses can obtain from appropriate digitization are revealed by recent research on IT deployment. Support and dedication from top management are required for the implementation process, which is predicated on well-defined organisational goals and investment reasons (Khan and Wisner, 2019).

Value creation amongst SC partners can be achieved through collaborations, according to research in the field of SCI. Technology, open communication, cooperation, a common goal, shared decision-making, and mutual trust between the parties are the cornerstones of the integration process. An interorganizational system that businesses use to digitise the transaction and cooperation process is referred to as a digital supply chain with their supply chain partners (Xue, (2014); Flynn, Huo and Zhao, (2010); Munir *et al.*, (2020)).

1.1.2 Conceptual model of dimensions of supply chain digitalization

These days, companies link the data, material, and financial flows across information technology integration in the supply chain. The expansion of the internet has made knowledge more accessible to people worldwide. Additionally, the integration of the current systems in domains like financial accounting, customer relations, inventory control,

etc. is made possible by apps and software like ERP systems. Supply chains are more efficient and dynamic now that information and communication technology (ICT) technologies have been developed. The SC partners can now communicate more quickly and easily as a result. In the context of SCM (SCM), academics refer to Industry 4.0 by a variety of terms, such as digital supply network (DSN), e-Supply Chain, Supply Chain 4.0, etc. 14.0 primarily focuses on digitalization in industries, data interchange, and automation of systems and processes. Adoption of the concept of Industry 4.0 has the potential to decrease lead times and adapt efficiently to evolving client needs and unforeseen circumstances. to enhance system productivity. Overall, adoption of I 4.0 leads to advancement in SC, manufacturing and logistics systems. I 4.0 implementation improves digitization and automation in manufacturing by supporting stakeholder interfaces. of a firm idea has an impact on important supply chain components like distribution, purchasing, operations, and integration, which boosts productivity (Abdirad and Krishnan, 2020).

To develop a fully optimised supply chain, digitalization entails combining digital data with physical operations. Even though modern organizations are adopting tools like enterprise resource planning and customized software, these are not agile enough to ensure longevity and consistent growth. The technological advancements have resulted in the application and use of Software-as-a-Service (SaaS), which processes and stores data in the cloud.

This advancement of ICT tools in recent times has made SCM an essential domain for efficient business operations. An integrated supply management system is now required due to changes in customer demands and technology improvements. ICT tools can be used to enhance the value of products and services in response to the needs and expectations of customers, which should be taken into account when producing goods. As a result, the

digital environment produced by ICT tools smoothly integrates the tasks that must be completed by different supply chain participants. The end-to-end SC that is resulting from this integration will speed up the procedures and avert any obstacles. The use of ICT tools in SCM will improve information sharing amongst supply chain participants, facilitating the decrease in of overall costs.

1.2 Human Capital Skills and Knowledge in Supply Chains

Traditional source chain management requires a diverse skill set and knowledge base to guarantee product and service flow. SCM is essential, involving procurement, manufacturing, distribution, and logistics. Logistics and transportation skills are essential for cost-effective mode selection and warehouse management. Negotiation, supplier relationship management, and strategic sourcing are procurement and sourcing abilities. Production planning, lean, and quality management are operations management competencies. Knowledge of ERP and data analytics promotes optimization. Risk management prevents interruptions and maintains continuity. Effective communication promotes stakeholder cooperation. Continuous improvement with Six Sigma boosts efficiency. Financial knowledge aids budgeting and expense control. Knowledge of regulatory compliance guarantees legal and ethical conformity. These abilities help professionals improve operations, save costs, and boost competitiveness in traditional supply chains.

Since the 1990s, logistics and SCM (SCM) have meaningfully increased in value and importance due to globalization, advanced technologies, e-commerce, and evolving customer expectations. This growth has led to enterprises managing complex global supply chain operations. Managing these operations requires highly skilled employees. However, the existing literature lacks consensus on SCM skills and their categorization. Various

frameworks with differing numbers of skill areas exist, leading to confusion among practitioners and academics (Mageto and Luke, 2020).

1.2.1 Skills and Knowledge for Digitalized Supply Chains

Digital supply chains demand technical and strategic skills. Data analytics and ERP, WMS, and TMS skills are needed to get meaningful insights. Understanding IoT, RFID, and blockchain allows real-time monitoring and visibility. Cybersecurity protects digital assets, while automation, robots, AI, and ML improve operations and decision-making. Strong communication and cooperation abilities guarantee supply chain ecosystem integration. Continuous improvement and change management help organizations change. Awareness of ethics and sustainability supports responsible actions. Legal risks decrease with regulatory compliance expertise. Professionals can traverse digital supply chains and drive efficiency, resilience, and value in an ever-changing company context by developing these abilities.

Digital technologies in manufacturing are changing value creation, promoting service delivery, and creating new business models. Scholars have linked service delivery with digitalization, creating the notion of digital service delivery, which improves services using digital technology and shifts to smart offers and ecosystem-oriented business models. This transformation requires strategic thinking, knowledge management, and data use to build new digital business models. Despite growing interest, supply chain digitization and knowledge management are underexplored (Pizzichini *et al.*, 2023).

1.3 Challenges in Recruiting for Digitalized Supply Chains

Today's fast-changing technology makes recruiting for digital supply chains difficult. First, data analytics, AI, blockchain, and IoT experts are few. Second, supply chain jobs are changing, requiring digital literacy and agility. All businesses want digital skills, so competition for top personnel is tough. As technology advances, people must

keep learning and upgrading. Finally, incorporating digital tools demands cultural change and people who can effortlessly integrate technology and operations. Strategic planning, creative recruiting, and thorough training are needed to overcome these problems.

Big data analytics transformed supply chain sustainability by using massive volumes of data from transaction records, social media, and IoT devices. Predictive analytics foresee disruptions using historical and environmental data for proactive risk management. Understanding transportation patterns and resource allocation inefficiencies allows resource optimization. Traceability enables sustainability and ethical sourcing, promoting supply chain transparency. By examining data from raw material extraction to product disposal, lifecycle evaluations help firms reduce environmental impact. Big data-driven client preferences enable sustainable product and service creation, innovation, and market distinction. Responsible usage requires addressing data privacy and ethical issues notwithstanding its promise. Big data analytics helps firms make educated choices, improve productivity, and generate enduring supply chain value while achieving sustainability objectives (Sanders et al., 2019).

Recruiting for digitalized supply chains presents unique challenges due to that specialized services and knowledge compulsory to manage then optimize these complex systems. Here are some key challenges:

1. **Skill Shortages**
    - **Technological Proficiency**: The increasing reliance on technologies such as AI, IoT, and blockchain requires employees to have advanced technical skills. There is a significant gap between the skills required and those available in the labor market.

- **Data Analytics Expertise**: Proficiency in data analysis and interpretation is crucial for optimizing supply chain operations. Finding candidates with strong analytical skills and experience with big data tools is challenging.

2. **Rapid Technological Changes**
   - **Constant Upgradation**: Because technology is developing so swiftly, abilities can become out of date very soon. In addition to being skilled, candidates must also be flexible and eager to learn new things, according to recruiters.
   - **Integration Complexity**: As digital technologies evolve, integrating new systems with existing supply chain operations can be complex. Candidates need to understand both legacy systems and new technologies.
3. **Cultural Fit**
   - **Adaptability to Change**: Digitalized supply chains require a culture of continuous improvement and innovation. Finding candidates who are not only technically skilled but also adaptable to cultural shifts is challenging.
   - **Cross-Functional Collaboration**: Collaboration between multiple departments is necessary for effective SCM. To function well in cross-functional teams, candidates need to possess good teamwork and communication abilities.
4. **High Competition for Talent**
   - **Demand for Tech Talent**: There is intense competition for candidates with digital and technological expertise. Companies across various industries are vying for the same talent pool, making it difficult to attract and retain skilled professionals.
   - **Attractive Employer Branding**: Companies must construct a strong employer brand that emphasises their dedication to innovation, staff development, and a healthy work environment in order to draw in top talent.

5. **Geographical Constraints**
   - **Global Talent Pool**: Digitalized supply chains often require a global perspective, necessitating the recruitment of talent from various geographical locations. This can lead to challenges related to relocation, remote work, and managing a geographically dispersed team.
   - **Local Market Knowledge**: While global expertise is valuable, understanding local markets and regulations is also crucial. Balancing the need for global and local knowledge can be difficult.
6. **Training and Development**
   - **Continuous Learning**: Even after hiring, ensuring that employees keep pace with technological advancements requires continuous training and development programs. This can be resource-intensive and challenging to implement effectively.
   - **Customized Training Programs**: Although it might be difficult and time-consuming, creating customised training programmes that cater to the unique requirements of a digitalized supply chain is crucial.
7. **Retention of Talent**
   - **Career Development Opportunities**: High rates of employee turnover can be a serious problem. Retaining top talent requires offering opportunity for internal growth and clear professional development paths within the company.
   - **Competitive Compensation**: Offering competitive salaries and benefits packages is necessary to retain skilled professionals in a highly competitive market.

8. **Regulatory and Compliance Knowledge**

- **Compliance Requirements**: Digitalized supply chains must adhere to various regulatory and compliance standards. Recruiting candidates with knowledge of these requirements is essential but can be challenging.
- **Security and Privacy Concerns**: With the increasing focus on data security and privacy, candidates must be well-versed in cybersecurity best practices and compliance regulations.

Addressing these challenges requires a strategic approach to recruitment, including investment in training and development, building a strong employer brand, leveraging technology for talent acquisition, and fostering a culture of continuous learning and adaptability.

1.4 Sustainability in Supply Chains

Sustainable business practices are rapidly gaining traction and becoming a big trend, especially in the industrialised west. There is an easy way to explain that. A few of the social and environmental issues that the world community is currently dealing with are gender inequality, social inequality, unequal wealth distribution, failing economies, war and conflict, lack of education, widespread poverty, climate change, loss of habitat, extinction of species, and ecological loss. If the private sector adopts more environmentally friendly business methods, many of these issues can be resolved. Particularly in developing and less developed nations, these issues are grave. The world community was expected to accomplish the 17 goals set forth by the UN in 2015. Established twenty years ago, the Sustainable Development Goals (SDGs) have (MDGs) (UNDP, n.d.). The 17 goals centre on these same issues that today's global communities face. Several parties now have a accountability to address these problems on a regional, governmental, and global scale. They consist of the public (government), private (business and industry), non-profit, non-

governmental, educational, and research institutions, as well as the scientific and technical community and consumer advocacy groups. The secluded sector is seen as one of the most significant and powerful of these stakeholders, having the most impact on achieving these goals. As a matter of fact, the private sector bears much of the blame for the current problems, to the point where questions concerning the fundamentals of free markets and capitalism have arisen. It is outside the purview of this essay to evaluate the benefits and drawbacks of the current capitalist system. Undoubtedly, the private sector exerts a substantial impact over these matters. Studies on climate change have demonstrated a clear connection between industrial activity and changes in the global climate. These changes have far-reaching effects on a variety of sectors, such as freshwater depletion, ecological degradation, extinction, and global warming. Consequently, business cannot continue as usual. It is vitally important to revisit, reassess, and reconsider business aims, procedures, and beliefs (Lucci, 2012; Daood, 2019).

1.4.1 Sustainable Business Practices – Examining its Values and Principles

It's important to define "sustainable business practices" and examine the principles and ideas that behind the phrase. It's not widely known what ""sustainable business practices" actually imply. To a diverse spectrum of individuals, it could mean many different things. The majority of people agree that a firm that is socially, environmentally, and fiscally responsible is a sustainable business. Stated differently, the company is independent, profitable, and ensures that none of its operations—from producing its products and services to using them—have an adverse impact on the environment. Lastly, it strives to enhance how its actions affect important social stakeholders, including the government, society, workers, and customers. The primary distinctions between sustainable businesses and traditional for-profit ones are their emphasis on social and environmental issues. The title of his publication was "Social Audit - A Management Tool

for Co-operative Working." Businesses are required to report on their environmental responsibilities, social wealth creation, and financial performance Freer Spreckels' first point (Bocken *et al.*, 2014).

Organisations have quite different ideas on what sustainability is. Some only consider the internal operations of the company, having a very narrow perspective on sustainability. By adopting sustainable practices like going paperless, upcycling, recycling, keeping an eye on their energy usage, utilising green products, etc., these organisations may think of themselves as sustainable. Some, however, embrace a more expansive definition of sustainable practices that encompasses partners and suppliers in addition to organisational boundaries. Their concept of sustainability is significantly more expansive and profound. Dyllic and Muffler offer one of the most thorough systems for categorising sustainability commitment. They propose grouping businesses into four categories based on their sustainability initiatives: (i) business as usual; (ii) sustainability of the business 1.0 (iii) Sustainability of business 2.0 Sustainability of business 2.0 to 3.0. The business-as-usual layer is at the bottom of the sustainability pyramid, while organisations that prescribe business sustainability are at the top. The sustainability pyramid represents the rising level of dedication and effort towards sustainability. 3.0.

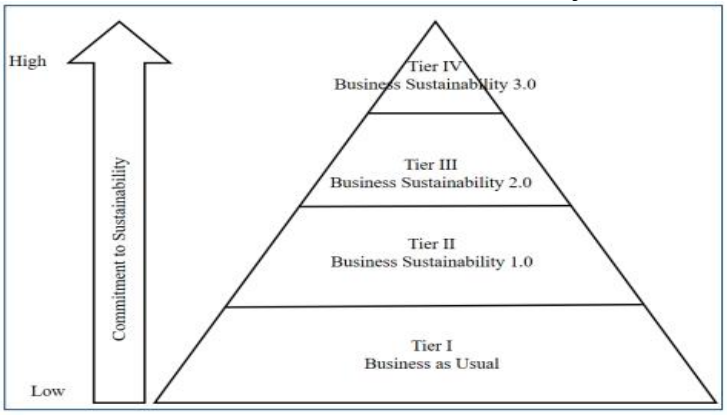

Figure: 1.1 Dyllick and Muff Business Sustainability Typology According to their Commitment to Sustainability Effort (Chungyalpa, Professor and Gd, 2019)

Understanding awareness, the importance of sustainable business practices requires an awareness of the role played by the private sector. The private sector plays a significant role in the developmental cycle and may have a significant influence on how issues and obstacles pertaining to development are resolved. Companies are increasingly integrating social and developmental objectives with their core business objectives and operational goals. Companies are using their production process and supply chain, for instance, to use suppliers' supplies and raw materials who are located nearby and who acquire their raw materials ethically. They support the goals of growth in this way. Similarly, businesses are utilising their "business innovation capacity to fill funding gaps, tackle complex development challenges, or target the needs of low-income consumers." By offering its staff members top-notch medical treatment, education, and training, they support societal development. They support social development and protect the surrounding environment and ecosystems by implementing Social, Environmental, and Human Rights norms. These standards establish guidelines for behaviour on a broad spectrum of moral and responsible governance matters, including openness and anti-bribery, tax and social, environmental, and human rights concerns. In this way, they reduce negative impacts while promoting excellent practices. Another way that the private sector contributes to growth and development is through its charitable activities and corporate social responsibility (CSR). They influence public policy and take part in developmental activities by supporting community projects, assisting with resource mobilisation, and contributing cash or in-kind to various local, national, and international causes (Lathabhavan, 2022). The United Nations and other prominent international institutions have made great efforts to incorporate the private sector in the decision-making process for development. Compared to the previous strategy, which viewed the private sector primarily as an external stakeholder, this one involves a change in strategy. Involving the private sector in the

development agenda-setting and decision-making process is the aim of the post-Millennium Development Goals (MDGs) programme. The Cerciello, Busato and Taddeo, (2023) China's impressive economic growth and accomplishments in reducing poverty are proof that the private sector is essential to economic progress.

The United Nations and other prominent international institutions have made great efforts to incorporate the private sector in the decision-making process for development. Compared to the previous strategy, which viewed the private sector primarily as an external stakeholder, this one involves a change in strategy. Involving the private sector in the development agenda-setting and decision-making process is the aim of the post-Millennium Development Goals (MDGs) programme. China's impressive achievements in poverty reduction and economic growth serve as proof that the private sector plays a pivotal role in driving economic progress.

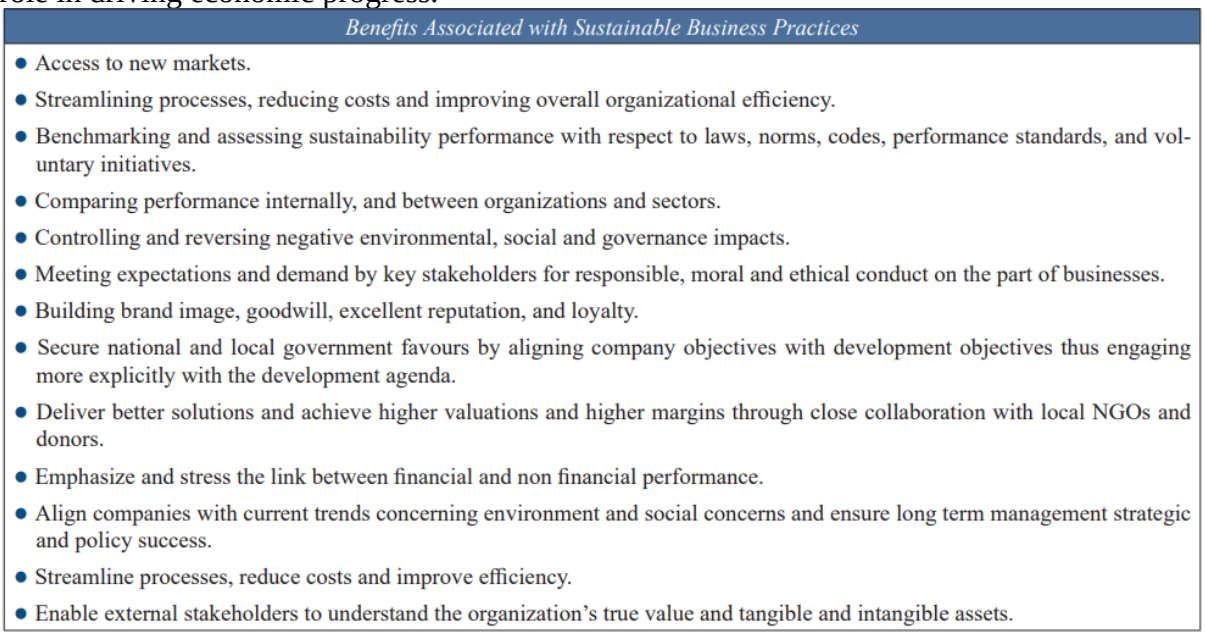

Figure 1.2: Benefits from Sustainable Business Practices Defined at Organizational Level (Whelan and Fink, 2016)

1.5 Sustainability Trends in Supply Chains

Sustainable supply chains emphasize waste reduction and resource efficiency via circular economy techniques. Rising renewable energy utilization reduces greenhouse gas emissions. To prevent human rights and environmental damage, ethical sourcing is stressed. Blockchain-enabled transparency and traceability comfort customers. Supplier collaboration promotes sustainability and creativity. Sustainable packaging like biodegradable and reusable containers reduces waste. Route optimization and modal changes reduce fuel use and emissions. Energy-efficient operations and carbon offsetting help companies lower their carbon impact. Resilience-building reduces environmental and social threats. Compliance with sustainability rules and reporting is crucial. These patterns show how sustainability boosts supply chain competitiveness, lowers costs, and builds stakeholder confidence.

Due to the reduction of natural possessions, the rise in waste and pollution, the corruption of logistical production and consumption activities, and the rapid global population growth, Concern over sustainable SCM, or SSCM, is on the rise everywhere (Rebs, Brandenburg and Seuring, 2019). Over the last 10 years, researchers and business experts have endeavoured to broaden the definition of sustainable development to encompass SCM (SCM) and have undertaken SCM-related studies (Bui *et al.*, 2021). Gaining an understanding of the many aspects of the sustainable supply chain is becoming more important as sustainability research advances. As such, the accurate meaning of SSCM is wide and nuanced and has to be considered from several perspectives. Integrated perception techniques are required to manage a company's external upstream and downstream activities in addition to its internal operations. They must also consider any possible differences of opinion on the overall advantages (Brandenburg *et al.*, 2014; Ansari and Kant, 2017).

Sustainability in supply chains is undergoing a transformative evolution, impacted by a complex interaction of environmental, social, and economic elements. A prevalent trend is the adoption of circular economy ideas and closed-loop systems, in which supply chains are reinventing their product life cycles to prioritise reuse, recycling, and responsible material management. This method not only reduces waste, but also promotes a more sustainable product ecology. Simultaneously, the logistics and transportation industry are undergoing a significant change towards green practices, with increased adoption of electric and hybrid vehicles, as well as enhanced route optimisation technologies. This dedication to eco-friendly logistics tackles not just the pressing need to reduce carbon emissions, but also the growing consumer demand for environmentally conscious operations. Furthermore, the integration of technology, such as Internet of Things (IoT) devices and blockchain, improves transparency and traceability in supply chains, allowing consumers to make more informed decisions regarding sustainably sourced products. Social responsibility is also becoming increasingly important, with an emphasis on ethical labour standards, diversity and inclusion, and community engagement throughout the supply chain. Furthermore, sustainable procurement and supplier collaboration are gaining traction as organisations recognise the importance of maintaining ethical and ecologically beneficial practices throughout their whole value chain. Governments and regulatory organisations are exerting influence by enforcing strict environmental standards and rewarding sustainable business practices, compelling corporations to embrace greener techniques in order to remain compliant and competitive. In this era of increased environmental consciousness, including sustainability into SCM has progressed from a basic corporate obligation to a strategic necessity, as organisations attempt to build resilient, responsible, and future-ready supply chains.

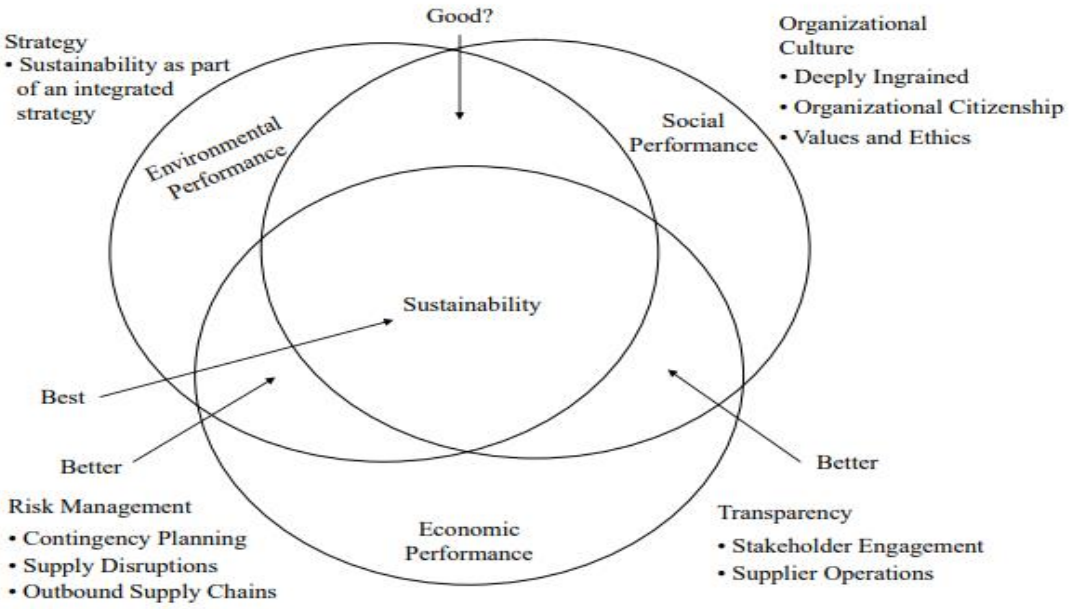

Figure 1.3: Sustainable SCM (Carter and Rogers, 2008)

The four SSCM supporting facets are as follows:

1. Strategy: systematically and thoughtfully choose certain SSCM initiatives that align and enhance the organization's overall sustainability goal.
2. Risk management includes backup plans for both the upstream and downstream of the supply chain.
3. A deeply rooted corporate culture that includes high ethical standards and expectations, organisational citizenship, and respect for society (both within and outside the business). These components serve as SSCM's cornerstone.
4. Transparency in terms of being able to trace and see information about supply chain activities both upstream and downstream, as well as actively interacting and talking with important stakeholders (Carter and Rogers, 2008).

1.6 Drivers and Benefits of Sustainable Supply Chains

Consumer demand, regulatory compliance, cost reduction, risk management, and competitive advantage drive sustainable supply chains. Eco-conscious customers want

ethically sourced items, while governments' strict environmental and labour rights standards require compliance. Energy efficiency and waste reduction reduce costs and climate change and social unrest concerns. Sustainability boosts brand reputation, consumer acquisition, and innovation. Stakeholder involvement creates shared value, while legal compliance decreases fines. Sustainable supply chains save money, reduce risk, improve brand, innovate, involve stakeholders, and comply with laws. They respond to external challenges and have the potential to produce long-term value for enterprises, society, and the environment. The forces that compel organisations to execute particular sustainability efforts are known as SSCM drivers. (Caniato *et al.*, 2012).

1.6.1 Categorization of Drivers

SSCM drivers can be classified according to various theories or according to whether they are impacted by external or internal factors within the organisation. The classification of drivers that is the subject of this thesis is shown in Figure 5.

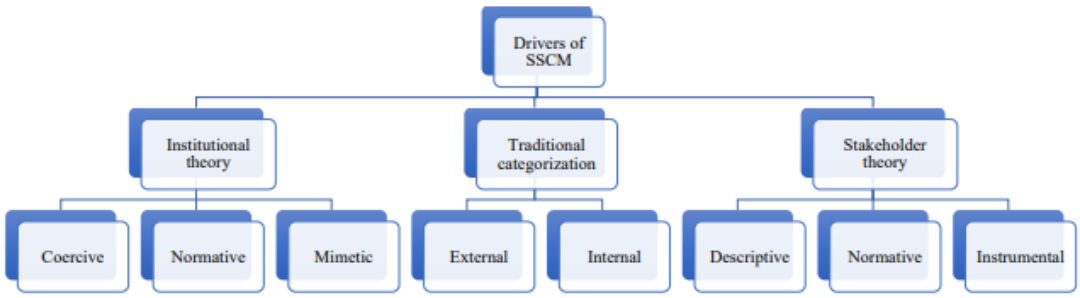

Figure 1.4: Categorization of SSCM drivers (Oo et al., 2018)

Drivers come in two varieties: internal and external. A fundamental procedure inside businesses is the identification of internal and external drivers and impediments in order to assess potential possibilities and threats by companies. It's also the start of the SSCM implementation process. Businesses can prevent failure and anticipate possible issues with SSCM deployment by doing this. It is also the primary stage in assessing the

performance of the SSCM (Narimissa *et al.*, (2019); Tay *et al.*, (2015); Sajjad, Eweje and Tappin, (2015)).

But, not every supply chain participant, whether internal or external, has the same level of value creation or access to organisational data. According to the principle of stakeholders, several parties may exert direct or indirect pressure on the implementation of sustainability initiatives. Institutional theory drivers can also be SSCM drivers. Coercive Mimetic Normative Conventional classification The doctrine of external internal stakeholders Normative Descriptive Instrumental 28 can be classified as primary or secondary drivers according to the degree of supply cable information accessibility and price contribution (Saeed and Kersten, 2019a).

1.6.1.1 EXTERNAL DRIVERS

The external drivers or pressures are those that originate from outside the organisation and have a significant effect on the internal operations of the organisation. The adoption of sustainable practices by focal organisations is instigated or encouraged by external SSCM drivers. The literature categorises external drivers in a variety of ways; the external drivers identified from the literature are presented in this chapter (Saeed and Kersten, 2019a).

Tay et al. (2015), External drivers were categorised into six groups: 6. NGOs and their impact; 7. government; rules and laws; 8. competitors; 9. consumers; 10. suppliers; collaboration with suppliers; 11. investors; investor pressures; (Narimissa, Kangarani-Farahani and Molla-Alizadeh-Zavardehi, 2020) employing a Delphi analysis, it was possible to identify five external factors for increasing sustainability in the Iranian oil and gas supply chain. The main factors that have been discovered include the availability and distribution of financial resources, product life management, supply chain risk assessment, importance of waste reduction, and environmental concerns. Abdul-Rashid et al. (2017)

discovered three primary external drivers: suppliers, community consciousness, and regulations. Regulation comprises, among other things, abiding by laws, rules, and regulations pertaining to the local market. Pressure from regional or global public advocacy and environmental groups can increase public awareness. Suppliers are under external pressure to select environmentally friendly activities. Jia, Diabat and Mathiyazhagan (2015) claim that pressure from external stakeholders is the main factor influencing a company's choice to adopt sustainable practices. Saeed and Kersten, (2019) categorised external forces into three groups: market, societal, and regulatory factors. There are five drivers in the regulatory pressure cluster. Government regulations push businesses to implement sustainable practices and raise awareness of sustainability-related issues. In order to implement sustainability-related policies as recommended by lawmakers, a firm that works internationally must adhere to regional (such as the European Union) or international regulations. Trade and professional bodies put pressure on businesses to adopt sustainable practices (Zhu and Sarkis, 2007). While non-compliance can result in fines and removal from the members list, compliance can help the business by giving it access to foreign markets. Businesses that implement sustainable practices can benefit from a number of incentives, including monetary gains. The financial advantages consist of ISO 14001 certification and tax exemptions. According to the literature, certifications serve as a motivator for businesses and encourage SSC practices. Businesses that hold certifications have a higher propensity to implement sustainable practices and exhibit greater concern for their environmental sustainability metrics. A company can enhance its operational performance, obtain a competitive edge, and expand its market share by obtaining certifications (Walker, Di Sisto and McBain, (2008); Saeed and Kersten, (2019); Xu et al., (2013)).

There are six forces at work in society. One of the factors pressuring businesses and their supply chains to implement sustainable practices is pressure from NGOs. If a business engages in unethical social or environmental actions, the press and media are quick to alert customers to this. Value-based networks may also have a significant role in motivating businesses to embrace sustainability efforts. Furthermore, society groups and the general public's pressure are key forces behind organisations' efforts to perform sustainably. Customers now demand that businesses create high-quality, safe, and ecologically responsible products because they are more conscious of sustainability issues. Additionally, consumer organisations have the power to put pressure on businesses to act more responsibly and implement sustainable practices. Furthermore, social welfare and community focus are motivators that force businesses to meet the expectations of their local communities. (Saeed and Kersten, (2019); Harms, Hansen and Schaltegger, (2013); Tate, Ellram and Kirchoff, (2010)).

There were eight drivers in the cluster of market pressures. Businesses are under pressure from a variety of market players, including shareholders and suppliers. Additionally, market-related factors typically address sustainability concerns pertaining to the business performance and relationship-building of organisations (Saeed and Kersten, 2019a). Competitive advantage is a primary motivator. To obtain a competitive edge, businesses are motivated to enhance their sustainability performance and create eco-friendly solutions (Meixell and Luoma, 2015). Additionally, pressure from rivals forces businesses to attain the same standard of sustainability performance as their rivals (Saeed and Kersten, 2019a). Companies are also subject to pressure from investors and shareholders (Harms, Hansen and Schaltegger, 2013; Meixell and Luoma, 2015). If a company is not adhering to sustainability principles or operating sustainably, investors have the option to withdraw their investments (Saeed and Kersten, 2019a). Furthermore,

banks, financial institutions, and stakeholders exert institutional pressure on organisations (Ayuso, Roca and Colomé, 2013). When a corporation engages in unsustainable practices, banks have the authority to terminate or stop credit. Businesses are also compelled to embrace sustainability standards throughout the supply chain by the demand from their suppliers. Additionally, suppliers might offer fresh concepts for carrying out environmental initiatives. Saeed and Kersten, (2019) The pressure from customers is a key factor in attaining sustainability success (Gualandris and Kalchschmidt, 2014). In order to satisfy their clients, businesses pay attention to their wants and desires. The literature indicates a positive correlation between the implementation of sustainability activities and increased customer satisfaction (Saeed and Kersten, 2019a). Furthermore, a major consideration in putting sustainability policies into effect is reputation and image (Mzembe et al., 2016). Companies aim to improve their sustainable image and meet the expectations of their stakeholders. Furthermore, a strong brand reputation boosts sales and sets an example for rivals (Saeed and Kersten, 2019a). One of the key forces behind the company's adoption of sustainable practices is globalisation. Additionally, it provides businesses with the chance to get insight into the sustainable practices and outcomes of their international rivals (Hsu et al., 2013).

1.6.1.2 INTERNAL DRIVERS

Internal drivers of SSCM include organizational components that are supported by corporate responsibility goals, efficiency targets, and business values.

Saeed and Kersten (2019), The literature has classified internal drivers in a number of ways; this chapter enumerates the recognised external drivers (Tay et al., 2015) three categories: 1. people concerns, 2. strategy issues, and 3. functional matters were used to group internal drivers. Concerns about people include the dedication of upper management, organisational culture, and participation from middle management. In turn, strategic

concerns include competitive advantage, risk management, performance management, organisational scale, and the connection of the company's strategy with its purchasing strategy and SSCM plan. Purchasing and supply function are examples of functional difficulties. Senior management's backing, it is said, is essential to the introduction and success of a company's social or environmental programmes (Tay et al., 2015). Additionally, make the case that one of the internal drivers is a supportive culture and senior management involvement. Furthermore, it is advantageous to involve middle management and staff (Sajjad, Eweje and Tappin, 2015).

Figure 1.5: Internal and external drivers of SSCM (Lailatul Mufidah, 2021)

1.7 Skills and Knowledge for Sustainability-Oriented Supply Chains

Maintainable source chains must address environmental, social, and economic factors. To traverse current supply chains and ensure sustainability, professionals in this

industry need a variety of skills and expertise. Understanding key sustainability concepts, executing circular economy methods, and engaging stakeholders throughout this need competence in SCM, environmental awareness, and regulatory compliance. These experts use data analysis, stakeholder cooperation, and innovation to construct resilient, efficient, and ethical supply chains that minimise environmental damage and maximise social benefits.

Sustainable healthcare is in demand due to worldwide concerns about resource depletion, environmental damage, and social inequity. This crucial shift to sustainability is complicated by healthcare supply networks' various stakeholders contending for few resources. Managing these stakeholders internally and externally across departments is crucial yet difficult, requiring optimum relationships to accomplish shared objectives like improved service and patient happiness via sustainable techniques. Healthcare administrators also face rising prices, lack of direct supplier-patient partnerships, and environmental concerns. Waste management, material handling, and consumption reduction must improve to address these issues. Sustainable-Oriented Innovation (SOI) has been studied in many fields, but healthcare supply chains have not (Elabed, Shamayleh and Daghfous, 2021).

1.8 Benefits of a Digital and Sustainable Supply Chain

One aspect of the modern era is the digitization of supply chains, which is altering the way supply chains operate and generate value globally. Electronics, networked databases, big data, and advanced analytics form the basis of digital SCM. When all participants in the value chain adopt these practices, the value chain as a whole will reap the following rewards:

- Improved Visibility into Supply Chain Performance Digital supply chains allow for much greater visibility into their constituent pieces and processes than their

analogue counterparts. Organizations can see how their suppliers are doing in real time, closing any gaps that could lead to interruptions. Furthermore, digital supply chains are customer-centric, allowing businesses to better comprehend what it is that customers want and take appropriate measures to meet those needs

- Process Automation When a supply chain is digitalized, the paper and labour-intensive manual operations that were once necessary are no longer necessary. Both manual data input and the requirement for stakeholders to phone or email for updates are eliminated. All the information required to coordinate with external parties and simplify operations is readily available to anybody who requests it. Automating business procedures is an additional advantage of digitization that increases productivity, profitability, and performance. In the end, technology connection enables companies to rethink business plans and boost supply chain effectiveness.
- Cut Expenses and Quicken Innovation Thanks to digitization, a supply chain's needs, performance, and state may be seen in a more comprehensive and up-to-date manner. Among the activities that might gain from this data are resource planning, inventory levels, predictions, management and optimisation of raw material flows, and operational logistics. These are the ensuing effects of lower expenses and more earnings Improved communication and teamwork can shorten product development cycles, boost innovation rates, and increase the financial value of new ideas.
- Advanced Analytics using Data The digital supply chain is made feasible by a variety of data-driven technologies, such as big data, machine learning, the Internet of Things, including statistical analysis. By integrating and coordinating disparate data sets, businesses may optimize stock management and maintenance

schedules. Data can help them spot inefficiencies, improve product quality, and provide better service to customers. Data may be visualized with the use of advanced analytics provided by a digital supply chain, making it easier for users to see patterns, draw conclusions, and refine their approach to problem solving.

- Boost Planning for the Supply Chain Identifying issues and projecting their consequences in conventional supply chains may be a time-consuming, costly, and error-prone procedure. Businesses in a digital supply chain are better able to anticipate issues and take prompt action to keep them from getting out of hand when they have access to the same, precise data on quality and control. Organisations are implementing digital tools and technology to enhance coordination and collaboration with vendors, consumers, intermediaries, and external service providers, with the goal of promoting the efficiency of the whole value chain.

1.9 Integration of Human Capital Management

HCM techniques must be integrated with SCM to optimise efficiency and resilience throughout the supply chain ecosystem. This integration aligns SCM goals with people acquisition, workforce planning, performance management, collaboration, and communication. By hiring and training competent experts, projecting workforce need, creating performance goals, promoting cooperation, and managing change successfully, organisations may prepare their staff for contemporary SCM. Integrating digital solutions allows HR and SCM to share data and make decisions seamlessly, improving operational agility. HCM practises also promote fair work, diversity, inclusiveness, and environmental responsibility in supplier chains. Through HCM-SCM integration, organisations can establish a robust, flexible, and high-performing workforce that drives sustained competitive advantage in today's changing market.

Organisational strategy must integrate HRM practises with supply chain learning to recognise workers' vital role in contributing value and gaining knowledge from supply chain partners. HRM—a cohesive collection of techniques to recruit, motivate, and train employees—impacts supply chain efficiency and effectiveness. Scholars argue that a variety of HRM methods impact employee behaviour, emphasising the need to link HRM strategies with supply chain goals. According to the Knowledge-Based View (KBV), organisational learning improves performance and competitiveness, with supply chain learning affecting operational, relationship, and service performance. Supply chain learning encourages creativity by making it easier to obtain and apply new knowledge and information. Innovation performance and supply chain learning have not been extensively studied in empirical research. To close these gaps in the literature, this study looks at how high-performance HRM practises enhance supply chain innovation and learning. The study looks at how HRM strategies like empowerment, training, and teamwork promote supply chain learning and how different facets of supply chain learning impact the success of innovations. By offering theoretical insights and useful implications for HR and supply chain managers, this book enhances academic research and managerial decision-making in HRM and SCM. The paper outlines the theoretical context and hypotheses first, followed by the methodology and empirical findings, and lastly the conclusions and their practical and theoretical ramifications (Haq, Gu and Huo, 2021).

1.9.1 Human Capital in the Supply Chain Context

Over the past ten years, there has been a steady increase in scholarly interest in strategic human capital as a source of competitive advantage for a company. SMEs have, however, received little research attention; none have been conducted in nations like Colombia or the investigated region. Existing research on these topics has mostly come from large, private, international corporations with headquarters in Europe or the US.

Because of this, a lot of the well-established theories that describe human capital strategies—which are primarily defined in the setting of these kinds of businesses—might be evaluated and modified in the context of different geographic areas and organisational configurations. Research comparing SMEs to big companies conducted in various locations, especially developing economies, is therefore important since it adds to the increasing amount of knowledge regarding the strategic role that human capital plays in attaining performance excellence (Vargas, 2018).

Human capital may be described as the set of resources, competencies, and aptitudes that enable individuals to do activities inside an organisation from an economic-productive standpoint. The resource-based approach, capabilities, and human capital theories serve as the foundation for this description. Its impact on company performance and creativity has generated debate. On the one hand, scholars like contend that human capital directly affects organisational outcomes. However, some academics, including and, contend that the incidence of human capital is indirect. They contend that operational efficiency is directly impacted by human capital, and that this has an impact on firm performance and the effectiveness of the supply chain (Santa et al., (2022); Huo et al., (2015); Crandall and Crandall, (2008)).

Various human resources management techniques moderate the beneficial benefits of humanoid capital on the supply chain, operational efficiency, and corporate innovation. Businesses that enable their SCM and HRM to work together in a flexible and effective manner should see an improvement in performance. Thus, from an intra-organizational as well as an inter-organizational perspective, human resources practices can significantly enhance the company's competence geared towards the SCM and achieve high performance. All of this is achieved by developing trust, encouraging synergy between the various participating enterprises, establishing strategic relationships, and encouraging

learning both inside and between organisations. (Lengnick-Hall, Lengnick-Hall and Rigsbee, 2013; (Crandall and Crandall, 2008).

Specifically, training and teamwork, Menon, (2012), Global thinking in particular, variable payment, and selective hiring all contribute to the supply chain's improved long-term performance. When it comes to staff incentives, link them favourably to internal supply chain integration, adversely to purchaser integration, and having not at all bearing on contractor addition. The three dimensions are connected to employees' direct involvement in integration management. In addition, mention how personnel with a strong commitment to excellence and training can manage challenging assignments in the supply chain, both within and between businesses. Supply chain managers at Smith-Doer Flein, Tracey, and Tan are responsible for making sure that HRM procedures are in line with the needs of the business. Additionally, they need to guarantee that staff members possess the knowledge and abilities needed to make decisions and find practical answers to a range of issues at the tactical, strategic, and operational levels (Koot, Mes and Iacob, (2021); Hohenstein, Feisel and Hartmann, (2014); Liu et al., (2007); Smith-Doerflein, Tracey and Tan, (2011)).

1.9.2 Agility

Customers who base their decisions on the "cost of time" put pressure on SCM as businesses are forced to adapt to ever-increasing shifts in demand. Customers are time-sensitive and have access to online resources that let them source from providers who can fulfil their requirements for quality and cost more quickly than their rivals. Because of this, being able to react more quickly and efficiently to shifting demands in terms of product volume and diversity is often necessary for success in the marketplace—and potentially even longevity (Alon, Madanoglu and Shoham, 2017; Knemeyer, 2006).

When used as a broad term for responsiveness, agility refers to the degree to which participants in the upstream and downstream supply chains can respond quickly and innovatively to shifting consumer preferences and shifting market situations. The ability of a company's supply chain to respond swiftly to market developments generates value for customers. Variations might affect the variety of items available, the amount required, the delivery order, or the timetable; for this reason, mix, volume, and delivery responsiveness are required. The meanings of short and medium words vary according on the context. Changes happen far more swiftly in certain sectors than others, such as the automobile industry, where models stay in production for an average of six years. In others industries, such as electronics, product life cycles might span as little as a few months (Holweg and Pil, (2004); Power, Sohal and Rahman, (2001); Christopher, 2000)).

According to earlier studies, businesses that exhibit greater agility than their rivals in a variety of crucial areas of their operations typically outperform them over time. Businesses may better adapt to shifting market conditions and reduce the cost of retaining inventory by establishing an agile supply chain, which increases capital returns (Holweg and Pil, 2004).

Lead time reduction has been a prevalent technique in manufacturing and supply chain planning as a result of firms continuously pursuing agility as a major performance target.greater profitability, lower expenses, greater inventory rotation, more effective scheduling, and better service are all achieved by reducing lead times. Companies that guarantee expedited delivery times might command a greater fee and experience an increase in clientele. Lead times can be shortened to help businesses cut inventory expenses. Schedules and assets must be frozen for an extended period of time when lead times are longer. Consequently, there is a greater chance of inaccurate demand projections, necessitating the need for increased safety stockpiles to accommodate fluctuating demand

and avoid stock-out issues and the expenses that come with them during restocking. (Bris et al., (2021); R., (1999); D, P and E, (2000)).

Information sharing throughout the supply chain is extremely beneficial to agility and the resulting lead-time reduction. Information sharing lowers uncertainty, ordering process costs, and time. On the other hand, shorter lead periods enable businesses to maximise the exchange of demand information. Longer lead periods, on the other hand, require businesses to invest time and money in integrating their planning and forecasting data with supply chain partners. (De Treville, Shapiro and Hameri, 2004).

Businesses need to understand that antagonistic relationships hinder everyone's ability to take advantage of chances for increased agility. The idea of agility is made possible by the high degrees of connectedness and information exchange found in close, long-term partnerships. Since cooperative partnerships or alliances aren't always viable, businesses should carefully consider how to build supply chain agility in less intimate, less cooperative connections. (Baah et al., 2022).

As globalisation increases and the focus on human capital grows, most economies place a strong emphasis on enhancing human capital in order to accelerate economic growth. Therefore, one of the most important strategies for increasing competitiveness in the global market is the development of human capital. Thus, the organization's ability to successfully implement strategic initiatives that enhance competitive advantages is a result of the talents possessed by both managers and employees (Lin et al., 2017).

1.9.3 Quality

The literature now in publication offers numerous definitions for quality, some of which may be applicable in particular situations. When it comes to manufacturing, quality is meeting requirements and taking a product-focused approach to guarantee high-quality products right from the start. From a marketing standpoint, quality is defined as matching

or beyond the expectations of the consumer. This is a difficult word to define because it can be difficult to pinpoint these expectations. From a more strategic perspective, decision-makers and quality specialists have acknowledged quality as a means of achieving overall quality and implementing change management strategies. As a result, quality is essential to the advancement of management techniques. Total quality management, or TQM, is a crucial strategy for raising effectiveness, flexibility, and company competitiveness in order to satisfy consumer demands and get a competitive edge. TQM has also been mentioned as a way to achieve excellence, develop a right-first-time mentality, find practical tactical solutions, surpass client and supplier expectations, etc., and, most significantly, as a way to improve organisational performance through continuous improvement in supply chain firms' operations. (Claver-Cortés et al., (2008); Elshennawy, (2004); Dean and Bowen, (1994); Arumugam et al., (2009); Hoang, Igel and Laosirihongthong, (2006); Terziovski, 2006)).

From a supply chain standpoint, quality management is evident when each organization's supply chain architecture delivers high-quality goods and services that meet customer expectations (Santa, 2011). All supply chain processes that are improved in terms of quality lead to cost savings, better use of resources, and increased process effectiveness. Studies on the application of quality methods to enhance the whole supply chain and resolve issues within the supply network have been carried out (Dowlatshahi, 2011).

It has been suggested that further study is required to completely comprehend the connection between supply chain-related continuous improvement activities and quality procedures and overall organisational success. Guidelines for the use of quality processes in the supply chain are therefore suggested for more research that may prove advantageous to companies. carried out early studies, for example, on how quality management affects the performance of integrated supply chains. They suggest that further research be done on

the cause of the significant influence that quality procedures have on an integrated supply chain. However, not much research has been done on how strategic strategies like outsourcing influence the relationship between quality and company success (Dowlatshahi, 2011; Lin and Gibson, 2011).

1.9.4 Costs

Costs are the monetary outlays made when conducting business, and they are crucial in determining how well a company is performing. All pertinent costs associated with supply chain costs are the total expenses incurred by a firm or organisation during its supply chain activities. Operating costs for a firm can be reduced with an effective SCM. Costs can be stated as merely the logistical costs, as well as the total cost of the supply chain or as the cost of each individual step in the supply chain. There are several ways to undertake a supply chain cost study. Numerous cost groups, including those for manufacturing, transportation, inventory, packaging, product storage, and order processing, are included in the literature (Sachan, Sahay and Sharma, 2005).

The necessity of quantifying and managing supply chain expenses is becoming more significant as businesses expand in size and scope. As a result, supply chain partners must to actively look for ways to reduce costs along the supply channels by learning more about how various value-adding activities are connected (Ballou, Gilbert and Mukherjee, 2000).

Two significant, but sometimes disregarded, cost components are of special importance to this study: switching costs and transaction costs. Participants in the supply chain must pay to get information. Businesses have to pay for information searches and security against other players' opportunistic behaviour. The cost of searching and information-sharing transactions tends to go down when information is shared more frequently, which lowers the cost of goods and services as a whole. Moreover, asset

specificity tends to rise with increased frequency and openness in information sharing. It's interesting to note that decreasing transaction costs increases switching costs because it becomes more expensive for supply chain participants to look for new partners in the market (Eccles and Williamson, (1987); Simpson, Power and Samson, (2007); Erik and Michael, (2000)).

1.9.5 Outsourcing

The competitive strategy of an organisation is becoming more and more operationalized as a result of certain supply chain operations being outsourced. The common definition of outsourcing is the transfer of work from an internal operation processing standpoint to external, competent third parties. In the past, manufacturing companies have used third-party logistics (3PL) buying tactics as a means of cutting costs. However, outsourcing is becoming a more common strategic choice for all types of businesses, and its advantages go beyond the typical cost savings linked to economies of scope and productivity through specialisation. (Lau and Zhang, 2006).

One of the many types of outsourcing that has drawn interest recently from businesses, scholars, and researchers is logistics outsourcing. Its relationship to the bottom line of the organisation performs the following functions, all of which help to provide a competitive edge: leadership, gaining access to high-quality processes, adjusting to changes in technology, and downsizing (Erturgut, 2012).

The expansion in global service transactions that is reflected in the emergence of these practices provide an opportunity to understand the role of offshore and outsourcing as well as the participation of human capital in the effort to enhance competitiveness (Contractor and Mudambi, 2008). Contractor and Mudambi competitiveness, Contractor and Mudambi, (2008) examined how human capital affected both goods and services

exports. The findings, however, did not show that human capital was a deciding factor in the relative importance of services vs commodities exports.

In some circumstances, outsourcing might be a chance to raise the talent premium between foreign nations. One example of this is the relationship between the US and Mexico, which is based on the North American Free Trade Agreement (Feenstra and Hanson, 1997). It's interesting to note that, in Austria, highly skilled professionals are suffering from outsourcing, whereas in Poland, outsourcing is helping (Lorentowicz, Marin and Raubold, 2023). Furthermore, emerging economies such as Asia have been far more impacted by the impact of human capital investment than established nations (Contractor and Mudambi, 2008).

1.10 The Role of Human Capital in Digitalized Supply Chains

Human capital in digitalized supply chains is more important than ever before, and its function is growing beyond traditional operational duties. The supply chain environment has been transformed by the incorporation of modern technologies similar data analytics, blockchain, the Internet of Things (IoT), and artificial intelligence (AI). In order to successfully traverse the intricacies of contemporary supply chains, human capital is crucial for maximising the potential of these technologies.

Competence in data analytics and interpretation is a key component of human capital's extended function. Skills in data analysis and the capacity to draw useful conclusions are becoming more important in supply chains as they produce massive amounts of data. To maximise the efficiency of the supply chain, data scientists and analysts are crucial for seeing trends, making predictions, and figuring out patterns. Their responsibility extends beyond data management to include the extraction of insight that can be used to improve responsiveness and efficiency.

When it comes to cybersecurity and data privacy, human capital is also crucial. Cyber dangers are becoming more common in today's increasingly digital supply chains, making human knowledge and experience crucial for developing and executing effective security protocols. Protecting private data, guaranteeing the honesty of online transactions, and keeping everyone's faith in the supply chain in the hands of cybersecurity experts are all vitally important.

Strategic planning places a premium on human capital. Although some tasks can be automated by technology, when it comes to making strategic decisions, nothing beats human intuition and expertise. Strong and flexible supply chain plans are the result of the combined efforts of supply chain experts with in-depth knowledge of market dynamics, geopolitical issues, and industry trends.

Also, the ability to work well with others and establish rapport is crucial in today's increasingly globalised supply chains. Building solid relationships with stakeholders like as suppliers, manufacturers, and distributors relies heavily on human resources. Supply chains that are nimble and sensitive to demand shifts, interruptions, and market dynamics are the result of strong communication and teamwork.

The importance of human capital in modern, digital supply chains is vast and ever-changing. Adaptability, creativity, and strategic thinking are just as important as technical expertise. To make sure technology is used to its maximum capacity to build sustainable, efficient, and resilient supply chains, human knowledge will remain crucial as the digital revolution progresses.

1.11 Aligning Human Capital Management with Sustainability Goals

Aligning Human Capital Management (HCM) with sustainability goals is a strategic need for organisations looking to succeed in an era of environmental awareness, social responsibility, and ethical business practices. This integration necessitates a

comprehensive approach that goes beyond compliance and aims for a symbiotic interaction between the workforce and sustainable efforts. At the heart of this agreement is an understanding that human capital is both a driving force and a beneficiary of sustainability efforts. One important aspect of this integration is to build a sustainable culture inside the organisation, in which employees are active contributors to environmental and social stewardship rather than passive participants. Leadership is crucial in building this culture, emphasising the importance of sustainability in the company's mission and values.

The incorporation of sustainability into human capital management begins with recruiting and talent acquisition. Organisations committed to sustainable practices seek individuals whose beliefs are consistent with the company's environmental and social objectives. Job descriptions can clearly reflect the company's commitment to sustainability, attracting individuals who share those values. During the hiring process, it is critical to examine candidates not just on their skills and qualifications, but also on their alignment with sustainable practices.

Once talent is on board, employee engagement becomes critical to the sustainability-HCM nexus. Organisations can use internal communication channels to educate staff about sustainability initiatives, making sure that everyone understands their role and influence. Employee training programmes can also incorporate lessons on sustainability, which promotes a sense of responsibility and empowerment. Recognising and rewarding sustainable behaviours might encourage employees to actively participate in the company's green activities.

Performance management systems can be modified to include sustainability metrics, which provide a quantifiable measure of employees' contributions to the organization's sustainability objectives. This guarantees that sustainability is more than just a linguistic commitment; it is an essential component of how personnel are evaluated and

rewarded for their performance. Furthermore, career development programmes can include sustainability leadership training, fostering a network of professionals capable of driving sustainability initiatives across several organisational areas.

Beyond human contributions, the physical workplace can be optimised for sustainability. using energy-efficient procedures, minimising waste, and using eco-friendly technologies are real ways for organisations to align their HCM with sustainability objectives. This strategy extends to remote work rules, which encourage telecommuting to reduce the carbon impact of everyday journeys.

Furthermore, creating diversity and inclusion in the workforce is an essential component of integrating HCM and sustainability. A diverse and inclusive workplace reflects society ideals while also fostering creativity and innovation. Prioritising diversity and inclusion helps organisations achieve broader societal goals while adhering to social sustainability principles.

Health and well-being programmes are also important for achieving long-term HCM. Initiatives that promote physical and mental well-being improve employee satisfaction while also contributing to the organization's overall sustainability. For example, wellness programmes that promote active commuting, healthy eating, and stress reduction are consistent with both employee-centric and larger sustainability aims.

Organisations can increase their influence by pushing sustainable practices throughout their supplier chains, in addition to internal efforts. Collaborating with suppliers who follow ethical and sustainable standards helps to create a more complete approach to sustainability. This includes evaluating the environmental and social effect of the full supply chain, from obtaining raw materials to delivering the finished product.

Transparency and accountability are critical components of integrating human capital management with sustainability. Organisations must communicate their

sustainability goals, progress, and difficulties transparently. This transparency not only fosters confidence among employees and stakeholders, but it also holds the organisation responsible to its obligations. Regular reporting on sustainability measures, both internally and externally, strengthens the incorporation of sustainability into organisational culture.

Legal and regulatory compliance should not be the only driving force behind HCM sustainability efforts. Instead, organisations should aspire to go above and above the minimum criteria, establishing themselves as pioneers in sustainable practices. Proactive steps, such as voluntary certifications and collaborations with sustainability organisations, demonstrate a commitment that beyond mandatory norms.

1.11.1 Supply Chain Disruptions and Resilience Strategies

A number of events, such as natural catastrophes, political unrest, economic downturns, pandemics, and technology malfunctions, can cause supply chain disruptions. These disruptions can have severe consequences for businesses, including delays in production, increased costs, damaged reputation, and lost revenue. To mitigate the impact of disruptions and build resilience into their supply chains, companies employ sever To lessen the effects of interruptions and strengthen the supply chains' resilience al strategies.

1. **Diversification of Suppliers**: Dependency on a single source makes you more susceptible to interruptions. Businesses can reduce this risk by making sure they have several suppliers and diversifying their supply base regionally. for critical components. In the last 20 years, network science has expanded across several fields by providing new insights into system structure and research methods. Examples of economic and financial networks include international commerce, product exports, transaction networks, and interbank networks following the 2008 crisis. Recently, production networks have attracted attention as manufacturing enterprises increasingly reliant on suppliers for output. Globalisation and improved

efficiency have led to interconnected manufacturing networks, which are the foundation of the The latest natural and man-made calamities, Like the COVID-19 epidemic, for example pandemic and Russia-Ukraine conflict, have caused business delays. Economic shock transmission has typically been investigated using industry-level input-output tables, but firm-level supply data is now recognised for its impartial evaluation of individual failures. Similar to the 2008 financial crisis, network theory is gaining popularity for analysing industrial systems. However, obtaining firm-level datasets is challenging due to technological and privacy concerns.

2. **Supply Chain Mapping and Risk Assessment:** Understanding the entire supply chain network and identifying potential risks allows companies to proactively address vulnerabilities. This entails mapping logistics providers, suppliers, and subcontractors and evaluating the hazards connected to each node. Human activity carries risk, which can result in disastrous events like natural disasters, financial crises, product malfunctions, fluctuations in commodity prices, and changes to regulations. Risk is the unpredictability and ambiguity of potential outcomes, including subjective assessments and probability. Suppliers, customers, and internal manufacturing procedures are all sources of supply chain risk. The supply chain is less effective as a result of these risks. To effectively manage risks, ascertain safety, quality, shortages, compliance, legal concerns, disasters, security threats, and dangers related to terrorism. Precise identification of risks facilitates effective management. The complex and efficient mechanisms of globalisation increase the risks connected to the supply chain and make it more susceptible. The supply chains in the construction sector are complex and vulnerable due to the large number of parties involved, including manufacturers, suppliers, retailers, logistics

providers, port authorities, and national and international government organisations. Construction projects require effective supply chain risk management (SCRM). Risks to the supply chain can be classified as either disruptive (external) or operational (internal) . Internal risks, such as capacity issues, informational difficulties, end-user problems, and operational inefficiencies, arise within the company and have the potential to negatively impact the supply chain. On the other hand, external risks are uncontrollable external factors that could cause the supply chain to break. These risks include those related to the economy, competition, politics, terrorism, and natural disasters. Because of their unpredictable nature, location, and impact on partners, man-made risks in global supply chains are difficult to control. Despite the fact that there is research on supply chain risk management in many industries, a comprehensive analysis of the construction sector is required (A *et al.*, 2024).

3. **Inventory Optimizati strategies for inventory optimisation, such just-in-time inventory on:** Keeping too little inventory can result in holding expenses and capital constraints, while keeping too much inventory can leave a company vulnerable to supply disruptions. Employing inventory optimization techniques, such as just-in-time inventory management or safety stock, helps find a middle ground between cutting inventory expenses and ensuring adequate supply. Today's complicated and competitive retail business demands efficient inventory management. It This is essential for fast-paced market expansion and profitability. Bad inventory management loses money, according to industry statistics. Examples: rising carrying costs, outmoded products, and stockouts. Inventory losses, or "shrink," grew from 1.4% to 1.6% of sales from 2015 to 2020. Organised retail crime losses climbed 0.045% to 0.07%. Despite $3.1 trillion in retail sales in

2020, $49.6 billion in cumulative shrinkage was predicted, with organised crime accounting for $2.1 billion. With less shoplifting and staff theft and more paperwork mistakes, shrink increased expenses. To survive this changing climate, merchants must improve inventory management. This project requires a thorough literature research, trend understanding, and forward-thinking retail inventory management. This initiative aims to increase knowledge, promote multidisciplinary cooperation, and generate academic debate on inventory management best practices.

4. **Supplier Relationship Management:** Establishing trusting ties with suppliers promotes cooperation and transparency, enabling better risk management. Close relationships can facilitate early identification of potential disruptions and collaborative problem-solving. Due to global crises including supply shortages, capacity constraints, and demand shocks, companies must mitigate risk and adapt. Specialists advocate enhanced management for supply chain resilience. Proactive and concurrent strategies may assist firms control risk, maintain operations, and recover from disasters. Lambert, Cooper and Pagh, (1998) say SCM should include end-user to supplier activities to provide goods, services, and information to consumers and stakeholders. Supply networks include 8 business processes (Croxton *et al.*, 2001). The topic covers product development, supplier relationship management, and marketing. Suppliers may create supply chain opportunities and issues(Manuj and Mentzer, 2008). Reliable, communicative, and flexible partners improve buying and industrial agility, but value-added services could be disrupted by global sourcing and bottleneck suppliers. activities (Sheffi, 2001). The domino effect distributes supply chain risk and momentarily impacts performance (Jüttner, 2005). Supplier relationship resilience is critical for managing unpredictability and

delivering exceptional customer service during external disruptions. SCRES identifies risks, reacts quickly to disruptions, and boosts customer service, market share, and finances.

5. **Alternative Sourcing and Dual Sourcing**: Identifying alternative sources of supply and establishing relationships with backup suppliers can help mitigate the impact of disruptions. Dual sourcing, where feasible, ensures redundancy and reduces dependency on a single supplier. Sourcing selections are crucial for a corporation's development and success. Even service businesses, 50% of the services acquired come from other firms due to supplier dependence. Changes in upstream stages of a supply chain can impact downstream firms' performance by affecting material quality, price, or availability. Anton and Yao found that given comprehensive knowledge and vendors with convex costs, buyers benefit from choosing a single source (Norbis and Meixell, 2011).
6. **Supply Chain Visibility and Transparency**: Putting technology to use such as IoT sensors, blockchain sophisticated analytics offers supply chain visibility in real time, allowing companies to anticipate and respond to disruptions more effectively. Handling shifting events quickly and accurately ma to recognise and react to interruptions y affect crisis success. Visibility is crucial for accurate decision-making, as the epidemic revealed. Supply chain visibility may boost conflict material disclosure operations and markets. Due to poor supply chain visibility (SCV), supply chain stakeholders use inaccurate, outdated, and incomplete information, which can result in supply chain disruptions, bullwhip effects, unsuitable stocks, and inaccurate predictions. Unexpected events may have a negative impact on manufacturing companies' global delivery, supply, income, and productivity. SCV is the amount of information that supply chain participants may

communicate or access that they believe is essential to their business operations and advantageous to both sides. Without visibility between and within sites, organisations find it difficult to plan internal logistics and react to unanticipated events. Real-time data on inventory, deliveries, order processing, and supply chain interruptions are rarely shared throughout production units. Focused corporations struggle to observe every actor due of poor SCV. Internal and external activities must be visible for broader supply chain visibility. SCV concerns organizations since visibility is crucial for decision-making yet scarce. AI, blockchain, cloud, and RFID may improve supply chain visibility.

7. **Resilient Infrastructure and Transportation**: Investing in resilient infrastructure and transportation networks reduces the likelihood of disruptions caused by physical infrastructure failures or transportation bottlenecks. This may involve building redundancy into transportation routes or using multiple modes of transportation. The evidence shows that human-caused climate change is worsening severe weather occurrences, causing transportation infrastructure and emergency services problems. The 2021 German Ahr valley flood showed how such floods may destroy bridges, hamper traffic, and hinder emergency response (Wassmer, Merz and Marwan, 2024).
8. **Business Continuity Planning**: Creating comprehensive business continuity plans that specify how to handle various disruptions is essential. These plans should include protocols for communication, alternative sourcing, and contingency logistics. Organizations are becoming more vulnerable to various forms of disruptions and disasters, which are difficult to anticipate and are occurring more often with significant consequences. Organizational risk management has been explored in two distinct ap the handling of organisational risk has been proaches in

response to these challenges. One Our strategy has been to implement approaches like enterprise risk management (ERM), business continuity management (BCM), and other comparable techniques. Conversely, operations management and in order to adjust to the increasing unpredictability of business conditions, supply chain professionals have committed their efforts to establishing various types of flexibility, agility, and resilience (Suresh, Sanders and Braunscheidel, 2020). Businesses operate in an increasingly complicated, dangerous, and worldwide environment. Events that are social, political, technical, environmental, or economic in character have the ability to interfere with a firm's core business activities. Adverse events like as Events that can significantly affect growth and performance include unexpected shortages of vital production inputs, epidemics, terrorist attacks, strikes, financial crises, unstable systems, supply chain breakdowns, and logistics issues. Every interruption may have varying impacts on the resources of an organization. Predicting their type, duration, and extent has become very difficult. Developing robust business continuity plans is crucial in today's volatile environment. Organizations face increasing vulnerability to disruptions, necessitating strategies like BCM and ERM, alongside operational flexibility to ensure resilience.

9. **Scenario Planning and Simulation**: Conducting scenario planning and simulation exercises helps companies anticipate potential disruptions and evaluate the effectiveness of different response strategies. This proactive approach enhances preparedness and resilience. The future is subject to the effect of several potential events, making it difficult to forecast. However, every firm or institution relies on certain assumptions about the future to shape its vision and strategic direction. When preparing for future developments, it is prudent to contemplate numerous

potential situations when constructing a future vision (Sardesai, Stute and Kamphues, 2021). Manufacturing businesses strive to implement combined SCM to improve their efficiency in business operations. The Fourth Industrial Revolution's technologies might help by providing real-time information on physically distributed processes. However, a number of planning and control considerations that pose theoretical and computational challenges must be made in order to achieve the most effective distribution of interrelated production, inventory, and transportation resources. In this context, adaptive simulation-based optimisation and Industry 4.0 technologies might be applied to address the problems associated with dynamic supply chains. (Pires *et al.*, 2018). resources, multiple scheduling, and management foundational optimisation and Industry 4.0 innovations planning for an integrated supply chain their effectiveness in operations. Technology.

10. **Continuous Improvement and Adaptation:** Resilience of the supply chain is a continual activity that needs constant improvement and flexibility. Businesses should evaluate and adjust their plans on a regular basis. in response to changing market conditions, emerging risks, and lessons learned from past disruptions. The growing enthusiasm for enhancing SCM systems has spurred the creation of digital technologies to automate business challenges. Presently, organizations are required to consistently adjust to evolving circumstances in regards to the administration of their supply chain. Nevertheless, the absence of readily accessible real-time data and efficient planning tools hinders the process of adapting to new circumstances. The present state of digital twin technology is transitioning towards digitization. An increasing number of firms will create and implement their own digital replicas in their corporate operations (Marmolejo-Saucedo *et al.*, 2020).

1.12 Research Problem

The primary issue that this study has found explains that previous research doesn't have solid ground to justify the implication of human capital management over sustainability of digitally operated SCM. Also, these previously available studies not able to answer various essential impact of implication of human capital management. This study reveals that by monitoring human capital management it's become easy to find out its impact on SCM. And in turns result of this will help to answer various question which can help to understand interdependency of both the element. More specifically, the following research questions need to be addressed:

- How do the level of digitalization in procurement, logistics, and warehousing affect overall supply chain digitalization?
- What is the effect of supply chain digitalization on employee digital literacy and upskilling?
- How does the effects of supply chain operations on the environment influence the level of supply chain sustainability?
- What is the relationship between supply chain sustainability and employee motivation and engagement in sustainability initiatives?
- How do the supply chain digitalization influence organizational performance, specifically in terms of employee digital literacy and upskilling?
- To what extent does employee motivation and engagement in sustainability initiatives, driven by supply chain sustainability efforts, impact organizational performance?

1.13 Significance of the Study

The examination of the role of human capital in digitalized and sustainability-oriented supply chains is of top importance in today's fast-evolving business landscape.

The kind of how human capital donates to the addition of digital technologies in supply chains can lead to more updated and efficient operations. Skilled and informed personnel are crucial for the successful application and use of advanced digital tools, such as AI, IoT, and blockchain, which can result in reduced costs, minimized errors, and improved decision-making processes. Moreover, as businesses face growing pressure to adopt sustainable practices this research clarifies the critical role human capital plays in driving sustainability initiatives within supply chains. Employees armed with the right skills and mindset can champion sustainable practices, helping companies reduce their conservation footprint, follow regulatory supplies, and meet the growing demands of globally conscious consumers.

In a highly good market, companies that leverage their human capital well are more likely to transform and stay ahead of the curve. This study offers insights into how organizations can foster a culture of continuous learning and adaptability, enabling them to answer quickly to industrial progress and market changes. The results of this research can director governments in emerging strategies for talent gaining, holding, and development. By classifying the skills and services required for digitalized and sustainability-oriented supply chains, companies can design targeted training programs and career growth ways, ensuring their workforce remains capable and interested.

Policymakers and business leaders can benefit from this study by gaining a deeper kind of the interaction between human capital, digitalization, and sustainability. This information can inform the creation of policies and strategies that support workforce development, technical approval, and sustainable practices, finally contributing to economic growth and environmental protection. In an organized global economy, the principles resulting from this study can be applied across various industries and regions. By the importance of best practices and success stories, this research can serve as a

benchmark for organizations worldwide, fostering a collaborative effort towards building strong and sustainable supply chains.

From an academic view, this research enhances the corpus of information regarding SCM. human capital theory, and sustainability. Links gaps between these corrections, present new insights and frameworks that can be utilized in future research. To sum up, this study is important since it can lead to improved personnel management, increased operational efficiency, sustainability, innovation, and policy support. It can also add to scholarly theory and worldwide practices by explaining the function of human resources in the digital and sustainability change of supply chains, this research offers actionable insights for trades, officials, and scholars alike.

1.14 Research Purpose and Questions

The objective of this research is to look at supply chains, human resources management, and to show how human capital management functions in supply chains that are digital and sustainability-focused. Through this, the study will analyse the influence of human capital management in a digitized and sustainable supply chain. Particularly, the study has the following sub-objectives:

- To determine the degree of digitalization in procurement, logistics, and warehousing in supply chains.
- To assess the impact of supply chain digitalization on employee digital literacy and upskilling.
- To analyse the environmental impact of supply chain operations and its influence on the sustainability of the supply chain.
- To investigate the connection between the supply chain sustainability and employee motivation and engagement in sustainability initiatives.

- To assess the influence of employee digital literacy and upskilling, influenced by supply chain digitalization, on organizational recital.
- Toward investigate the impact of employee motivation and engagement in sustainability initiatives, influenced by supply chain sustainability, on organizational performance.

The study's findings will give an appreciated and improved sympathetic of the human capital’s role in digitalized and sustainability-oriented supply chain in the organization. This will also provide a comprehensive understanding on how businesses may use human capital to enhance the supply chain efficiency, sustainability, in addition organizational presentation.

CHAPTER II:

LITERATURE REVIEW

2.1 Human Capital Theory

According to Stiles & Kulvisaechana (2003), measuring human capital has been described as "a problematic issue in this field, yet measuring is unquestionably crucial to assessing the results of efforts in human capital and identifying areas in need of development. Remarkably, a significant return on investment was cited in the human capital literature assessment. ROI, or return on investment, is still regarded as a useful metric and is even becoming more popular globally (Phillips, 2006).

The Human Capital Theory was applied in this study. Organizations prioritize knowledge supply and limited resources in the knowledge-based economy to enhance organizational effectiveness & competitive advantage (Abubakar *et al.*, 2019). Proficiency in knowledge, skills, and talents is seen as a precious commodity that is necessary for long-term organization benefits. To be competitive, one must keep up with changing global technological trends and never stop learning and growing (Subburayan, 2023). The theories of performance improvement—which include Scare Resource Theory, Sustainability Theory, and Economic Theory under Human Capital Theory—explain how businesses may increase performance by using staff knowledge and labor capacity to the fullest (Wuttaphan, 2020). This study examines how Human Capital Theory affects Human Resource Development (HRD) professionals, including how to measure human capital, how it affects HRD, and future directions to consider (Rajabhat, 2017).

In this work, Yusuf & Yulianeu (2022) investigated the impact of energizing the organizational learning process on a performance of SMEs in Indonesia. A quantitative research study was undertaken to examine the links proposed by the model. The research

utilized covariance-based SEM to examine the associations among variables. To accomplish the goals of the research, a survey methodology was used. The survey targeted a total of 205 SMEs, specifically owners and managers. These 280 embroidered SMEs were chosen from a bigger pool of 280 in the West Java region's Tasikmalaya Regency and City. A theoretical framework that SMEs can employ to improve their performance in a market that is continuously evolving is the objective of this research. Results demonstrate that embroidered company performance is favorably impacted by the invigorating organizational learning process. The authors also discovered that while transformative leadership may have an influence on organizational performance (OP), it is mitigated by a dynamic corporate learning process. One singular style of leadership is used in this study. You may use an empirical model to examine a variety of leadership styles. Also, while doing cross-cultural comparisons, it's important to think about using a more diverse sample. One goal of the study was to fill a knowledge vacuum in transformational leadership by investigating how effective SME collaboration interacts with energizing organizational learning processes.

In, Nadezhina & Avduevskaia (2021), researched where the concept of human capital came from in relation to major economic theories that have developed from the 18th century up till the current day, marked by a growth of a digital economy. The author searched academic publications and books on economic theory history for details on human capital development as economic theory has progressed. The three categories of human capital production they proposed were (1) traditional economic, (2) institutional, and (3) contemporary. The classical economic method is based on the work of thinkers from the eighteenth century who laid the groundwork for classical economic theory, such as William Petty, Adam Smith, Karl Marx, Jean-Baptiste Say, Irving Fisher, and many more. During that time, the terms "human capital" and "human resources" were often used

interchangeably, even though the notion of human capital was heavily contested. The contributions of economists working throughout the neoclassical era (late 19th–mid 20th century) are the foundation of the institutional approach. T. Schultz, Jacob Mincer, Gary S. Becker, and other twentieth-century institutionalists were instrumental in developing the concept of human capital in the 1960s and 1970s. Human capital may be measured using the institutional method by looking at expenditures on things like education, training, healthcare, and mobility. Evidence of the positive effect of investing in "human capital" on a country's GDP growth is essential to the institutional framework for this kind of investment.

An objective of the existing investigations conducted by Hung & Ramsden (2021) contended that life chances they're somewhat vertically replicated. In the Chinese setting, the life opportunities that children got there, to some degree, were influenced by their parents' hukou status. The author of this research presented HCT and EST and evaluated how the use of every model enhanced the comprehension of how people's social mobility prospects are passed down through generations. The author further outlined the constraints of each model while addressing pertinent Chinese situations.

In, Jin & Waldman (2020) examined the correlation between horizontal mobility and career advancements. The first part of the study built on previous theoretical work by include lateral movements in a model of job assignment that takes task-specific human capital accumulation into account. A model indicated that workers who underwent lateral mobility within a certain time had a higher probability of being promoted and experiencing greater income increases compared to individuals who did not undergo lateral mobility. Furthermore, those with a much higher degree of education were less prone to experiencing horizontal job transfers in comparison to those with lower educational attainment. The researchers evaluated the accuracy of the model's forecasts by analyzing a comprehensive

dataset that connected employers and employees. The dataset focused on top managers in a selection of significant US companies from 1981 to 1985.

Khaykin et al. (2020) The study discussed the primary phases of the development of human capital theory as presented by L. Walras, J.M. Clark, F. List, D. Ricardo, and J. McCulloch. They demonstrated how ideas like marginal value, costs, supply and demand, and human capital development are impacted by these principles. The proponents of this view argued that "intellectual capital," which encompasses scientific and artistic achievements, constituted the bedrock of every prosperous nation. Staff proficiency was emphasised by G. McLeod, and the concept of "personal capital" was proposed by A. Marshall. A concept of human capital was interpreted with ambiguity, including both the notion of an individual possessing a certain set of attributes and the idea of an individual's capacity to engage in productive labor. A fully developed (classical) conception of human capital emerged as an outcome of many factors, including a shift to creative production, a rise in the proportion of expenses associated with intellectual and highly professional labour, etc. Also, during this time, the social environment took the stage in the emerging institutional theory of human capital. Other branches of human capital theory, including those dealing with the economics of knowledge, intellectual property, and education, build on this base. A more inclusive definition of human capital has been proposed.

Donald et al. (2019) This study's main goal was to investigate first-year college students' perceptions of their own employability. Their intended emphasis was the effect of human capital, which includes social and cultural capital as well as psychological capital, intellectual capital, competencies, and market-value capital. The relevance of career counselling and the idea of career ownership, often called a protean career, were also among the topics they explored. Moreover, additional information was supplied by variables including gender, degree subject, and academic year. Experimental designs

included a cross-sectional study (Model II) and a two-wave study (Model I). The researchers surveyed 387 first-year students at a UK institution. Human capital, career guidance, and career ownership were shown to have significant impacts on individuals' perceptions of their own employability. At a point when students are making the leap from university to the workforce, this research contributes to human capital theory as well as modern career theory. A better knowledge of students' perceptions of their own employability will benefit everyone engaged in the processes of preparing, recruiting, hiring, and retaining graduates.

Kuzminov et al. (2019) For many industrialized nations, human capital theory has served as the foundation for educational policy in the previous few decades. Nevertheless, expert debates often underestimate the significance of research discoveries and advancements in this theory. These discoveries have steadily improved our understanding of human capital's contribution to societal socioeconomic progress and individual well-being since the 1970s. There has been little improvement in education's impact on world growth due to stagnant educational policy. Around the globe, including in Russia, educational institutions are facing tremendous difficulties in the 21st century due to radically new developments in socioeconomic dynamics. Education expenditures and time have increased quantitatively, yet performance relative to these factors has declined. The capitalization of human potential, which is generated through education, is increasingly challenging due to the economic slowdown at the national and global levels. This situation presents new opportunities to assert the insignificance of education in terms of individual success and economic development.

Marginson (2019) The human capital hypothesis argued that education was a key factor in determining the marginal productivity of labor, which subsequently influenced pay. Since the 1960s, this idea has been the prevailing influence in the fields of economics,

politics, and public perception about the connection between education and employment. There was a widespread belief that intellectual development was considered a type of economic health, that higher education was a means of being ready for employment, and that educational attainment (rather than one's social background) was the main factor influencing the success of graduates. Human capital theory, on the other hand, isn't realistic because its methods are too thick: they rely on closed system modelling and a single theoretical lens, they misuse mathematical tools, and they analyze interdependent factors using many variables. The human capital theory simplifies what is otherwise a complex process of moving from a well-rounded education to a position of employment. It fails to account for the role of status, the widening wealth gap, or the correlation between education and increased production. The constraints of studies on incomes, employment, education, and social stratification are explored.

2.2 Human Capital and Supply Chain

Yamin et al. (2024) The aim of this study was to determine the factors that affect the supply chain resilience and agility of logistics organizations. In order to ascertain the dynamism and resilience of logistics firms, an integrated research model was established that is founded on strategic HRM and AI. Empirical data was gathered from 221 workers at Saudi Arabian industrial enterprises. The data analysis step included the implementation of a SEM technique. Findings indicated that AI, human capital development, competitive intensity, organizational culture, employee talents, and joint leadership all had a substantial impact on supply chain agility (80% explained variance). A noteworthy performance analysis revealed that leadership, organizational flexibility, and human capital development were a most crucial factors impacting SC resilience in an integrated research model of supply chain agility. Governments throughout the world should take into account the favorable correlations found between supply chain agility and variables including

leadership, staff capabilities, company culture, level of competition, human capital development, and AI. Research like this is valuable because it investigates supply chain agility and how elements like SHRM, organizational flexibility, and AI affect supply chain resilience.

Al-Ma'aitah (2024) The study's objective was to look at the healthcare industry in Jordan from the perspective of supply chain performance and agility. Also investigated was the role of human capital as a moderator of this association. Using an online poll, this quantitative study collected data from 139 managers in varying hierarchical levels across many Jordanian hospitals. They ran the numbers via SPSS, version 23. A favourable and large effect of human capital on supply chain agility and performance was found in the results of the hypothesis testing using multivariate regression analysis. The importance of human capital as a resource for an organization's potential success has been established. In addition to giving healthcare facilities a competitive advantage, such an organizational resource may assist them react quickly to patients' urgent medical needs.

Ambe et al. (2023) investigated how human capital affected SCM in South African state-owned companies. Approach: Data for this research was collected from a poll sent to members of South Africa's State-Owned Entities Procurement Forum. The data was analysed descriptively using the SPSS application after it had been collected using structured questionnaires. DISCOVERIES: Human capital level positively and significantly affects SCM performance in state-owned organisations, according to the findings. The three factors that make up human capital practices are the following: organisational structure, competence and skills, with training and development. Based on a finding, SCM skills and competence a strongest and highest predictors of supply chain performance in such entities RECOMMENDATIONS/VALUE: A performance of SCM may be improved by coordinating efficient human capital practices with those of SCM.

Additionally, it is suggested that an accounting officer should be directly reported to by the head of supply chain management at a state-owned firm. Additionally,

Rener (2022), A purpose of this research was to find new ways to use industrialized building practices in order to make the construction industry more sustainable, efficient, and productive. To accomplish these goals, the research objectives of this study are (1) Evaluation of Industrialized Construction Challenges in Supply Chain, Sustainability, and Construction Schedules; (2) Innovative Design and Execution Model for Improving Productivity of Interior Prefabricated Wall Assemblies; (3) Innovative Model for Forecasting Trailer Usage for Prefabricated Exterior Wall Panels; (4) Multifaceted Sustainable Impacts of Construction Waste Through the Application of Industrialized Construction. To evaluate challenges in industrialized construction relative to supply chain, sustainability, and construction schedules, subject-specific hypotheses developed that they then tested through two targeted industry surveys and the results they analyzed. An innovative concept was created for the design and execution of using prefabricated interior wall panels to increase worker productivity on-site. A one-of-a-kind project with four similar structures served as the basis for the case study that evaluated this methodology.

Papaioannou et al. (2020) investigated the impact of unfavourable economic and human capital circumstances on various forms of cooperation within agri-food SC. A Greek agricultural industry provided data, and that data included times of economic distress. The findings reveal that economic hardship has a nonlinear effect on a collaborative aspects of goal congruence, decision synchronisation, resource sharing, incentive alignment, and cooperative knowledge development. In particular, when the economy is in a bad place, these collaborating components have an inverse U-shaped connection. The findings indicate that farmers do not engage in cooperation for knowledge sharing and collaborative communication under challenging economic circumstances.

Furthermore, they demonstrate that educational attainment, years of agricultural experience, and age are all components of human capital that influence teamwork. Their unique contribution is to study the possible non-linear connection between bad economic times and different forms of cooperation. Consequently, this research addresses a critical gap in a literature by offering policymakers and managers a number of implications and insights into the effects of unfavorable economic circumstances on agri-food supply networks.

In this work, L. Li (2020) has produced a number of useful contributions by studying problems in the realm of higher education through a lens of systems theory and thinking. An impact of Industry 4.0 on education is far-reaching and thought-provoking. It prompts us to reevaluate the skills and information that students should have upon graduation, the best way to speed up the process of reskilling the workforce, and the fundamental components and interconnections of an education supply chain. In this research, a term "education supply chain" is first used. In addition, they have concluded from our study that educational systems and configurations like trans nationalization and international mobility are all products of the connected industrial revolutions. The last suggestion is a system thinking-based educational framework. They put our study on the advantages of exchanging top talent and worldwide intellectual resources via joint ventures in education and transnational mobility within the framework of Industry 4.0, and they connect our investigation with changes that are occurring in the higher education sector.

Chou et al. (2020) This research elucidates several processes among many mediation-moderation models pertaining to 622 restaurants in Taiwan that were recognised for their innovation and received government loan subsidies for entrepreneurship, and that were associated with an innovative brand for a period of shorter than three years, between 2015 and 2017. The researchers discovered that creativity and absorptive ability mediated

the association between market orientation and performance, whereas entrepreneurial orientation and performance were correlated via market orientation. Research shows that human capital is an important moderator that enhances the connections among innovation, absorptive capacity, and market orientation. The study also found that competitive strategy improves performance by strengthening the bonds between innovation and a focus on the market. The suggested models' first and second orders are also presented; they should make moderation and mediation studies in the hotel and tourism industries more applicable and accurate.

Suzan et al. (2019), This research examined various processes in several mediation-moderation models within the context of 622 restaurants in Taiwan. These eateries were associated with an innovative brand for little over three years, from 2015 to 2017, despite receiving government subsidies for innovation and loans for business. Our results show that an individual's capacity for absorption and inventiveness mediates the relationships among market orientation and performance. The connection between an entrepreneurial mindset and success is further moderated by a focus on the market. This study drew from all current populations by means of a census as its sample strategy. This research used a survey approach to examine SCM in Indonesian banking sectors. In order to analyze the data, a SEM method in conjunction with a LISREL programme was used. Accounting information systems are significantly impacted by operational risk management, intellectual capital, and business strategy when it comes to the study's findings. However, balanced scorecard users see a significant improvement in performance when focusing only on operational risk management and business strategy. OP-based balanced scorecards are known to be heavily influenced by the efficiency of an organization's accounting information systems.

2.3 Supply Chain Digitalization

Tian et al. (2024), An impact of digitising a supply chain on a company's total value was thoroughly investigated in this research. The analysis found that the company's total value was significantly increased by digitising the supply chain. Companies' internal control levels increased as an outcomes of supply chain digitization, which in turn increased their enterprise value, according to the intermediate effect test. Businesses that aren't in the high-tech or state-owned sectors have profited more from the supply chain's digitization, according to the heterogeneity research. Subsequent investigation reveals that SC digitization and government assistance work in concert to increase corporate value. The results have important policy ramifications for motivating market companies to digitalize their supply chains in a manner that optimises their performance and successfully changes them.

Salamah et al. (2023) This research looked at the mediating role of effective and integrated supply networks in an effort to close a substantial knowledge gap. The main objective was to get a deeper comprehension of the intricate impacts of digitalization on SC network operations. The research also examined how this relationship is impacted by the supply chain's dynamic character. They picked the survey respondents using a basic random sample technique, and then used SEM to analyse survey data obtained from 293 Turkish manufacturing businesses via an online survey. The study shows that digitalization leads to greater SC performance by improving integration and efficiency. They found that digitization mediated the association among SC performance and integration and efficiency in the SC. In addition, they look at how supply chain dynamism acts as a moderator, and they find that it positively affects the correlation among digitalization and integration of the SC.

Fahad Saddique, Urenna Nwagwu (2023), This study looked at how businesses may have an advantage in the market by improving their supply chain capabilities via an employ of digital technology, which can increase an efficiency of SC operations. The information was gathered from 322 managers and executives at Pakistani construction companies using a survey questionnaire. Findings from this research show that digitization is critical for improving supply capacities and performance, with digital supply chains mediating a relationship among digital SC and SC performance in a favorable way. The research found that digital technology helped construction businesses gain a competitive edge and enhance SC performance. This study contributes significantly to our understanding of digitalization skills, expanding upon previous work in the field. In addition, it provides insightful information for experts in corporate performance, legislation, and SCM. The study's findings may help shape plans and resources for SC members to work together more effectively when faced with uncertainty. This might ultimately result in the company's performance improving.

Bigliardi et al. (2022), SCM and coordination have become more effective because to the advent of cutting-edge digital technologies under the umbrella of Industry 4.0. A more intelligent model using digital technologies like blockchain, the IoTs, and ML is being achieved via the digitization of the supply chain. These technological advancements enhance and expand the ability to optimise methods for planning, sourcing, and procurement. The primary discussions surrounding supply chain digitization are the focus of this study. Because the issue is so significant to scientists, it will search, categorize, and analyze pertinent intellectual contributions to this area using a keyword-based organizing framework.

Chauhan et al. (2022), This study, which looked at an role of Industry 4.0 tech in sustainable SCM, uncovered several important areas for further investigation. In this

article, they will use the PRISM framework to talk about how important sustainable SCM is and how to include technologies that enable industry 4.0, such a digital twin, cloud computing, big data, AI, and the IoT. The research shows that most empirical studies on emerging nations are case studies, and that there is a dearth of research on this topic overall. A small number of studies have also addressed SCM from an operational, economic, and automated perspective. This research may add to what is already known about the role that the cloud computing, IoT, blockchain, big data, AI, and digital twins play in the future of sustainable SCM. Any company's sustainability performance may be examined using ESG measures, which stand for environmental, social, and governance, and the present research can be extended to include the technologies that enable Industry 4.0.

Q. Gong et al. (2022), established the theoretical foundation for supply chain firms' access to bank mortgage financing, and conducted a thorough examination of the economic principles guiding digital supply chain financing, contrasting it with conventional supply chain financing and highlighting its advantages and disadvantages. The results demonstrate that when there are an adequate number of businesses participating in the supply chain and enough accurate information about them, the supply chain's consensus mechanism can uncover nearly truthful business data while preventing data manipulation, fraudulent activity, and other ethical dangers. This enables banks to offer businesses on the chain affordable financing services while effectively controlling risks. Banks will still choose offline, more conventional approaches to risk management, including due diligence, if there aren't enough firms on the chain to ensure the reliability of their data. The decentralized and immutable ledger known as blockchain may dramatically improve the accessibility and efficiency of digital supply chain financing. This may be because of the digitization of businesses and the rising use of blockchain technology in supply chains.

Liu & Chiu (2021), The purpose of this study was to provide the groundwork for future research on the relationships between SC digitalization, integration, and company performance. A study model specifically looks at how supply chain digitalization acts as a moderator and how integration in the SC acts as a mediator. A total of 264 Chinese supply chain workers participated in an online survey. To analyze the data, SmartPLS 3.0 use PLS-SEM. This research found that digitization and supply chain integration both improve company performance. Supply chain integration plays a role in mediating a company's performance and is linked to the digitalization of the supply chain. The relationship between supply chain integration and company performance is even more favorably moderated by supply chain digitalization. The results provide useful information for ethical SC management and fill a need in the current literature. Based on the findings, digitalizing the SC may lead to a more ethical SC in terms of operational efficiency and transparency.

L. Han et al. (2021), addressed the difficulties and solutions associated with digitizing supply chains in contexts of decentralized, dispersed, and dynamic business. Industry 4.0 supply chains are described in detail, including their dynamics and complexity. The article goes on to evaluate supply chain performance from both a cost and quality of service standpoint, and then formulates SCM as an optimization problem with higher requirements for efficiency, timeliness, and quality of services. They have already gone over the difficulties of creating digital solutions for data collection, data fusion, and assistive data-driven decision-making. An effects on SCM are evaluated and possible solutions to these problems are suggested using information from a Chinese list of automakers. The suggested solutions have been determined to have a favorable and noteworthy effect on supply chains' digitization.

Seyedghorban et al. (2020), Objectives of this research were to categorize a body of current literature, analyze the themes that have been studied, pinpoint areas that need

more focus, comprehend the fundamental framework of the field, and suggest future avenues for research. They achieved this by combining quantitative and qualitative research techniques in a mixed-methods strategy. A qualitative content analysis was done after a bibliometric study of 331 studies with 12,709 references. The findings suggest a preliminary research agenda for the future that includes five avenues: supply chain agility, omni-channel and Internet of things, humanising manufacturing via digital manufacturing strategy, data science-enabled SCM, and resource-based perspective and beyond.

Kittipanya-Ngam & Tan (2020), Digitalization holds great promise, not the least of which is the possibility of revolutionising the food supply chain. Because they are more informed, consumers are wanting instant access to current information on the foods they have been consuming via digital media. Additionally, people are becoming more and more inquisitive about whether the food they eat is sustainable in terms of the environment and society. As a result, issues around the sustainability, safety, and traceability of food products are increasingly given significant consideration by farmers, distributors, processors, and retailers. Digitalization has opened the door to more efficient and flexible food supply chains that can meet the evolving needs of consumers and comply with regulations. However, digitizing an old-fashioned food supply chain is difficult and resource-intensive. Due to the abundance of middlemen, the long process of transporting food from farms to customers in poor countries may take months. There is a severe dearth of material available at the moment about the digitalization of the food SC.

Di Vaio & Varriale (2020), This research looked at the ways digital platforms affect BPM and the ramifications for executives. The initiative's stated goal was to reevaluate and revitalize seaport operating processes by reimagining the inter-organizational interaction structures that exist there. How might IT-based digital platforms cause seaport organisations to reevaluate and reimagine their business processes? That is the study issue.

Time savings and fewer research papers in operational procedures related to sustainability policy are among the many advantages shown by a multiple case study technique that compares two digital platform experiences at Italian ports (TPCS and GAIA). As a result, the company's operation becomes more efficient overall, and the sea-land SC benefits from better cooperative relationships. Providing a comprehensive analysis of the phenomena and empirical data, this paper seeks to address the existing research gap.

Muñoz-Villamizar et al. (2019) Examining scholarly works on digitization and sustainability as they pertain to SCM was a goal of this bibliometric research. In order to achieve this goal, 484 studies were analyzed in the Scopus database using the following criteria: publication date, field, source, centre, country, and citations. The dataset included articles published in peer-reviewed scientific journals between 2002 and 2018. Furthermore, the bibliographic information is mapped employing a co-occurrence of keywords and the most significant journals using VOS viewer software. According to the data, there have been two major shifts in the last decade: the first is the dominance of the United States as a global leader in SCM; a second is a structure of a subject matter, which is organized around two clusters: (1) energy-related technologies and (2) SCM, concepts and practices. Future study on this area may be better planned, designed, executed, and published if these findings hold.

2.4 Digitalization in Planning and its impact on the Performance of organization

Ribeiro-Navarrete et al. (2021) A performance of KIBS was examined in this research in relation to their digitization. The usage of information systems by them, together with the contingent variables of manager age, gender, and firm size, are the main subjects of the investigation. The performance of KIBS is examined in this research, with future financial performance serving as a proxy for performance. The fsQCA method was used to perform the study. According to a research, having elder managers, possessing a

high degree of digital tool training, updating social networks, and leveraging social networks for business goals may all improve an organization's success.

Mohamad Abou-foul & Soares (2021) Examining potential technological avenues for process transformation within industrial organizations was the driving force behind this study. This research fills this vacuum by creating and evaluating a paradigm for evaluating how servitization and digitalization affect business financial performance. Managers could get insight into the servitization process's digital transformation from this study's findings. These findings also have important theoretical implications for the servitization literature, since improving bottom-line outcomes requires integrating digital and service-specific skills that reevaluate a product.

Truant et al. (2021), This survey-based research investigates the spread of digitalization, the benefits and challenges of making the practical shift to digitalization, and how it affects performance. The sample consists of Italian listed enterprises from various industries. The results show how digital technologies are still being used in their infancy to assist day-to-day business operations, yet there are clear effects of digitalization on business performance. This study establishes new ground by concentrating on listed organizations, adds to the literature on digitalization and performance, and has consequences for management's investment in digitalization to create value.

H. Li et al. (2021), The researchers in this study used the information processing perspective (IPV) to conceptualize inter-organizational process coordination (IPC) that is facilitated by digital technology. Their research focused on the connections between market agility, organizational awareness, and IPC. Our survey of 102 US-based managers found that companies with a good grasp of digital transformation are more likely to have a digital tech infrastructure, foster internal and external relationships, and achieve strategic

alignment among digital tech and business processes. These factors ultimately improve the organizations' capacity to react quickly to economic volatility.

Volberda et al. (2021), Incumbent corporations, including both long-standing businesses and a few first-generation digital startups, have had to respond strategically to this proliferation. These revolutionary developments in digital technology are altering strategy in fundamental ways. Digital technologies have the potential to open up new avenues for innovation, client intimacy, and efficiency advantages. Digital transformation attempts, however, will not succeed in the absence of adequate digital routines, a change-oriented attitude, and structural adjustments. Considering this, they provide a framework for strategy development in the modern digital competitive landscape, highlighting the significance of the interplay between three elements: (1) the need to extend and reconfigure digital routines; (2) cognitive challenges encountered by managers in their pursuit of knowledge in the modern digital era and the creation of innovative digital business models; and (3) innovations in organizational structures that are more conducive to the acquisition of a competitive edge and the generation of value. Companies established before the rise of the digital economy may use this framework of fundamental pillars to map out four paths towards digital transformation. They continue by outlining the required management roles and explaining how the firm's reaction to or attempt to influence the ecosystem, together with the evolutionary or transformational character of the digital migration, affects top, middle, and frontline managers. Technology is at the heart of digital transformation, but how businesses adapt to this unfamiliar digital landscape is of greater significance. Digital transformation relies on more than simply technology; a well-thought-out plan is essential.

Martínez-Caro et al. (2020), Companies now have access to massive amounts of digital data, which may be utilized to generate new value. On the other hand, it is not quite apparent how businesses may maximize their performance by using digital technology.

The creation of a digital organizational culture is suggested as a research model that may help with company digitalization and the value creation from digital technologies, both of which lead to improved organizational performance. A global corporation with operations in over ten countries was the subject of the study, which included 93 manufacturing sites. SEM was utilized in order to test a theory. Based on a finding, businesses may increase the growth of value-adding activities by digitizing their operations. However, this potential can only be realized if organizations adopt a digital organizational culture. Businesses may raise performance by identifying the organizational culture that best aligns with their digital strategy.

2.5 Digitalization in Procurement and its impact on the Performance of organization

Wang & Bai (2024), They looked at how digitalization affected the way that strategic moves and layoffs affected a company's ability to turn around once it had entered a state of decline. In order for turnaround initiatives to be successful, declining companies need to be knowledgeable on how to carry them out. The argument must be made that digitalization allows organizations to create strong relationships with key players in their business ecosystem, and that these ties may provide useful information for response strategy development. Specifically, they argue that, because to digitization in its many forms, which links different stakeholder groups, firms may acquire data on different types of response operations.

Mebrate & Shumet (2024), This research established a framework for understanding procurement procedures, created new dimensions of those activities, and examined a connections among those practices and the performance of organizations. Through an use of structural equation modelling, the framework's postulated linkages were examined. The results showed that the performance of the organization is improved by

competent personnel and careful procurement strategy. Procurement planning and staff competence practices may help public institutions, especially universities, function at their best. The study wraps up with a discussion of its management implications, potential benefits and drawbacks, and recommendations for further research.

Amadi & Sampson (2024), In the context of the discourse pushing for changes in construction project procurement, digitization and environmental sustainability were the two main concepts that had gained popularity. Digitalization is widely seen as a critical facilitator of sustainability for the built environment. New standards for workflow and project deliverables have been established by digitalization, which has completely changed the dynamics between construction project teams. The lightning-fast development of digital technology has expanded the definition of project deliverables beyond physical products to include digital data describing the interplay between the two. Supply chains have changed as a result, and professional-client, contractor-end-user relationships have been reinterpreted. Project procurement processes are moving away from study-based documentation and towards digital workflows. The research shows how many parts of procurement may improve their sustainability performance with the use of digital technology. According to the research, a path towards sustainability in procurement for building projects must include dematerializing information flows.

Kirubakaran & John (2023), This research was essential in helping organisations assess their indent process more efficiently. For businesses, it meant better understanding vendor and dealer relationships and coming up with ways to keep dealers around. Insights like this might help the business plan better inventory management and payment procedures. It is always necessary for every organization to have a well-established organizational structure with top-level, middle-level, and bottom-level management. A positive rapport between the business and its suppliers has persisted. Suppliers like to speak

with customers over the phone. They need to be taught on contemporary communication technologies since the majority of them still use antiquated methods of communication like telephones. The purchase department is excellent at negotiating, which is advantageous for the firm since they will obtain the most business.

Raichuk et al. (2022), A scientific aim of the research was to provide a model for IT businesses' hardware procurement management business process to be digitalized. It emphasizes the usefulness and applicability of such a paradigm. An analysis and study of scientific literature on the topic of procurement management process optimization and digitalization across different sectors has been conducted. A number of models and methods were examined with the intention of building an integral model. These included a mathematical model of supplier selection using many factors, an optimisation model of cost determination, a regulating technique, a model for the border of delivery points, and an adaptive convolution approach. An investigation was conducted to inform the development of a model for IT organizations to digitalize their hardware procurement management business process. This paradigm is suggested with the following structure.

Andrea S. Patrucco & Glas (2021), In the case of local governments, this was especially true since procurement accounted for a large portion of budget costs and was therefore an important means of providing value to residents. This study uses quantitative data collected from Italian and American towns to look at how specific structural decisions for public procurement (such as degree of centralization, level of digitization, and level of standardization) relate to performance. While there is some evidence that levels of centralization and digitization are positively correlated with procurement success, little evidence exists to support the idea that the processes should be standardized. In the end, digitalization may be able to lessen the detrimental consequences of decentralization on cost reductions. Two kinds of procurement systems are identified by cluster analysis, one

more focused on quality and the other more on cost effectiveness. The procurement design is influenced by some antecedents (country, size, and amount of expenditure), but not performance.

Denicolai et al. (2021), Two types of organizational preparedness within SMEs were the focus of this disparity. The impact of AI preparedness on global performance was first the focus. Afterwards, it delves into the question of whether sustainability readiness affects the connection between digitization and internationalization. The empirical study draws on responses from 438 SMEs, including both local and foreign companies. As anticipated, the results corroborate that the international performance of SMEs is positively impacted by their level of Artificial Intelligence capability. Additionally, they discover that sustainability and digitalization are positively correlated; however, they become antagonistic development trajectories when the organization expands internationally.

Mapanga & Garidzirai (2021), The theoretical and practical gaps in our understanding of how Procurement 4.0 may affect the management of value chains in South Africa's public sector were the driving forces for this research's endeavour. This study sought to understand how the South African public sector views the effects of Procurement 4.0 on value chain management by conducting a cross-sectional survey research study using an online questionnaire. According to the detailed analysis of the South African government, a paradigm shift is necessary in the management of these organizations as a result of the many effects of Procurement 4.0 on SCM. Research from South Africa's public sector organizations reveals that smart and linked technologies from Procurement 4.0 have an effect on value chain management in terms of efficiency, overall costs, agility, resilience, flexibility, and value generation and delivery. The capacity of procurement 4.0 to integrate data from all stakeholders' value chains increases visibility

and cooperation, which in turn improves the efficiency of value chain management by lowering the frictional drag.

Thesis & Liberale (2021) Digital procurement techniques' effects on happy suppliers and top-notch operations were the focus of this study. Method - The 119 chemical industry suppliers who participated in the empirical quantitative data collection process were contacted. Using PLS-SEM, this research examines how digital procurement methods affect supplier satisfaction. It takes into consideration possible moderating effects and antecedents that are based on literature. Findings - Previous research has shown that relationship behaviour and development opportunities positively affect supplier satisfaction; our model adds to that body of evidence. It has also been confirmed that the latter is crucial in order to understand the preferred client status and, by extension, the preferential treatment. This study's null hypothesis states that supplier satisfaction, operational excellence, and profitability are not significantly related. There is no correlation between digital procurement procedures and supplier happiness, but they do have a good effect on operational excellence. There is little evidence that digital readiness or digital capacity imbalance mitigate the connection among digital procurement procedures and supplier satisfaction. Neither of these factors is considered a crucial antecedent for digital procurement practices.

Dijk (2021), The Corporate Group was the exclusive focus of this research, which laid the groundwork for future assessments of e-procurement utilizing an expanded maturity model. So, it proved that those who thought the four steps were too strict were correct. They suggest further studies to refine the evaluation method and the expanded model. The first things that need to be shown are how much e-procurement is covered in the additional dimension and whether the expanded model can be appropriately generalized. Experts in procurement from other organizations or sectors should be

interviewed in order to verify the extension using statistical analysis. Second, by adding a control subject and more seasoned participants, the evaluation method might be strengthened to ensure critical thinking and more realistic maturity levels. In contrast to external audits, self-assessments are not inherently less trustworthy; rather, they need assistance in order to lead the process via a defined methodology. Formalizing an appropriate action plan to start the improvement process should be the next step.

2.6 Digitalization in logistics and its impact on the Performance of organization

Nagy et al. (2023) The digital era has brought about a significant revolution in the logistics business. The effective flow of products and services across several sectors was made possible in large part by logistics service providers. Logistics companies, in order to be competitive in the face of ever-increasing technological advancements, must embrace digital solutions and adapt to a new terrain. Industry 5.0, the next wave of manufacturing, is characterized by seamless coordination between human and automated processes. Within this framework, the logistics industry is well-positioned to reap substantial benefits from implementing Industry 5.0 concepts, thanks to its complex supply chains and wide-ranging activities. This article will take a look at the logistics industry and service providers right now, analyzing the possibilities and threats brought about by digitalization.

Al-Ababneh et al. (2023), The study's objective was to catalogue a current pattern in an evolution of modern companies' digitization, marketing innovation, and logistical methods. Digital revolutionary technologies, when integrated into a company's marketing and logistics system, may optimise business operations, decrease management and operating expenses, and increase efficiency and competitiveness. Marketing and logistics work hand in hand, and there are some traits of key aspects impacting competitiveness that are proposed based on scientific generalizations. Modern businesses' commercial operations are increasingly automated thanks to remarkable technological advancements

and innovations in a marketing and logistics systems, which also help to identify the development trends of these companies. The foundation for this is logical and structural analysis. An organized strategy is required to take into account logistics and marketing as complementary parts of the never-ending loop that businesses operate in (production-promotion-sales-service-logistics).

Nagaraj (2023), Digital transformation has a major influence on the logistics and supply chain business. By using digital technologies, companies could improve their operations effectively. Advanced digital knowledge and artificial intelligence has transformed the logistics industry effectively and efficiently. The primary benefit of using digital technology is the reduction of expenses. The logistics sector is always coming up with new and inventive ways to modernise items and deliver them to customers as quickly as possible. Analysing the effects of digitalization in the logistics sector is the study's goal.

Chinelo (2021) This research looked at logistics companies in IfakoIjaye LGA, Lagos State, to see how digitalization affected their organizational performance. The investigation was framed by a set of five inquiries and two assumptions. The goal of the study aligned with the descriptive research technique. Participants were employees from 108 logistics companies in Ifako-Ijaye LGA, Lagos State. Using purposive selection procedures, 44 respondents were selected from the total population. A researcher-structured interview and a questionnaire named DOPLF were used to gather data. The null hypotheses were examined employing t-test statistics at a significance level of 0.05, and the research issues were solved by computing the mean and standard deviation. It was found that respondents were in complete agreement on the ways in which digital transformation has altered logistics companies and the degree to which connectivity and digital technology affect organizational efficiency.

Moldabekova et al. (2021), The study's objective was to highlight policymakers' responsibilities in enhancing national logistics performance in light of Industry 4.0. A country's industrial and economic growth are greatly influenced by the effectiveness of its logistics system. This is why they use statistical methods like multiple regression and correlation to examine how digitization has altered logistics performance. This empirical research makes use of World Bank metrics and dimensions from their DESI and LPI. The research indicates that for better logistics performance, governments should prioritise the following: increasing the number of IT experts in the workforce; promoting the long-term viability of online services like social networks and e-commerce; incorporating digital technologies like Big Data and Cloud computing; and guaranteeing digital connectivity through initiatives like fixed broadband and 4G coverage.

Bavrin et al. (2021) The study outlined the most common employment in logistics. To a sufficient degree, it examined the duties of roles in procurement, storage, transportation, information logistics, and extra-economic operations. Logistics staff members' work duties may be impacted by digitalization since as time goes on, less human individuals would be required. To that end, it is necessary to be able to recognise the kinds of tasks that information or automated systems may take over for. The following list highlights the key ways that digitization is affecting logistics: buying, information, transportation, and customs logistics.

Korepin et al. (2020) A goal of an investigation was to decide an optimal IT programme for an administration of MOOCs in digital logistics and the digital economy, with the intention of educating economics students. A survey was conducted by the authors to investigate the utilization of the Internet for self-education and education. In at least 80 areas of the Russian Federation, there are 1,600 respondents in the sample. There are four age categories of respondents: 18–24 years old, 25–39 years old, 40–54 years old, and 55

years and above. A research is based on information gathered from an online survey about digital transformation that 700 people participated in, representing 300 different Russian companies across 15 different industries. A research's findings support an idea that online education needs a major overhaul to meet the demands of the modern job market for digital logistics experts. These professionals must be able to effectively manage their time, focus on customers, communicate verbally, solve complex problems, be proficient in negotiations and information literacy, and teach others how to do the same. When economics students participate in online training courses within the context of the university system, the findings of this study may be put into effect.

Pokhylchenko & Flyk (2020), The study examined the methodological facets of the logistics customer service management process, emphasising ways to enhance the process's digitalization potential. Some international writers claim that the phenomena of digitization have not received enough theoretical attention and has enormous room for theoretical advancement. Still, the scientific community is just beginning to take notice of Ukraine's digitization of logistics. As a result, many domestic businesses face challenges when integrating innovations and digital technologies to maximize their productivity. This establishes the goal and the useful duties of the assigned research as well as actualizes the issues of the investigation. It has been found that the main benefits of digitizing logistics processes include better and more efficient management, the ability to address risks and threats quickly, easier processing of large amounts of data for analysis, and more accurate assessments of those results.

2.7 Digitalization in warehousing and its impact on the Performance of the organization

Kihel (2022), A warehouse served as a connecting point for all of the logistics chain's partners, an integral aspect of logistics management, and a competitive component.

Efficiently managing warehouses and allocating their resources is now crucial. One area of study within Logistics 4.0 is the digitization of warehouses. The approach for the digital transformation of warehouse management is described in this paper. It has four primary components: a warehouse diagnostic to determine the various processes, an employee engagement assessment to determine the level of maturity, a maturity calculation to determine a noval technology and methods of data transfer, and software for data collection and processing. This approach to digital transformation was used with an industrial business. The outcomes made it possible to enhance every metric that assessed the warehouse's performance in terms of the economy, society, and environment.

Minashkina & Happonen (2020), A major component of supply chain carbon footprints was the efficiency of outsourced warehousing, which was driven by the then-strong outsourcing trend. When properly implemented, a warehouse management system may significantly improve the eco-friendliness of warehousing by cutting down on space waste and the needless transportation of products, allowing for a constant and rapid flow of supplies while simultaneously minimizing the need for heating and cooling. The operator will need to automate, digitise, and robotize their processes if the maximum degree of efficiency is desired or required. All of this may occur to some extent within the classic manual warehouse scenario. The authors provide an example of automation in the context of warehousing, whereby a warehouse operator may reverse an order queue as an outgoing packet, even during periods of high peak demand that last less than three hours. Because products remain in the warehouse for shorter periods of time because to this efficiency, less storage space is required. Additionally, because of this automatization, 3PLs may store materials in highly automated systems such automated storage and retrieval systems to maximize their use of available space.

Hao et al. (2020) Conceptually modelling logistics businesses' adoption of green technology within the context of technology, organization, and environment, this study investigated the factors that prompted such adoption. Our model predicts that several factors impact green technology adoption rates, including company size, firm scope, operational effectiveness, cost, perceived benefit, and technical volatility. This study aims to ascertain the prerequisites and motivators for automated warehousing system adoption in logistics companies. The data was analyzed employing SEM and PLS after being collected from 98 Chinese enterprises. The results suggest that factors such as firm size, cost, scope of the organization, operation success, technical instability, business partner impact, and strong perceived relative advantage are important determinants of IT adoption in small businesses. Automated warehousing solutions may be more widely used if businesses have decision-making assistance that included technology, organization, and environment.

Kudelska & Niedbał (2020), The pace for these developments was determined by this region. However, one could not overlook the importance of personnel in the pursuit of cost reduction and improved warehouse process efficiency. A warehouse worker influences not only the structure of an organization's logistics system but also every link in the supply chain, in addition to efficiency and amount of produced expenses. The goal of this research is to find out how picking station personnel workload and picking process efficiency have changed as a result of organizational and technical innovations in warehousing. The investigation was conducted using models created in FlexSlim 3D Simulation Software for warehouse simulations. Warehouses in business-to-consumer (B2C) logistics are modelled after these virtual ones. Depending on the size and form of the selection, they cover the layout of bag-type warehouses. Each of the three warehouses has an identically sized

storage zone. The inventory is stored in these warehouses in a completely random order. They have run many simulations for each model.

2.8 Sustainability initiative and Key Drivers in the sustainability of supply chain

Afghah et al. (2023) A purpose of this research was to assess how oil and gas sectors' EA and MAE strategies fare when faced with challenging characteristics. The data has been ranked using the Ordinal Priority Approach (OPA) and the Bayesian BWM. Next, the DEMATEL method is employed to determine a cause-and-effect correlations. Findings show that different firms' business approaches and new product/technology development initiatives affect a ranking of a hard dimensions. Basically, the research shows that "innovation" is important for businesses that want to lessen their environmental effect, and that "technology for cleaner manufacturing" are important for businesses that want to create environmentally friendly goods. The most critical aspects of ESSCM in both kinds of business policies are "lean manufacturing," "total quality management," and "institutional pressures," while "supplier relationship management," "green purchasing," and "green logistics" are the least critical. This research's results may help oil and gas decision-makers prioritise and understand the interplay of the factors that have a major influence on the ESSCM.

Iranmanesh et al. (2023) Conducting this study served to find out how much of an impact blockchain technology has on supply chain characteristics and how much of an impact it had on SMEs' decisions to use blockchain. The research looks at how market volatility acts as a buffer, using contingency theory as a framework. Examining data from 204 SMEs in Malaysia, they used the partial least squares approach. The choice to embrace blockchain technology was influenced by the advantages it offers to supply chain agility and transparency, which in turn influenced the management of SMEs. The four pillars of an adaptable supply chain are alignment, transparency, agility, and adaptability. The

correlation between agility and intent to embrace blockchain is moderated positively by market volatility. Contributing to the existing body of knowledge, this research analyses the idea of relative advantages and investigates how blockchain benefits affect blockchain adoption. Market volatility acts as a moderator, suggesting that SMEs in volatile environments are more affected by blockchain's impact on agility than SMEs in more stable markets. The results provide policymakers and blockchain providers with useful information for accelerating the use of blockchain technology by SMEs. Furthermore, the findings reassure SME owners and managers that blockchain technology may provide a significant competitive edge.

Bubicz et al. (2021) Using NVivo software, content analysis was used to undertake a qualitative analysis for this research. The study's main objectives were to ascertain the supply chain's structure and key players, and then to comprehend the primary forces behind social sustainability management. There was an examination of six multinational corporations' sustainability reports covering the years 2014–2018. According to the results, social sustainability is an element of strategic objectives in the form of policies and commitments. As a result of input from outside parties, a number of supply chain initiatives have been launched to promote fair labour practices, safe working conditions, social progress, and product accountability. Ultimately, this study advances our knowledge of how social sustainability in the garment industry should be handled within the framework of an international supply chain. By illuminating avenues for future research, this work adds to the body of knowledge in the subject.

Geyi et al. (2020) It was necessary to investigate and clarify how agile methods affected sustainability performance metrics, particularly in light of the growing popularity of both technologies. It is still unclear how much agility contributes to sustainability performance improvements or not. As a result, they looked at the interactions among

sustainable practices, agile methodologies, OP targets, and organizational sustainability. A study was conducted in the UK with a net of 311 respondent organizations, focusing on supply chains with greater carbon and energy use. There is a robust relationship between sustainable SC strategies and agile ones, according to the research. In addition, the research suggests that agile techniques help achieve operational and sustainability performance goals. In contrast to the well-established association between agility and operational success, a novel link has been found between agile approaches and sustainability performance. The results also demonstrate that operational success and sustainability performance are both predicted by sustainable SC strategies. When agile methodologies are used to manage a relationship among sustainable practices and performance, a latter is enhanced.

Govindan et al. (2020) This researches pooled information from 167 effect sizes using a psychometric meta-analysis to see how various sustainability initiatives affected business performance. The effect sizes came from 129 different researches and included topics such as environmental, social, and integrated sustainability. Several dimensions of business success are positively correlated with sustainability, as demonstrated by the research, and this correlation becomes more robust over time. The outcomes also displays that compared to a service sector, the association between sustainability and company success is greater in the industrial sector. This research adds to our knowledge of how sustainable supply chain methods affect company success, which can be useful for businesses and politicians in various economies.

Zanin et al. (2020) The study's objective was to get an understanding of how the sustainability drivers identified by the TBL perspective—such as value chain support, enhanced technology and management practices, and assistance for farmers—operate in dairy farming. The research put four theories about what makes the dairy supply chain

sustainable to the test using data from 54 rural farms in the Santa Catarina area of western Brazil. In addition, the data was analysed using first- and second-order SEM in the SMART PLS programme. The results show that, although good management practices and government legislation both contribute to social sustainability, the former has a more beneficial impact on economic sustainability. Additionally, it was determined that environmental sustainability is positively impacted by enhancements in production techniques. This effect is primarily influenced by the implementation of effective management practices, with policies specifically targeting the supply chain having a lesser impact. The results of the second-order sustainability variable analysis show that while considering sustainability, the producers put an emphasis on economic considerations. Environmental aspects are nevertheless overlooked.

Hussain et al. (2019) The researchers set out to rank the four primary drivers of social sustainability in the healthcare SC and establish a method for identifying which one is most crucial. Conducting a survey to identify the healthcare supply chain's pertinent social sustainability drivers is the first stage. The 34 motivators that were discovered during the exploratory phase were organized into a hierarchical structure. Analytical hierarchy processing (AHP) is then used to rank the social sustainability motivators' criterion and subcriteria. The research uncovered 34 subcategories under the five overarching categories of "organizational practice," "media and reputation," "excellence and awards," "technology and innovation," etc. Media, Reputation, and Organizational Practice were ranked first with in AHP. By providing a systematic method, the study's framework aids healthcare practitioners in accepting social sustainability across the chain.

Zhuo & Ji (2019) Supply chain coordination allowed for the sustainable growth of China's livestock output, which was the focus of this research. Evidence of supply chain sustainability points to a combination of strong coordination across the chain and the

competence of the key enterprises. This work sheds theoretical light on the critical roles played by core business capabilities and supply chain coordination, which enhances our knowledge of supply chain sustainability. By better coordinating a SC and a capacity of the primary firms involved, the government and stakeholders in the livestock SC may apply this study's practical results to enhance the sustainability of the chain.

2.9 Benefits of Supply Chain Sustainability initiatives to Organization performance or Customer satisfaction

Cahyono et al. (2023) In this research, they looked at how SCM strategies affect both competitive advantage and business outcomes. Results for this research were compiled from questionnaires filled out by 165 individuals working for a SME in Indonesia's Halal Agroindustry. The results of the survey were analysed using PLS-SEM. OP and competitive advantage may be enhanced with a greater level of SCM practice, according to the findings. Gaining an advantage over the competition may also help a business run more smoothly. This research supports previous findings that suggest a mediating role for competitive advantage in the connection among SCM practices and OP.

Fan et al. (2021) In this study, 768 firm-year observations were analyzed using dynamic panel data analysis using data obtained by 4 secondary sources. Sustainable supplier development programmes were discovered to have the potential to boost customer satisfaction, which in turn led to better sales performance for enterprises. Furthermore, the firm's reputation negatively moderates the association among sustainable supplier development activities and customer satisfaction, whereas the firm's advertising intensity favourably moderates the relationship. These findings provide solid proof that increased sales performance is linked to sustained supplier development programmes via the legitimate mechanism of customer pleasure.

Jum’a et al. (2021) This research looked at how supply chain operations affect both financial success and environmental sustainability. Furthermore, a role of environmental sustainability in facilitating sustainable development was investigated by looking at how it mediates the relationship between financial performance and SCM. Manufacturing enterprises in Jordan were asked to fill out a well-crafted questionnaire in order to gather data. Using a SEM technique, they examined 376 answers and evaluated our assumptions. The results demonstrated that supply chain methods, such as customer interactions, latency, information exchange levels, and information quality, significantly affect environmental sustainability. Environmental sustainability, on the other hand, significantly impacted revenues. As a conclusion, with the exception of the strategic supplier partnership component, all practices of supply chain management were associated with financial success via environmental sustainability. Additionally, the research aids managers in enhancing sustainable practices in manufacturing organizations and gives policymakers advice.

Modica et al. (2020) The main objective of the study was to determine, from an economic, social, and environmental standpoint, what elements impact brand loyalty, customer satisfaction, and premium willingness in relation to sustainability initiatives carried out by different links in the hotel industry's supply chain. Consumer happiness, loyalty, and readiness to pay a premium are favourably impacted by sustainability practices that address economic factors, according to an examination of 288 visitors' experiences in southern Sardinia. Sustainability practices that prioritize social and environmental aspects, on the other hand, have a good effect on satisfaction, which in turn influences loyalty and premium willingness. Also, the results show that customer happiness mediates the relationship between environmental and social sustainability initiatives and brand loyalty. The study has the following theoretical and management consequences.

Y. Yu et al. (2019) The researchers set out to build a model that would explain the connection between SCQI, environmental performance, and GSCM—which encompasses both supplier and customer quality integration—in order to better understand the dynamics at play. Data acquired from 308 manufacturing enterprises in China is used to experimentally test the model. They discovered that integrating supplier and customer quality has a beneficial effect on environmentally conscious buying and customer green collaboration, leading to better environmental performance. Through eco-friendly purchases and eco-friendly partnerships, supplier and consumer quality integration indirectly affects energy efficiency and biodiversity. This study contributes to the literature on quality and green management by elucidating the pathways by which SCQI affects environmental performance and by demystifying the intricate connections between SCQI and GSCM.

M. Gong et al. (2019) The main purpose of the research was to find out what factors companies may use to boost their SSCM skills. Research shows that when consumers are aware of a company's information environment, it has a beneficial effect on sustainability performance and the adoption of SSCM. It used a fixed-effect model and analyzed data from 2206 enterprises worldwide from 2002 to 2015. Evidence from our study suggests that the connection among an organization's information ecosystem and its SSCM performance is moderated by its sustainability competency. Another thing they discover is that stakeholder participation changes this connection. At a time when environmental protection, social responsibility, and associated strategic opportunities are more important than ever before, this research is pertinent because it teaches companies how to enhance a sustainability of their SC by examining a factors that affected the development of SSCM.

Sutduean et al. (2019) Examining how SCM affects business output was the primary motivation for this empirical study. Additionally, this study is looking at the

connection between SCM and organizational performance, specifically how green marketing mediates this relationship. This research addresses a topic of managing green marketing by focusing on ideas from SCM. Using organizational performance and green marketing as lenses, this research will investigate a literature on SCM. SCM techniques affect a company's competitive edge and performance, according to the research. Their competitive advantage is anticipated to be enhanced via product innovation, speed to market, reliability of delivery, product quality, and pricing. Prior research has shown that a company's competitive advantage may be affected by certain supply chain management techniques. Findings from the research corroborate the idea that process design is only one part of the SC that has to be altered after get high performance.

Sutduean et al. (2019) This empirical research's main goal was to look at how SCM affects organizational performance. It is also the aim of this research to examine the role of eco-conscious marketing as a moderator among SCM and organisational performance. This study discusses managing green marketing by focusing on principles related to SCM. The research will make a contribution to the field by examining SCM literature from the perspectives of green marketing and organizational performance. The research findings indicate that SCM strategies have an influence on an organization's organizational performance and competitive advantage. Through product innovation, speed to market, delivery reliability, quality, and pricing of the product, it is anticipated that they would increase their competitive edge. An organization's competitiveness might be influenced by other SCM tactics, according to previous studies. The research's results indicate that, after get optimal performance, it is important to modify all facets of the supply chain, including the process design.

Tomic & Spasojevic Brkic (2019) A goal of this research was to examine an impact of ISO 9001 quality improvement standards in ISO 9001:2008, particularly internal audits

and corrective and preventative measures, on customer satisfaction. The study's findings came from a survey sent out to 200 transportation and aerospace companies that are linked to a Canadian multinational supply chain. The SEM approach was used to investigate the links between internal audits, customer satisfaction, and corrective and preventative measures. The primary finding of the research is that, throughout the ISO 9001 transition period, the most critical needs for continuing improvement were internal audits and corrective actions. In contrast, preventive actions in the current formulation had no discernible impact on customer satisfaction.

2.10 Human Capital Skills and Knowledge sets required for conventional supply chain

Qu (2024) A goal of this study was to improve SC human capital from a digital transformation standpoint. This study's research methodology included defining human capital differently and examining the conflict between the changing personnel structure. In terms of a SC, a need for human capital development, the state of businesses undergoing digital transformation, and more research into particular solutions. This study found that in order to create better digital human capital, companies should collaborate with schools to improve digital supply chain courses and competitions, raise staff awareness of digitalization in the supply chain, monitor and treat employees' mental and physical health, and teach them to be self-aware. To speed up and finish the digital transition, society should prioritize creating a digitally humanistic environment that helps people build their human capital.

Sakka & El Hadi El Maknouzi (2022), This research attempted to provide a three-pronged review of how AI has been incorporated into the field of HRM. The study's first portion highlighted the advantages of AI-assisted decision-making, suggesting that human resources professionals will eventually be able to focus more on strategic tasks and less on

routine ones. The second part relates to how the HR department is positioned inside companies. The HR department will transform into the hub of strategic decision-making when AI enables a shift by a reactive to a proactive approach to solving organizational challenges. The third thread offers a high-level overview of the legal concerns connected to anti-discrimination and regulatory laws, and it discusses the financial impacts of AI deployment (because cost-benefit analysis is more prevalent in decision-making). Adopting AI with prudence is essential if it is to realize its promise of improving organizational performance. To accomplish this, they must first hire the right people, train HR to mediate among human stakeholders and AI-generated assessments, and institute an internal transparency policy to prevent AI from becoming a control mechanism and instead encourage trust and commitment from staff.

In this research, Úbeda-García et al. (2021), they looked at two concepts that have recently gained traction in management literature: CSR and GHRM. Despite the fact that research in both fields has progressed in parallel thus far, they feel that a more thorough comprehension of the interplay between the two is necessary to comprehend the impact that both have on the financial and environmental outcomes of a company. The purpose of this research is to examine the connection among CSR and financial outcomes for companies by considering the direct relationship as well as any possible mediating roles played by variables like GHRM and environmental impacts. A variation-based SEM method called PLS was used to a cross-section of Spanish hotel chains. The findings demonstrate that there is a clear and beneficial correlation between performance and corporate social responsibility. Furthermore, they have discovered that GHRM and environmental outcomes mediate an indirect influence on the previously described link. The research's findings offers valuable insights for managers as well as many additions to the literature on GHRM and CSR.

W. Yu et al. (2020), The study's overarching goal was to learn how GHRM and internal GSCM impact one another in encouraging suppliers and customers to work together for environmental sustainability. Moderated regression analysis is implemented to evaluate a survey of 126 Chinese manufacturers. The study's conceptual paradigm is built upon the CT and the AMO theory. Findings show that environmental cooperation with clients and suppliers is strongly and favourably correlated with GHRM, and that internal GSCM considerably moderates these associations. It is suggested that HRM professionals, after facilitate an implementation of environmental collaboration, should establish GHRM practices that provide training, incentives, and conductive settings. Meanwhile, SCM experts may boost GHRM's advantages by improving internal GSCM. In order to understand these synergies and the moderating effect of internal GSCM, this study builds and tests a general model, and it identifies key GHRM actions that advance GSCM and enhance linked studies.

Stahl et al. (2020), The current study centred on the increasing pressures on corporations to engage in CSR and CS after meet the needs of a broader variety of stakeholders, tackle global challenges, and alleviate the business confidence crisis that was happening at the time. While HRM has not traditionally played a pivotal role in bolstering a company's CS/CSR activities, you may argue that this could change. Discuss how HRM may be more involved in creating and executing a company's CS/CSR strategy and examine the shortcomings of this approach. Develop a strategy for sustainable HRM that takes into account the needs of all stakeholders and aims to protect them while also advancing the triple bottom line. This strategy builds upon earlier attempts to include CSR and sustainability into the HRM performance framework. Construct a list of potential areas of research focus and suggestions for future studies, and discuss their potential effects on the field.

Yong et al. (2020), This research used cross-sectional data collected from 112 big Malaysian manufacturing companies to look at how green HRM practices affected sustainability. The findings demonstrate that sustainability benefits from environmentally conscious hiring practices and green training. Analysis and job descriptions, selection, performance assessment, and return on investment were shown to have little effect on sustainability. The model presented in this research sheds light on how green HRM helps Malaysian manufacturing enterprises remain viable in the long run, which is particularly useful since there is a lack of literature that specifically addresses the relationship among green HRM and sustainability within this industry. This makes the research highly relevant to both academics and industry professionals. This research only looks at developing economies like Malaysia's using a small set of contextual factors. In other settings, future studies may investigate how green HRM interacts with additional factors that might enrich the current framework. It is possible that future research may examine the many facets of sustainability in connection to each green HRM dimension, or additional green HRM components.

Gómez-Cedeño et al. (2015), The study's overarching goal was to provide empirical evidence that HRM mediated a relationship among SCM and CS and organizational performance (OP), two key performance indicators for any business. The PLS-SEM is used to validate a model and test a hypotheses formulated. Organisational performance, customer satisfaction, SCM implementation (SCMI), SCMO, and HRM are the five pillars upon which the model rests. The current model that was evaluated in a different geographical environment was used to borrow these components. This was accomplished by means of a survey, to which 231 legitimate replies were collected. According to the data, HRM significantly affected SCMO both directly and indirectly, while SCMI mediated the interactions between HRM and SCMO. When it came to the interactions between

SCMO and OP, CS was also the go-between. These results imply that CS and OP are indirectly enhanced as a result of a well-implemented SCM, in addition to SCMO being directly improved.

2.11 Blockchain Applications in Supply Chain Transparency and Traceability

Sied (2024) This research delves deeply into a topic of machine learning for blockchain-based SCM, specifically looking at solutions for decentralised transparency and traceability. Integration of blockchain and ML was one of the topics covered, with a potential benefits of SC optimization, traceability, and transparency being highlighted. An use of ML algorithms for predictive analytics and anomaly detection, the function of blockchain in creating a distributed ledger for SC data, and an advantages of decentralized transparency and traceability in enhancing SC efficiency and decreasing fraud are all important subjects. Additionally, they go into issues like data privacy, interoperability, and scalability, while also discussing the potential future of this groundbreaking method.

Azevedo et al. (2023), The enormous size of supply chains has an effect on company competitiveness since it complicates matters and makes it harder to provide transparency, chain of custody, and traceability. Organisations may show product origin, integrity, and compliance with their proposed Blockchain (BC) system that ensures chain of custody and traceability. The authors of this piece argue that digital certificates should be used to link product identifiers with Supply Chain Actors (SCAs) in order to achieve full traceability. Product tracing and identity authentication are both handled by a blockchain. A solution for off-chain data storage for product certificates, IDs, and data (i.e., WalliD) is used for importing, validating, and storing the certificates. The concept included the development of a Public Key Infrastructure (PKI) for use in certificate creation, validation, and chain of trust construction. Aftter better understand a needs of supply chain traceability and to offers a solution, our study adheres to a Design Science research

methodology. A PKI-based certificate authentication system and an Ethereum Smart Contract were among the architectural artefacts that emerged from the process. All organizations and end users may benefit from a supply chain system that guarantees the product's provenance, chain of custody, and traceability features via the deployment of these deliverables.

Khan et al. (2022), The study's overarching goal was to dissect how SC traceability and transparency were affected by digital changes including BCT, the SIoT, and AI approaches. A structural equation modelling (SEM) approach known as partial least squares (PSL) was used in conjunction with SmartPLS v3.3.6. This software was used to conduct a survey among SC Pakistani professionals utilizing the snowball sampling method after gather data. In order to improve SC performance via BCT, SIoT, and AI, traceability is essential for increasing transparency. Consequently, the report suggests that the SC begin its digital transformation, which is a complicated process involving many internal and external parties. As an analytical interdisciplinary approach, the study's outcomes highlight a significance of traceability and transparency technologies in improving a SC sector. Stakeholders should be aware of the limits. All parties involved in making investments in transparency and traceability technology in the SC may benefit from this study. This study reviews the literature on SC, finds gaps in our knowledge, and proposes research directions all while emphasizing the significance of transparency and auditability. There is much written on supply-chain traceability and transparency (SCT), but less on how digitalizing the SC may boost traceability and efficiency.

Sunny et al. (2020), A literature review on blockchain-based traceability solutions was the primary aim of this research. The main takeaway from this research is the insight it provides into how blockchain traceability technologies might enhance supply chain visibility. In addition, it delves into the ways in which smart contracts and the IoT expand

blockchain's capabilities, and it analyses how various supply chain distribution network designs' transparency is affected by blockchain traceability solutions. With the help of Microsoft Azure Blockchain Workbench, this PoC aims to show how cold chain supply chain transparency may be improved by leveraging blockchain traceability technology.

Mirabelli & Solina (2020), This research compiled and reviewed the most important findings from the literature on blockchain technology's potential uses in agriculture, with an emphasis on problems related to food traceability. There is a pressing need to compile a comprehensive inventory of the numerous techniques put forward by researchers in light of the rapid development of this technology and the abundance of published papers in the last few months. Finding current research trends and potential future obstacles is our goal. The demand for a comprehensive traceability system in agriculture is driven by a variety of unwanted practices and concerns, such as the extensive use of fertilizers and pesticides in produce, which have serious negative effects on human health. Furthermore, consumers' awareness of agricultural product quality has significantly increased in recent years. The results of this investigation indicate that blockchain technology is in its infancy. Relatively few applications have been put into practice in the real world, despite the abundance of suggestions in the literature. Italy is also deeply involved in this subject, but the US and China are the two countries investing in this technology from the standpoint of scientific research. Though a lot of work remains until blockchain technology reaches a mature state, overall, it seems quite promising.

Tiwari (2020), Participants doing business in circumstances where confidence is absent are able to rely on blockchain because to its immutability. Blockchain creates a trustworthy environment by using consensus methods. The incorporation of immutable data made available by blockchain technology makes it easy to track a product's origin. Using examples from the food and agricultural supply networks, this research shows how

blockchain technology may be useful. It explains how to increase traceability in an Agri Supply Chain by using blockchain technology. This connection allows organizations to easily trace the origin and distribution of potentially dangerous items. The integration has the potential to save lives, cut down on medical expenses, and avert product recalls.

Biswas et al. (2023), This study put up a game-theoretic model for a single manufacturer-retailer SC. Customers all throughout the globe buy from the SC, however there are problems with product quality assurance because to a lack of traceability. This problem can be addressed by using blockchain technology, which has advantages like reduced transaction costs and strong traceability. However, blockchain's high energy usage is a major environmental problem. Therefore, the authors of this study clarify the sustainability and traceability trade-offs associated with blockchain adoption by using a game-theory model. Firms fear using blockchain due to high levels of mistrust, according to our data. In these situations, blockchain alone is insufficient to convince customers of the quality of the products and to believe in the businesses' business operations. Alternatively, businesses must carefully consider the trade-offs between sustainability and mistrust. Low levels of mistrust, on the other hand, may make blockchain a commercially viable technology conditioned to minimum environmental effects. Low price sensitivity and high quality sensitivity are the two characteristics that decide whether to explore blockchain technology, as its acceptance leads to higher pricing and less suspicion.

Wu et al. (2023), The efficiency problem in supply chain traceability using blockchain technology has never been examined before, until this research. The old way, which included searching through the records, was contrasted to it. using parallel search to improve speed, duplicates the data in many chunks consecutively, and stores them in a single chunk. The record-searching primitives must be distributed among the chunks with the maximum parallelization ratio, but this is easier said than done. For this purpose, they

use a maximum matching technique to solve the allocation issue after modelling the records and chunks as a bipartite network. Affordable storage overhead may minimize time overhead by up to 85.1% according to the trial findings.

Ada et al. (2021), The purpose of this research was to analyze the difficulties encountered by the automotive sector across the board in supply chain operations. Total supply chain efficiency was also negatively affected by the automobile industry's supply chain's problems with traceability and waiting periods at different nodes. As a means to enhance supply chain traceability in the automobile industry and decrease waiting time, this research examines current blockchain designs and implementation methodologies before recommending a new blockchain-based architecture. To keep tabs on the passing of ownership in incoming and outgoing logistics, a blockchain architecture based on hyper ledger fabric is created. Items may be better monitored at various stages in the SC using a recommended blockchain architecture based on hyper ledger fabric, resulting to an enhanced IQR. Supply chain efficiency is enhanced across the board as a result of shorter average wait times at a manufacturer, wholesaler, and retailer. The use of blockchain technology will improve the security and efficiency of the automotive supply chain. The article also describes how blockchain technology is being used in the automotive supply chain.

Bai & Sarkis (2020) This research presented performance metrics for blockchain technology that include different technological aspects and transparency levels for sustainable supply chains. Additionally, it unveiled a brand-new hybrid group decision-making technique for blockchain technology selection and assessment that combines regret theory with hesitant fuzzy sets. This approach highlights the psychological traits of decision-makers and the diversity of their viewpoints. Researchers and supply chain managers may better grasp the blockchain technology selection choice with the help of an

example application and sensitivity analysis. The discussion begins with the introduction of the choice tool and its implementation, followed by the methodological and management consequences. Important future studies evaluating blockchain technology in a SC setting will build on this work.

Dutta et al. (2020), 178 studies in all were taken into consideration for this analysis, which looked at all a relevant study done in an area related to SC operations using blockchain integration. Along with highlighting the main trends and difficulties, they also emphasise the accompanying prospects, potential social implications, and present state-of-the-art technology. They take a look at how shipping, manufacturing, automotive, aviation, technology, finance, healthcare, energy, education, e-commerce, and agriculture and food can all be improved with blockchain-based technologies that manage business processes and increase visibility. A future research agenda may help to provide a firm groundwork for more research in this vital and rapidly growing field of study.

S. E. Chang & Chen (2020) Examining the current state, potential applications, and future advancements of blockchain technology in SCM was the objective of this research. A literature analysis and analytical assessment of blockchain-based SC studies were conducted to get a better understanding of the evolution of relevant research and to illuminate the pros, cons, and challenges of the blockchain-supply-chain paradigm. This research aimed to summarize the 106 review papers that looked at SCM using smart contracts and blockchain technology. Academics, engineers, and industry professionals are paying more and more attention to the wide range of practical uses for these technologies across many industry sectors. The future of supply chain digitalization and integration, stakeholder involvement and collaboration, common frameworks on blockchain-based platforms, and transparency and traceability are four main issues. Trust, performance, and several middlemen are typical problems in a traditional SC. The decentralization, improved

performance, and process automation made possible by blockchain technology might radically alter the way supply chain activities are run. This paper offers a blueprint for blockchain applications in SCM based on literature analysis and helps to our understanding of these applications.

Chan et al. (2019), The study's objective was to offer the groundwork for a blockchain-based, transparent, and traceable SCM system in Malaysia's agri-food industry. When different enterprise resource planning (ERP) systems use centralized SCM, many studies think that there are a lot of theyak points in the existing SCM system. Consequently, there is a lack of data traceability and transparency. This research postulated that the aforementioned constraint might be mitigated if blockchain technology is associated with SCM transparency and traceability, given that blockchain operates in a distributed fashion. In this study, the agri-food domain "pepper" is used. In comparison to permissionless blockchain, permissioned blockchain is more suited, according to the study.

Haroon et al. (2019), To replace the FSC's traditional third-party data authentication process, this study proposed a blockchain-enabled IoT platform architecture. All parties participating in the system have agreed upon the parameters that this platform will use to verify the authenticity and compliance of product data gathered by sensors at each step of a SC. They provide a case research that backs up a concept of creating a data network using accessible IoT technologies. It describes in depth the many technologies that may be integrated into the IoT platform and how it bolsters the suggested design. demonstrate the feasibility of employing blockchain technology in conjunction with IoT technologies to enhance and modernize the conventional FSC.

Benton et al. (2018), The study highlights the need of managing global supply chains in an ethical, safe, and ecologically conscious manner, with a particular emphasis on data quality and management. Despite the benefits, it has historically been too expensive

to create an auditable data trail that follows a product as it moves through the SC. A distributed ledger technology known as blockchain offers a possible solution to this issue. Worldwide SCM is the setting for this study's comprehensive analysis of distributed ledger technologies based on the blockchain. As an example, it compares permissioned consensus settings often used in commercial applications like SCM with trustless consensus environments used by Bitcoin and other cryptocurrencies. They provide transactional use examples to demonstrate important ideas in using permissioned blockchain for SCM.

Francisco & Swanson (2018), Transactions are now far more open and auditable than they would be via a centralised system. Therefore, transactions are carried out via the distributed trust that is created via the network's consensus, rather than depending on the explicit confidence of a third party. This third party might be other users of the blockchain. There are numerous opportunities to improve a transparency of the SC by implementing this technology. All products have a rich and illustrious history. Nevertheless, a significant portion of this history is currently obscured. Frequently, the exposure of negative practices results in their rapid escalation to scandalous and financially debilitating levels. Numerous recent instances, including the unethical utilisation of rainforest resources and the disclosure of child labour involved in the manufacturing process, are available. Currently, the adoption of blockchain technologies by academics and managers is restricted by our comprehension, despite the potential for unprecedented transparency in the SC. This research takes a shot at the issue by constructing a supply chain traceability framework based on UTAUT and the concept of technological innovation adoption. Following a development of a conceptual model informed by theory and literature analysis, the research concludes with blockchain's implications for the supply chain.

2.12 Specific skills and Knowledge sets required in Human Capital to perform in the Sustainability Supply Chain

Ali et al. (2024) With a particular emphasis on how supply chain dynamic modifies this interaction, this study sought to investigate the complex link among sustainability, DSC, and SCR. An objective is to learn how these parts function together in the context of modern SCM to improve sustainability results. A total of 300 managers and CEOs make up the sample. An strategy based on quantitative research is used in the study. Statistical analysis is performed using SEM to investigate the direct and indirect effects of SCR and DSC on sustainability. Their extensive surveying of supply chain ecosystem players paints a detailed picture of real-world consequences and subtleties in context. Our first results point to a positive correlation among SCR and sustainability, demonstrating the need of robust supply networks in this context. moreover, discover the positive influence of digital technology on sustainability by means of improving environmental management and regulating supply chains for efficiency.

N. Han & Um (2024) The researchers' primary objective was to identify the interplay between sustainability concerns, global uncertainty, and methods for strengthening supply chain resilience. In order to tackle sustainability concerns in the supply chain, the study proposes a resilience capacity for SCs and four basic tactics to reduce risk. The survey data is utilised in SEM and moderation testing (MT) to identify potential actions to mitigate sustainability risks in various scenarios. According to the results, a structural approach is necessary to make supply chains more resilient to different sustainability issues. This research experimentally investigates the influence of sustainability concerns and global uncertainty on supply chain resilience, filling a gap in the literature. The system then recommends the best risk management strategies, such as accept/avoid, control, and share/transfer, based on the many sustainability issues. A major

roadblock to addressing the sustainability risk in the SC is the lack of research on effective mitigation measures to promote resilience capabilities. They hope that the results will be useful for future research on sustainability and resilience in supply chains.

Abdul Mumin et al. (2024) The purpose of this research was to look at how SMEs in Ghana use their ICT skills in relation to SC fraud and sustainability. Furthermore, the study investigates how SC fraud mediates the connection between ICT competencies and supply chain longevity. Design/methodology/approach A total of 102 SME owners and operators in Ghana participated in the survey, which drew on the dynamic capability theory as its theoretical underpinning. The study employed PLS-SEM to create and analyse the proposed model. Findings Results demonstrate that supply chain fraud has dropped dramatically in Ghanaian SMEs with enhanced information and communication technology capabilities. Plus, knowing how to use ICT effectively considerably improves the supply chain's efficiency and longevity. An important step forward, supply chain fraud elucidates how supply chain sustainability and ICT skills are interdependent. Originality/value This research adds to the little literature on the topic of supply chain fraud, sustainability, and ICT abilities, with a focus on SMEs in Ghana. Notably, this research is the first of its kind to investigate how supply chain fraud acts as a mediator between information and communication technology skills and the sustainability of supply chains.

Dassanayake et al. (2024), Global SC have begun to prioritise environmental sustainability in the last decade. More and more, businesses are realizing that their supply chains have negative effects on the environment, especially in light of recent environmental reforms. To be really sustainable, businesses must follow these guidelines, which will benefit society as a whole as well as an environment. The primary goal of this research was to examine GSCP in detail, their methods for achieving environmental sustainability, and

the ways in which Sri Lankan companies use them in their SC to reduce their environmental impact. All the way through the supply chain—from manufacturing to shipping, storage, and even reverse logistics—are included in the study's methodology. At each level, the emphasis is on how GSCP may help businesses cut down on supply chain emissions, water use, waste, and energy consumption. Secondary sources were used to get data from Sri Lankan industrial businesses. The research found that GSCP had a beneficial influence on environmental sustainability after analyzing the collected data using narrative analysis.

Fritz (2022), The complementarity of sustainable SCM from a systems approach and stakeholder theory was first discussed in this work. Second, a brand-new supply chain theory was created to improve sustainability management by identifying supply chain participants and associated sustainability issues. A comprehensive grasp of sustainability issues is made possible by connecting SSCM with stakeholder theory. This allows one to see potential to enhance present consumption and production patterns as well as one's own choices and actions. Rather than focusing on the company or the customer, the SC approach clarifies the many stakeholders (both within and outside the SC) and the sustainability issues that arise from their involvement in a product or service. It encourages companies and individuals to use systems thinking skills to improve their sustainability mindset and, by extension, their ability to solve issues connected to ethics and sustainability. With the use of the suggested supply chain perspective, managers, legislators, educators, consultants, customers, and people may effectively identify stakeholders and comprehend the sustainability difficulties associated with production and consumption.

Mousa & Othman (2020) This research set out to evaluate the extent to which Palestinian healthcare organizations have adopted green HRM practices and how such practices have affected long-term performance in this vital service industry. In a mixed-

methods study carried out in the West Bank, fourteen semi-structured interviews were carried out with various hospital department heads, operational managers, and HRM. A total of 69 managers at different levels who had been using green HRM practices were surveyed to provide the quantitative data. Using PLS-SEM, the data was examined. When looking at the total mean implementation level of green HRM practices, the findings indicated that it was low, at 2.42 out of 5. With a score of 3.42 out of 5, the level of sustained performance was likewise very excellent. The two most consequential green approaches were "green training and engagement" and "green recruitment," but "green performance management and compensation" had the little impact. This was done after identifying and prioritizing green activities.

Zaid et al. (2018) Finding out how GSCM and GHRM are related and how they affect sustainability performance in terms of the environment, society, and the bottom line was the driving force for this study. A quantitative technique is used to collect data from 121 enterprises in Palestine's food, chemical, and pharmaceutical industries, the three most polluting of these sectors. Analysed by means of SEM using PLS. Data analysis shows that more sustainable performance is a result of both green HRM and GSCM. Actually, the findings showed that sustainable performance is directly impacted by green HRM practices, with the effect being mediated by green supply chain management techniques.

Delery & Roumpi (2017), Research in SHRM has long looked to the RBV of an organization as a possible unifying factor between the "micro-macro" spheres of influence. However, RBV has not achieved its full potential because to the conflict between SHRM and the strategic human capital literature. This research starts by reviewing the conceptual logic that links HRM practices and business results. The goal is to show how the strategic human capital literature and SHRM address RBV differently. Next, they put forward a theoretical framework that challenges the prevailing belief in strategic human capital

research, namely that HRM practices do not serve as straightforward tools for companies to establish long-term competitive advantage. Instead, they contend that HRM policies shape supply-side and demand-side mobility limitations, which in turn improves workers' ability, motivation, and prospects, and ultimately contributes to a firm's sustainable competitive advantage.

2.13 Challenges of Recruiting Human Capital for Digitalized and Sustainability Supply Chains

De Vass et al. (2021) Findings from grounded theory interviews with retail sector managers in Australia provide light on the pros and cons of IoT use in supply chains. IoT adoption enhances visibility of products movement, data collection, partner communication, and business analytics, according to the NVivo thematic study. Inadequate compatibility across partner systems, stakeholder resistance to change, high costs of acquiring new technology, and a lack of top-down effort all pose problems for retailers. In order to bolster the investment choice connected to the IoT, this study provides a proof-of-concept of IoT advantages, analyses the obstacles to adoption, and proposes areas for further research.

Tseng et al. (2021), With the advent of Industry 4.0 rapidly approaching, this research added to the current literature by doing a state-of-the-art bibliometric evaluation on sustainable industrial and operations engineering. It set the stage for future studies and practical applications in this ever-evolving area. Despite progress towards sustainability in industrial and operation engineering, there is still a lack of systematization in the information that makes up a firm's production and operations, including its wide conceptions and many complementary elements. Within the framework of Industry 4.0, this research examines operations and modern sustainable industrial engineering. Bibliometric analysis and the fuzzy Delphi technique are recommended. The outcome is a

set of thirty indicators, all of which have been critiqued and categorized into eight study groups. A number of issues are addressed by these indicators, including cyber-physical production systems, safety and security, the circular economy in the digital environment, AI for sustainability, cyber-physical production systems, virtual reality for enterprises, and environmental sustainability.

Y. Chang et al. (2020), The report provided a comprehensive and up-to-date review of the present state of international commerce and supply chains, including the obstacles, voids, and possibilities faced by public and commercial organizations alike. It drew on a wide range of sources, including studies, trade journals, conferences, supply chain consulting businesses, important international organizations, and senior business leaders. The authors then go on to discuss potential future research directions and collaborative frameworks that the public, private, and academic sectors can work together to ensure that blockchain technology is fully utilised despite the many social, economic, and geopolitical challenges currently affecting international trade and supply chains.

Brunetti et al. (2020), This study provided appropriate methods that firms, government officials, and educational organisations may utilise to successfully manage digital transformation challenges within a regional innovation system. A distinctive example of a very original European microregion is the Tyrol-Veneto, which comprises the regions of Tyrol, Veneto, and South Tyrol. This research considers the parties involved in this microregion's operations. In this study, exploratory research is carried out using a qualitative methodology. By using a place-based multi-stakeholder approach, it highlights the role of three stakeholder groups—corporations, educational institutions, and regional governments—in navigating digital transitions. Through the use of text mining and content analysis, sixty stakeholders from the Tyrol-Veneto macroregion had their replies examined. To begin, they used IRaMuTeQ's correspondence factor analysis to group

similar concepts into usable pillars or macroareas for our strategy. Secondly, in order to tackle the issues of digital transformation, NVivo software was used for two rounds of coding in order to identify particular strategic plans and strategic action areas. The findings show that digital transformation is a big problem for the regional innovation system and calls for a trifecta of different approaches.

Ageron et al. (2020), The editorial addresses the most recent advancements, difficulties, and prospects for further study in digital SCM. The first section introduces the new theories surrounding digital supply chains, which center on cutting-edge technology (big data, cloud computing, IoT, etc.). Second, it is emphasized how important it is to investigate fresh organizational, human, and strategic aspects of a digital SC. Third, a brief overview of a studies covering digital supply chain concerns is given in this special issue. Lastly, a focus on future research directions for scholars and practitioners is indicated.

Branca et al. (2020), The study came to the conclusion that although digitization was a major process that had been started many decades earlier, Industry 4.0 significantly accelerated it and had an impact on every area of production and process. It is anticipated to enable the European sector to improve both the sustainability and the efficiency of its production. Two primary, sometimes overlapping, areas of digitalization are specialized technology for low-carbon and sustainable manufacturing and sophisticated tools for optimizing the production chain, which is especially important in energy-intensive sectors such as the steel industry. The use of associated technology in manufacturing is what digitalization is all about. Furthermore, a industrial workforce's skills must be updated continuously due to the steel industry's fast technological progress. The background of digitalization and several key terminologies in the European industry and iron and steel sector are introduced in this review research, which is the outcome of a recent study conducted within a Blueprint European project. There is an analysis of the key

advancements supported by European Research Programmes and a depiction of the present technological transition. Along with anticipated economic trends, they also take into account the effects of digitization on the workforce in the steel sector.

Yadav et al. (2020), This research found a distinct set of 28 problems with SSCM and 22 ways to solve them. Additionally, the created framework's applicability was evaluated utilizing a hybrid BWM - ELECTRE method on an automotive example organization. The BWM-ELECTRE method relies on inputs derived from an expert panel assembled from inside the case organization. The BWM comparisons are used to calculate the height of the SSCM problems, and the ELECTRE technique is used to rate the solution measures to overcome these difficulties based on additional comparisons of the challenges and the solutions. Findings from this case study highlight the importance of management and organizational difficulties as well as economic hurdles in an implementation of SSCM. The results of this research will be valuable for scholars studying SSCM industry 4.0 and the circular economy. On the other hand, practitioners may utilise the metrics for prioritised solutions to devise effective strategies for overcoming the obstacles to SSCM adoption.

Bressanelli et al. (2019), This research compiled a list of twenty-four potential roadblocks to the Circular Economy's supply chain redesign. Related studies have found sixteen of these difficulties. Alternatively, the other eight either have a different focus or are more recent developments within the framework of the Circular Economy. To investigate the real-world manifestations of these difficulties and potential solutions, a multiple-case study is conducted inside the supply chain for home appliances. Based on the scenarios studied, which include supply chain players at various levels, it seems that a high level of vertical integration by a single supply chain actor is not required for an implementation of a Circular Economy. A framework that connects the difficulties to certain levers that businesses might use to address them is developed as a result of the

empirical research and the literature analysis. Managers embarking on the journey towards a Circular Economy may find the framework useful as a guide.

Tambe et al. (2019), This study detailed four challenges that arise when attempting to apply data science methods to human resources tasks: the intricacy of HR phenomena; limitations imposed by datasets; worries regarding equity and ethical/legal constraints; and the prospect of unfavourable employee responses to data-driven algorithmic decisions made by management. The research proposed practicable solutions to overcome these challenges by utilising three interconnected principles: employee input, randomization and experimentation, and causal reasoning. The objective of these principles is to guarantee that the application of data science in employee administration is both socially appropriate and economically efficient.

Kache & Seuring (2017) This study set out to lend a hand to the development of SCM theory by assessing how Big Data Analytics can change the way companies and SC use data. The potential and difficulties of using Big Data Analytics for SCM are explored in this exploratory study, which aims to provide companies with the rapid, accurate, and useful information they want. A topic of Big Data Analytics has received little empirical attention, despite the increasing interest in management. Since there is little published work on the subject of SCM and Big Data Analytics, the writers' resort to the Delphi technique for their investigations. Providing a glimpse into the current trend away from digital business environments, the results of the presented Delphi survey add to what is already known by highlighting 43 possibilities and threats associated with the rise of Big Data Analytics from both the corporate and supplier chain vantage points.

CHAPTER III:

RESEARCH METHODOLOGY

3.1 Overview of the Research Problem

We lack a strong sound empirical basis to support or refute the claims about the impact of human capital management (HCM) on digital supply chain management (SCM) & sustainability-oriented supply Chains. Existing studies have not sufficiently addressed the different types of effects and key questions that must be considered when HC practices are incorporated into SCM activities. This lack of understanding exposes the research gap to determine the effects of HCM on SCM sustainability.

1. **Insufficient justification in prior research**

This is a research gap as no theoretical background is provided by the existing literature to justify that HCM does have an impact on sustainable & digital SCM practices. While being aware to the importance of human resources for successful organizational performance, the exact mechanisms on how HCM influences SCM sustainability & digitalisation are unclear (Farooque *et al.*, 2019).

3.2 Essential Impact - Unanswered Questions

Moreover, the current literature that is available in the field of the research might not offer enough details that are vital in answering key questions of how HCM impacts on factors of SCM resilience, innovation as well as operations' efficiency (Garcia-Buendia *et al.*, 2023). This gap limits the development of hypotheses and subsequent strategies for enhancing HCM practices in the context of DSCs.

3.3 Monitor HCM for Impact Analysis

This is where the current research fits the bill by proposing a framework for catering to tracking of HCM practices and analysing the first order and second order impacts for

sustainable & Digital SCM. From HCM metrics and performance indicators: the systematic study of HR planning factors, as well as human capital contribution to supply chain resilience, agility, and responsiveness (Lee, 2021).

3.4 Idea-Generation and Understanding Model

Many factors influence the supply chain including Human capital and the Human capital topic has barely been looked at in prior studies. This points to the need for emergence and improvement of the widespread concepts, as well as the enhancement of the comprehension of the relationships between HCM and SCM.

The goal of this study is to contribute to the development of concepts by identifying the key skills and capabilities in human capital that have an impact on sustainable & digitalised supply chain management outcomes.

3.5 Operationalization of Theoretical Constructs

The process of translating theoretical ideas into concrete, quantifiable words so they may be observed or tested Experientially is known as operationalization of theoretical notions. This practice is essential to research methodology because it fills in the gaps between theoretical concepts and the practical steps involved in gathering and analysing data. In this study the theoretical constructs which are used are;

Human Capital, Digital Transformation, Sustainability in Supply Chains, Skill Sets for Digitalized Supply Chains, Change Management, Innovation and Creativity, Stakeholder Engagement, Transparency and Traceability, Future Trends.

- **Human Capital**- The idea of "human capital" describes how people invest in themselves through training, education, and other endeavours that increase their lifetime wages and, consequently, their future income. Investing in human capital requires applying the same methods of analysis and evaluation of investments that are normally used for physical capital. When considering the future benefits or

income stream that the capital will create in comparison to the cost of acquiring the capital asset, the profitability, also known as the rate of return on investment, is a measure of the predicted yield of the investment. The idea of human capital is explained by pointing out that worker productivity increased with education or training. Health care and migration both have the potential to raise earning potential; as such, they can be seen as investments in human capital.

- **Digital Transformation**- The aim of this research is to elucidate the manner in which supply chain participants might enhance company performance through the utilisation of digital transformation technologies and to pinpoint the factors that contribute to its implementation. The results have ramifications that can assist businesses looking to achieve effective corporate performance by allocating time and resources to digital innovation. It was discovered that the more advanced a company's corporate culture and the greater the level of trust it enjoys with its partner businesses, the more actively the partner companies use digital transformation. Furthermore, we verified the mediating role of information sharing between businesses, which can have a stronger beneficial impact on corporate performance as its level rises, even though digital transformation has a direct impact on corporate performance.
- **Sustainable practices in supply chains**- Implementing environmentally and socially responsible practices throughout the product lifecycle is essential in ensuring sustainability in supply chains. This consists of eco-friendly procurement, cutting down on waste and emissions, supporting energy conservation, and guaranteeing fair labour standards. These actions reduce environmental harm, boost social accountability, and enhance the financial sustainability of the organization,

meeting the consumer's desire for ethical products and giving a competitive advantage.

- **Skill Sets for Digitalized Supply Chains -** Proficiency in IoT, AI, machine learning, and blockchain are crucial skills for digitalized supply chains. Workers must possess data literacy for analysing and interpreting data for decision-making, along with cybersecurity expertise for safeguarding digital assets. Knowledge of cloud-based systems and ongoing skill development are essential for staying current with technology advances and ensuring effectiveness and competitiveness.
- **Change Management -** Change management entails methodically leading people, groups, and companies through changes in objectives, procedures, or technologies. In supply chains, this involves getting stakeholders ready for and backing new processes and technologies, minimizing resistance, and guaranteeing a seamless implementation. Important factors include effective communication, teaching, backing from leaders, and ongoing feedback.
- **Innovation and Creativity -** In supply chains, efficiency and sustainability are improved by the development of new ideas and technologies driven by innovation and creativity. Encouraging innovation within a company motivates employees to suggest new ideas, which can enhance process efficiency, product development, and waste minimization. Collaboration in innovation, whether within or outside the company, enables supply chains to remain competitive and flexible.
- **Engaging with stakeholders-** Engaging stakeholders includes actively involving all individuals impacted by supply chain operations, such as suppliers, clients, workers, and government officials. Ensuring effective engagement involves taking their perspectives and needs into consideration to promote sustainable and ethical practices. Clear communication and trust-based long-term relationships are

essential for garnering backing for sustainability efforts and bolstering corporate image.

- **Transparency and traceability -** offer insight into where products come from and how they are distributed. Transparency is the act of openly sharing information about the supply chain with stakeholders, whereas traceability is the process of monitoring products from their origin to the consumer. These methods guarantee adherence to regulations, enhance quality monitoring, and establish credibility with consumers. Blockchain and IoT technologies improve traceability by creating secure records that cannot be altered and providing live monitoring.
- **Future Trends -** Supply chain advancement plans for the future include the increased use of Artificial Intelligence and machine learning for the automation of processes, Blockchain for achieving transparency, and Internet of Things or IoT for Live viewing. The key subject in and for sustainability activities will therefore be circular economy and carbon reduction. These are perpetuated processes, of new investments, and of building of new skills capable of managing and running these tendencies.

3.6 Research Purpose and Questions

This study investigated supply chains, human capital management, and to show how human capital management functions in supply chains that are digital and sustainability-focused. Through this, the study analysed the influence of human capital management in a digitized and sustainable supply chain.

1. How does the level of digitalization in procurement, logistics, and warehousing affect overall supply chain digitalization?
2. What is the effect of supply chain digitalization on employee digital literacy and upskilling?

3. How does the environmental impact of supply chain operations influence the level of supply chain sustainability?
4. What is the relationship between supply chain sustainability and employee motivation and engagement in sustainability initiatives?
5. How does the supply chain digitalization influence organizational performance?
6. To what extent does employee motivation and engagement in sustainability initiatives, driven by supply chain sustainability efforts, impact organizational performance?
7. What are the key challenges & factors in driving Digitalization & Sustainability within Supply Chains?
8. How is the talent availability & steps being take to further improve the talent availability for driving Digitalization & Sustainability within Supply Chains?

3.7 Research Design

An exploratory sequential mixed method research design was utilized to study how human capital affects digitalized and sustainability-focused supply chains. The qualitative insights gathered in primary literature review guided the creation of a specific questionnaire for the next quantitative stage, where the questionnaire was sent to a bigger group of supply chain experts to measure the influence of the human capital factors identified. Survey data was analysed using statistical methods, in this study IBM's SPSS. Ultimately, the qualitative and quantitative data were combined and joint displays to offer a complete comprehension of how human capital impacts the efficiency of digital and sustainable supply chain practices.

3.8 Population and Sample

The Questionnaire Survey was used to manage the surveys online in English. Consequently, the purpose of the survey was to gather data regarding participant perceptions. The non-probability sampling technique has been employed to collect data from dependable and easily accessible sources. The sampling technique does not discuss subjects who are chosen at random for the sampling; instead, it selects samples that are useful to us. The sample size was selected taking into account the feasibility of the study and the resources available for data collection. A total of 330 individuals with a range of backgrounds were selected to participate in the study. The sample covered a diversity of perspectives and experiences about supply chain because it included individuals from a variety of departments and backgrounds.

3.9 Participant Selection

Inclusion and Exclusion Criteria for Survey

Inclusion Criteria	Exclusion Criteria
• **Industry:** Employees from various industries relevant to AI integration.	• **Industry:** Employees from industries not relevant to AI integration.
• **Experience with Supply Chain:** People having experience with AI.	• **Experience with Supply Chain:** People not having experience with AI.
• **Position/Level:** Employees from different positions that are relevant.	• **Position/Level:** Employees in positions that are not relevant.

• **Language Proficiency:** People having good communication skills in English.	• **Language Proficiency:** People not having good communication skills in English.
• **Consent and Availability:** People who are fine to share their inputs.	• **Consent and Availability:** People who are not fine to share their Inputs.

3.10 Instrumentation

3.10.1 Research Questions

1. **Please rate your Supply Chain digitalization and Sustainability orientation maturity levels as compared to your Industry.** *(Rate each option on Scale of 1- Emerging, 2 - Developing & 3 – Leading)***.**

Sr. No	Factors	1	2	3
A	Supply Chain core performance maturity			
B	Supply Chain Digitalization maturity			
C	Supply Chain Sustainability maturity			
D	Overall Supply Chain maturity			

2. **What are key factors driving Supply Chain Digitalization & Sustainable supply Chain initiative in your organization?** *(Rate each option on Scale of 1- Not so Critical, 2 - Critical & 3 - Very Critical).*

Sr. No	Factors	1	2	3
A	Customer Requirements			
B	Competition Pressure			

C	Management Vision			
D	Regulatory & Statutory Requirements			

3. **Please rate the scope of Digitalization in the supply Chain functions of your organization?** *(Rate each option on Scale of 1- Not so Critical, 2 - Critical & 3 - Very Critical)***.**

Sr. No	**Functions**	**1**	**2**	**3**
A	Procurement			
B	Planning			
C	Logistics			
D	Warehousing & Distribution			

4. **Please rate the scope of driving Sustainability initiatives in the supply Chain functions of your organisation?** *(Rate each option on Scale of 1- Not so Critical, 2 - Critical & 3 - Very Critical)***.**

Sr. No	**Functions**	**1**	**2**	**3**
A	Procurement			
B	Planning			
C	Logistics			
D	Warehousing & Distribution			

5. **What are the key challenges for driving Digitalization in your supply chain?** *(Rate each option on Scale of 1- Not so Critical, 2 - Critical & 3 - Very Critical).*

Sr. No	**Factors**	**1**	**2**	**3**
A	Availability of Talent to operate the Digitalised supply Chain			

B	Availability of Customised digital tools meeting the requirements			
C	Internal challenges related to Capability & Process Standardization			
D	Cost & ROI Challenges			
E	Lack of Vision & Stakeholder support			

6. **What are the key challenges for driving Sustainability initiatives in your supply chain?** *(Rate each option on Scale of 1- Not so Critical, 2 - Critical & 3 - Very Critical).*

Sr. No	Factors	1	2	3
A	Availability of Talent to operate the Sustainable supply Chain			
B	Availability of relevant inputs and proper framework to drive Sustainability in your Industry			
C	Internal challenges related to Capability & Process Standardization			
D	Cost & ROI Challenges			
E	Lack of Vision & Stakeholder support			

7. **Which can be the top initiative to improve the talent availability for Supply Chain digitalization & Sustainability initiatives?** *(Rate each option on Scale of 1- Not so Critical, 2 - Critical & 3 - Very Critical).*

Sr. No	Factors	1	2	3

A	Government and Educational institutions to Design vocational skills curriculum driving Supply Chain digitalization & sustainability in academics			
B	Industry collaboration for On-the-Job training			
C	Internal Job transfer and Upskilling			

8. Supply Chain Employee digital literacy and upskilling

(Rate the below Given statements from 1 to 5: as, 1: Strongly Disagree, 2: Disagree, 3: Neutral, 4: Agree and 5: Strongly Agree)

Sr. No	**Statements**	1	2	3	4	5
A	Our company provides sufficient training opportunities for employees to improve their digital skills.					
B	Our existing Supply Chain employees have adopted well with digital skills and able to perform satisfactorily					
C	Our existing Supply Chain employees are finding value and better job satisfaction post implementation of Supply Chain digitalization initiatives					
D	Our company offers continuous learning programs to keep employees updated on digital advancements to ensure relevance and effectiveness					

E	Growth and recognition are provided to employees who actively engage in digital upskilling efforts.					

9. Supply Chain Employee motivation and engagement in sustainability initiatives

(Rate the below Given statements from 1 to 5: as, 1: Strongly Disagree, 2: Disagree, 3: Neutral, 4: Agree and 5: Strongly Agree)

Sr. No	**Statements**	1	2	3	4	5
A	Our organization provides opportunities & training for employees to participate in sustainability-related projects or committees.					
B	Our existing Supply Chain employees are driving Sustainability initiatives with same intensity as their core supply Chain role					
C	Our existing Supply Chain employees are finding value and better job satisfaction in driving Supply Chain Sustainability initiatives					
D	Sustainability goals are integrated into individual performance evaluations and goal-setting processes.					
E	Our organization actively seeks employee input when developing or revising sustainability policies and initiatives.					

10. Organizational Performance

(Rate the below Given statements from 1 to 5: as, 1: Strongly Disagree, 2: Disagree, 3: Neutral, 4: Agree and 5: Strongly Agree)

Sr. No	Statements	1	2	3	4	5
A	Our organization is driving impactful Supply Chain Digitalisation and Sustainability initiatives					
B	Our organization's ability to meets its financial targets has improved post Supply Chain Digitalisation and Sustainability focus as compared to earlier					
C	Our organization is able to effectively manages resources and controls costs post implementation of Supply Chain Digitalisation and Sustainability initiatives					
D	Our company is able to effectively manages risks and mitigate potential threats post implementation of Supply Chain Digitalisation and Sustainability initiatives					
E	Our company is able to engage and retain employees better post implementation of Supply Chain Digitalisation and Sustainability initiatives					
F	Our organization has a strong leadership team that drives success and innovation in implementation of Supply Chain Digitalisation and Sustainability initiatives					

G	Our organization has gained competitive advantage over competitors post implementation of Supply Chain Digitalisation and Sustainability initiatives					
H	Our organization is able to command premium from customers post implementation of Supply Chain Digitalisation and Sustainability initiatives					

3.11 Data collection

Respondents receive questionnaires as part of the primary data collection process. It is easier to see the variables under study, operational definitions, indicators, measurement scales, and reference materials. Statistical analysis techniques were used to test the hypotheses. All variables and questionnaire items are found to be valid and reliable based on the reliability testing.

To collect primary data using surveys on the role of human capital in digitalized and sustainability-oriented supply chains, a structured questionnaire was developed and distributed to a representative sample of supply chain professionals. The survey included sections on demographics, key human capital factors, digitalization practices, sustainability initiatives, and challenges/best practices. Questions were closed-ended formats. After conducting a trial test to refine the questionnaire, allocate it through online platforms and professional networks to achieve a diverse sample of 330 respondents.

3.12 Analysis

The study's population consists of both male and female employees at various levels who work in organisation. In addition, a thorough literature analysis was done to determine which survey questions are appropriate for the variable being studied. A well-structured questionnaire that was adopted was used as the main method of data collection. A small

portion of the resulting primary data were retrieved, imported into Excel, and examined using the proper statistical methods, such as regression analysis, descriptive analysis, and correlation analysis in SPSS. To determine the right questionnaire for the study, a comprehensive evaluation of the literature was conducted. A separate setting was used to validate this questionnaire. A small number of sample items from several other researchers' questionnaires guaranteed the validity of the questionnaire for gauging SCM performance. Each of the four main portions of the scale has a distinct variable. The four categories of performance are: environmental, operations, employee-centred, and performance-centred. A five-point & three-point Likert scale was employed to gauge the respondents' level of agreement. The study involved 330 respondents.

- **Descriptive –**In SPSS, descriptive statistics offer an overview of a dataset's salient features. Metrics like mean, median, mode, standard deviation, minimum, maximum, and different percentiles are included in this. Using an integrated framework to analyse the impact of foreign direct investment (FDI) on urban green innovation and expanding upon previous models from Luo's studies, this technique has been applied here to obtain the essential data features.
- **Correlation -** In SPSS, correlation analysis facilitates the investigation of the connection between two or more variables. The Pearson correlation coefficient, which assesses the linear relationship between two continuous variables, is the most widely used correlation coefficient. In order to reduce the impact of heteroscedasticity, logarithmic processing has been applied to all variables utilised in this investigation. Test the correlation coefficients as well as the variance inflation factors for every variable at the same time to prevent multicollinearity.
- **Regression-** In SPSS, regression analysis is utilised to forecast a variable's value by utilising the values of one or more predictor variables. Regression analysis

comes in various forms, such as multiple regression, logistic regression, and linear regression. Here, a nonlinear threshold regression model has been utilised. Investigations into the threshold effect are frequently conducted using cross-term models and grouping tests. Nevertheless, the grouping test fails to estimate the precise threshold value and assess its significance from the standpoint of mathematical statistics, making it challenging to objectively understand the sample grouping criterion. The two earlier approaches' drawbacks are compensated for by Hanse's threshold regression analysis methodology.

3.13 Research Design Limitations

3.13.1 Sample Size and Sampling Method

The method of data collection was non-probability sampling technique which could restrict the ability to generalize the results. The selection of the sample was done non-randomly and thus it would not be possible to have perfect generalization specifically on the general population. Despite the fact that 330 participants were enrolled, such approach to sampling might not be sufficient for identifying a wide range of experiences among employees of different industries and positions within SCM teams. This could potentially reduce the external validity of the research findings in that the results cannot be exported to the population at large.

3.13.2 Quantitative Research Constraints

Structured questionnaire however may not capture all the intricate details of human capital as it relates to digitalized and sustainability-oriented supply chain. These closed-ended questions may limit the respondents' responses and may also result to loss of the full view from the respondents. However, it is important to note that even with the efforts to make the construct valid and reliable the measures used to measure the construct could be a poor approximation of the theoretical construct which in turn could influence the results.

3.13.3 Methodological Limitations

However, the identified sequential design may imply that the findings obtained in one phase may not necessarily guide the other phase in the mixed-method approach. It could, for instance, result in lack of clarity on some aspects or failure to fully expand on one or several variables.

3.13.4 Context-Specific Limitations

The study may not be very applicable in other industries or areas of the world. The analysis of the supply chain dynamics may differ with other industries and regions and therefore the results may not be generalized to other environments. The swift rate of advancement in the digital supply chains is also an area of concern because the current study might be soon out of date with the changing trends. This temporal constraint may pose a problem in the applicability of the research in the long-run.

3.13.5 Ethical Considerations

Participants may provide socially desirable answers, particularly in surveys related to sustainability and digitalization, which are often seen as positive or necessary in today's business environment. This could introduce bias into the data and affect the study’s conclusions. There may be limitations related to confidentiality and data security, especially given the sensitivity of information in digital supply chains. This could impact the willingness of participants to share candid insights.

3.14 Conclusion

Integrating human capital into digitalized and sustainability-oriented supply chains is crucial for modern SC management. Probably the most important reasons behind the requirements for better skilled and environmentally conscious workforce stem from the digitalization processes and increased emphasis on sustainability. Therefore, both of these goals rely on the skills, knowledge, and abilities of workers.

Some of the limitations and factors that are underlined in the research include the following that must be addressed in order to more effectively analyse this complex relationship. Thus, it is crucial to define preliminary parameters of the study because it is unlikely that digitalization and sustainability initiatives within various industries and geographies will show universal results. The main challenge is the possibility to gain access to some of the data; while using novel and valuable information, corporations might be reluctant to present sensitive data for the audience due to the concerns about confidentiality.

CHAPTER IV:

RESULTS

4.1 Reliability Statistics

Table 4.1: Reliability Statistics

Cronbach's Alpha	**N of Items**
.955	47

The above table data designate a Cronbach's Alpha of 0.955 for a 47-item scale, representative of excellent interior consistency. This high value proposes that the items are highly correlated and consistently amount to the same original construct, making the scale appropriate for research or valuation purposes.

4.2 Frequency Analysis

Table 4.2: Participant's Total Years of Supply Chain Work Experience.

	Frequency	**Percent**
0-5	63	19.1
>5–10	57	17.3
>10-15	64	19.4
>15-20	65	19.7
>20-25	42	12.7
>25	39	11.8
Total	330	100.0

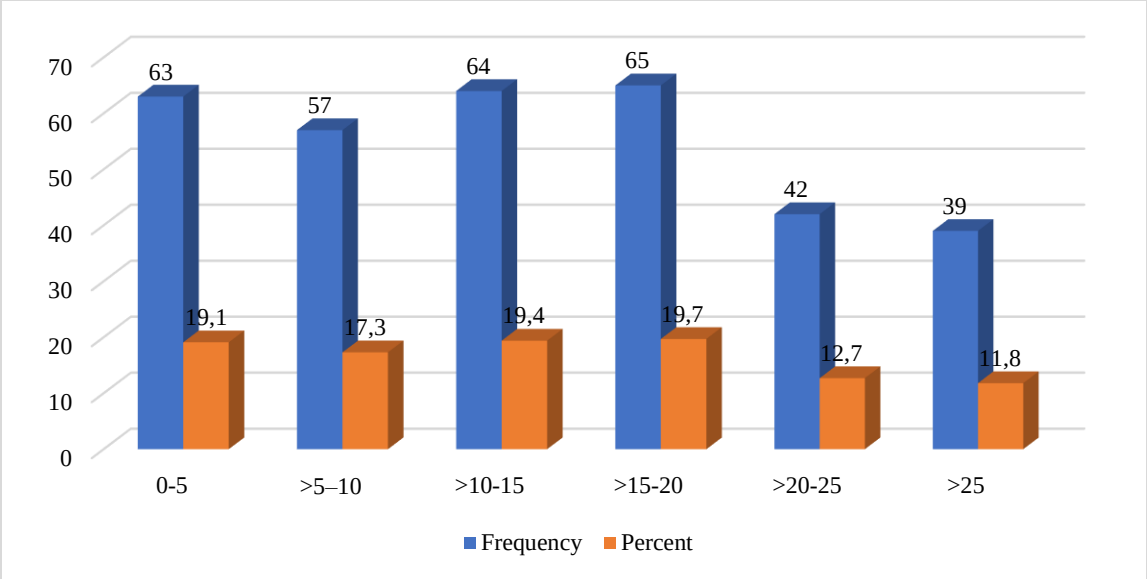

Figure 4.1: Participant's Total Years of Supply Chain Work Experience.

The above figure 4.1 proves the wide range of supply chain work skills that participants possess. The largest groups consist of participants with 15-20 years (19.7%), 10-15 years (19.4%), and 0-5 years (19.1%) of experience; 5-10 years make up 17.3%; 20-25 years and over 25 years represent 12.7% and 11.8%, respectively.

Table 4.3: Participant's Designation

	Frequency	**Percent**
Lower Management (Mgmt Trainee to Manager)	5	1.5
Middle management (>Manager to General Manager)	136	41.2
Top Management (> General Manager to CXO)	116	35.2
Board Member & Promoters	62	18.8
Prefer not to say	11	3.3
Total	330	100.0

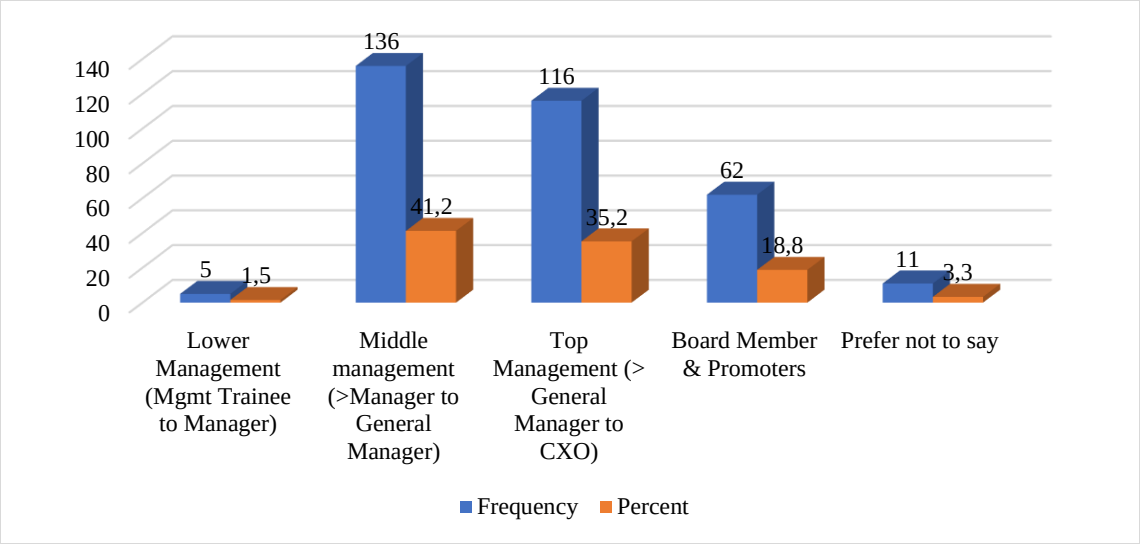

Figure 4.2: Participant's Designation

The above figure 4.2 shows the distribution of the Participant's designation the majority of participants (41.2%) are in middle management, followed by high management (35.2%) their designations. Lower management makes up 1.5% of the total, and board members and promoters make up 18.8%. 3.3% of respondents would rather keep their designation a secret.

Table 4.4: Operating Region of Organization (Multiple Choice)

Regions	**Frequency**
India	307
China	72
APAN	34
Korea	26
Rest of APAC	29
EU	53
UK	37
USA	51
Rest of World	43

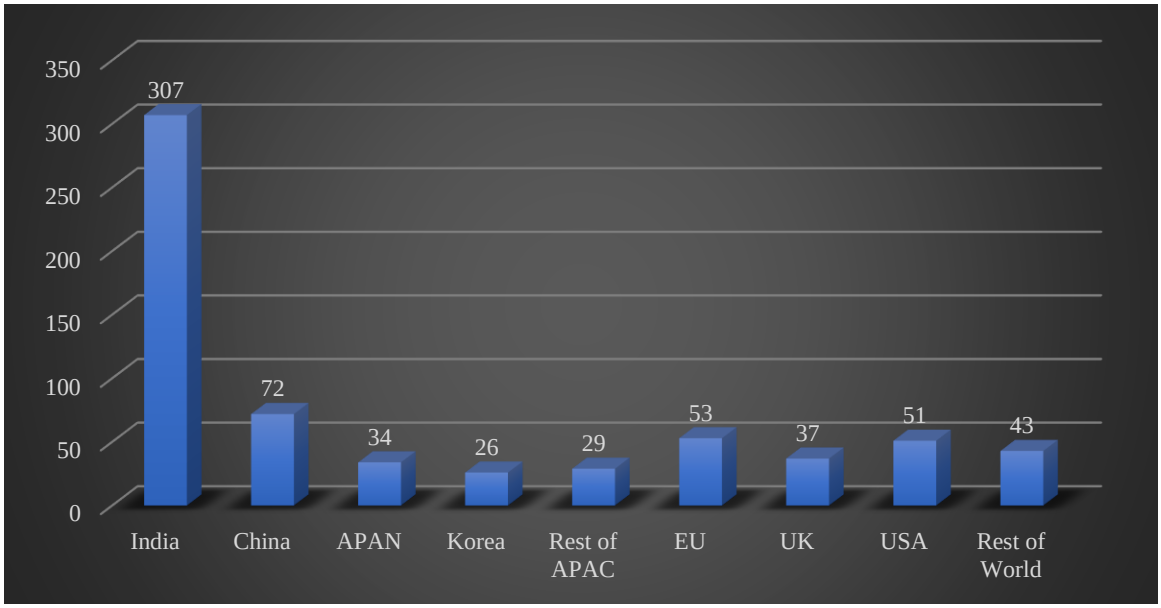

Figure 4.3: Operating Region of Organization (Multiple Choice)

In the above figure, the working territories of the organizations are displayed; India accounts for the majority of these regions (64.8%). Three percent of organizations are based in China and India, and three percent operate in numerous locations, including the United States, the United Kingdom, the European Union, China, and the rest of the world. 4.5% of organizations are those that only do business in China. Less than 1% of the sample operates in any combination of the EU, USA, and Rest of APAC. This is a small percentage of all operators. Other noteworthy pairings are India and the EU (1.5%), India and the USA (2.1%), and India and the Rest of the World (2.4%). This distribution shows a high concentration of companies catering to the Indian market, some of which also have global operations in many countries.

Table 4.5: What Was Last Year Revenue (Million USD) Of Your Organization?

	Frequency	**Percent**
<=50	141	42.7
>50-100	52	15.8
>100-250	38	11.5

>250-500	22	6.7
>500-1000	24	7.3
>1000-1500	9	2.7
>1500-2000	6	1.8
>2000	38	11.5
Total	330	100.0

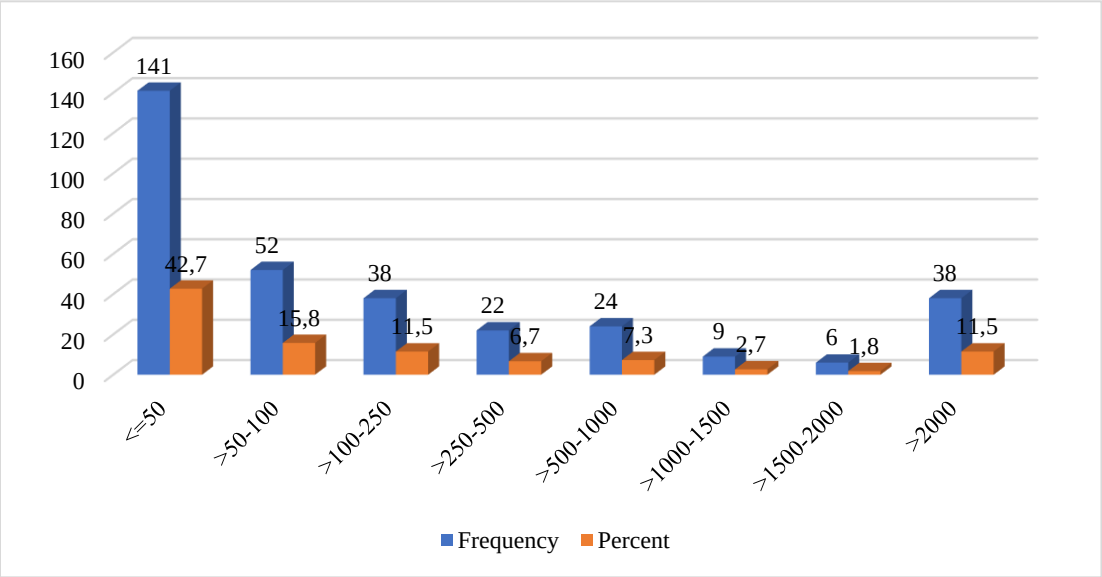

Figure 4.4: What Was Last Year Revenue (Million USD) Of Your Organization?

The above figure 4.4 represents the distribution of the majority of firms (42.7%) that made up to $50mn in income in the previous year. Between $50 and $100 million in revenue made up 15.8% of total revenue; over 2000 million and between $100 and $250 million made up 11.5% each. Revenues of 250–500 million USD (6.7%), 500–1000 million USD (7.3%), 1000–1500 million USD (2.7%), and 1500–2000 million USD (1.8%) were reported by smaller percentages. This suggests a broad range of income levels, with a notable concentration in the lower range.

Table 4.6: What is the Employee Strength (On-Rolls) Of Your Organization

	Frequency	**Percent**

0-100	156	47.3
>100-500	64	19.4
>500-1000	25	7.6
>1000-3000	20	6.1
>3000-5000	17	5.2
>5000-7500	10	3.0
>7500-10000	3	.9
>10000	35	10.6
Total	330	100.0

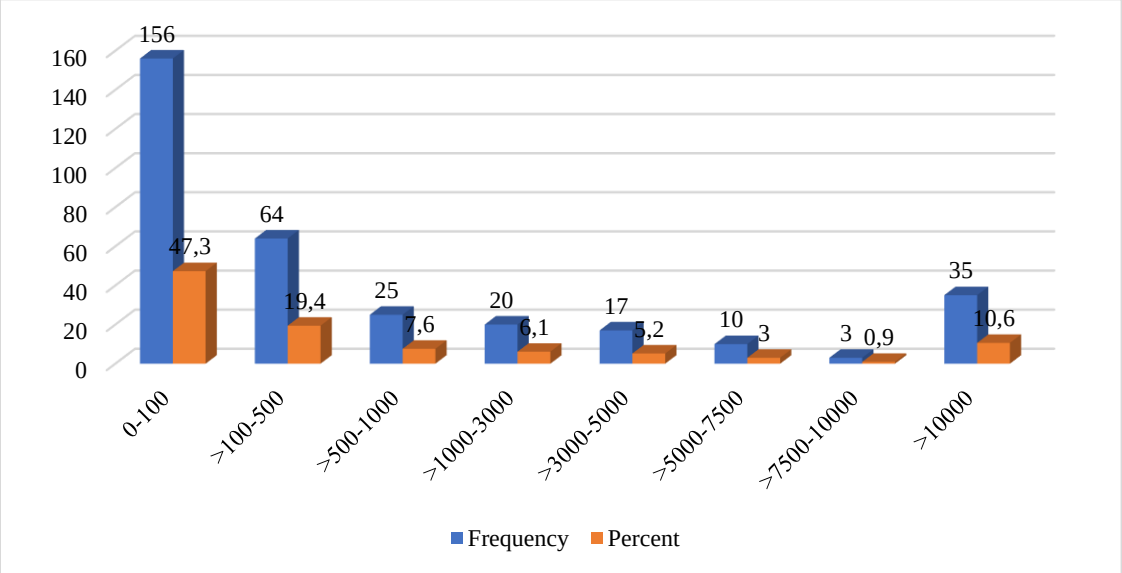

Figure 4.5: What is the Employee Strength (On-Rolls) Of Your Organization

The above figure shows the employee strength (On-rolls) of your organization. The majority (47.3%) have between 0 and 100 employees. Organizations with 100–500 employees make up the next significant group (19.4%), which is followed by those with 1000–3000 employees (6.1%) and more than 10,000 employees (10.6%). The remaining groups contain smaller percentages, ranging from 3% to 7.6%, and represent larger

enterprises. The variation in structural sizes within the sample is demonstrated by this distribution.

Table 4.7: What Is the Supply Chain (Logistics, Procurement, Distribution, Planning & Warehousing) Employee Strength (On- Rolls) of Your Organization?

	Frequency	**Percent**
0-10	137	41.5
>10-30	82	24.8
>30-50	20	6.1
>50-150	44	13.3
>150	47	14.2
Total	330	100.0

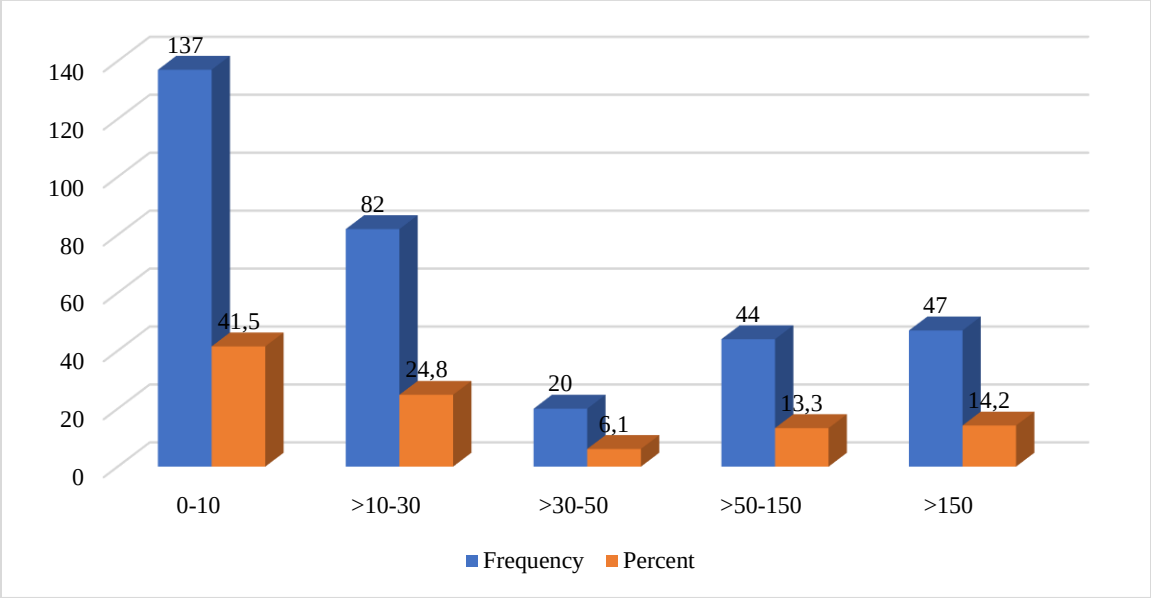

Figure 4.6: What is the Supply Chain (Logistics, Procurement, Distribution, Planning & Warehousing) Employee Strength (On-Rolls) of Your Organization?

As shown in the above figure 4.6, 24.8% of firms employ 10–30 people in supply chain functions, compared to 41.5% that employ 0–10 people in these positions. 14.2% more people work in this sector than in any other, followed by 13.3% with 50–150 workers and

6.1% with 30–50 workers. This illustrates how different firms' Supply Chain teams vary in size.

Table 4.8: Years Your Organization Has Been Operating Since Inception?

	Frequency	**Percent**
0-5	41	12.4
>5-10	42	12.7
>10-15	44	13.3
>15-20	41	12.4
>20-50	112	33.9
>50	50	15.2
Total	330	100.0

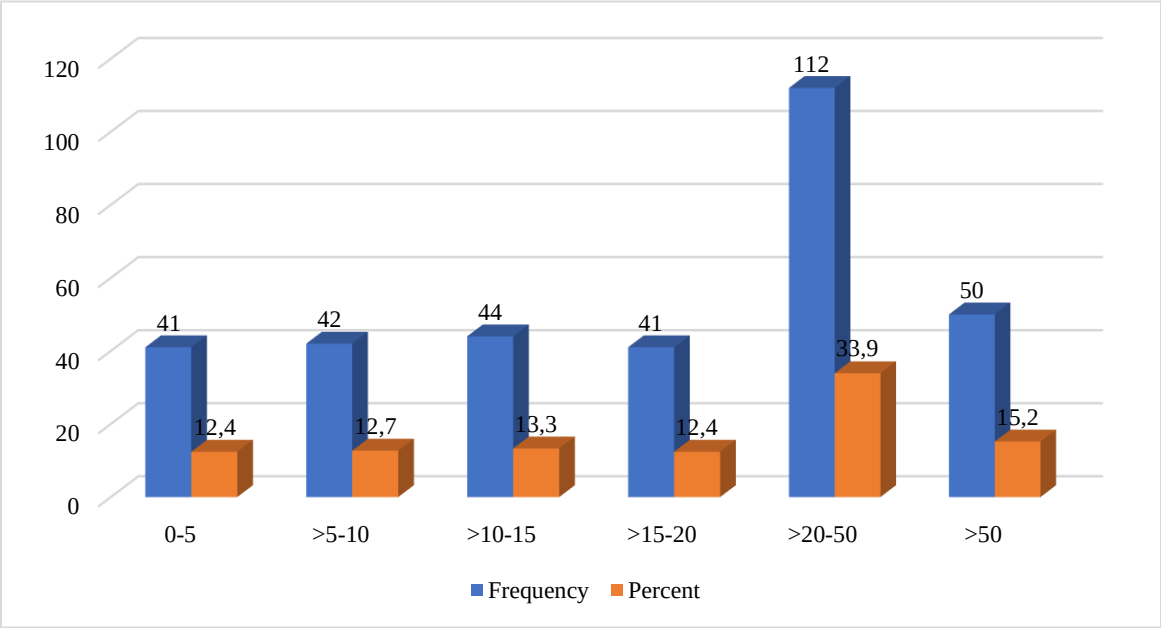

Figure 4.7: Years Your Organization Has Been Operating Since Inception?

The above figure illustrates the years that numerous organizations have been in existence since their founding. The majority (33.9%) have been in business for 20 to 50 years, with 15.2% having been in business for more than 50 years. The categories of 10-15 years

(13.3%), 0-5 years (12.4%), >5-10 years (12.7%), and >15-20 years (12.4%) have smaller percentages. This distribution shows that the sample's organizational ages span a wide range.

Table 4.9: What is the Industry Your Organization Operates?

Industry	**Frequency**
Pharma Manufacturing & Services	210
Agriculture & Food processing	36
Paper & Textile	17
Tourism & Hospitality	4
Information Technology (Technology services, Software & Hardware)	27
Financial & Insurance services	8
Media & Telecommunication	6
Automobile & Transport equipment Manufacturing	16
Oil and Gas E&P	18
E-commerce & Retail	11
Commercial Real Estate	6
Electronics Goods & Durables	20
Mining & Metal production	9
Chemicals & Paints	74
Healthcare (Hospitals, Diagnostic labs, Equipments)	49
Transportation, Logistics & Warehousing services	24
Others	65

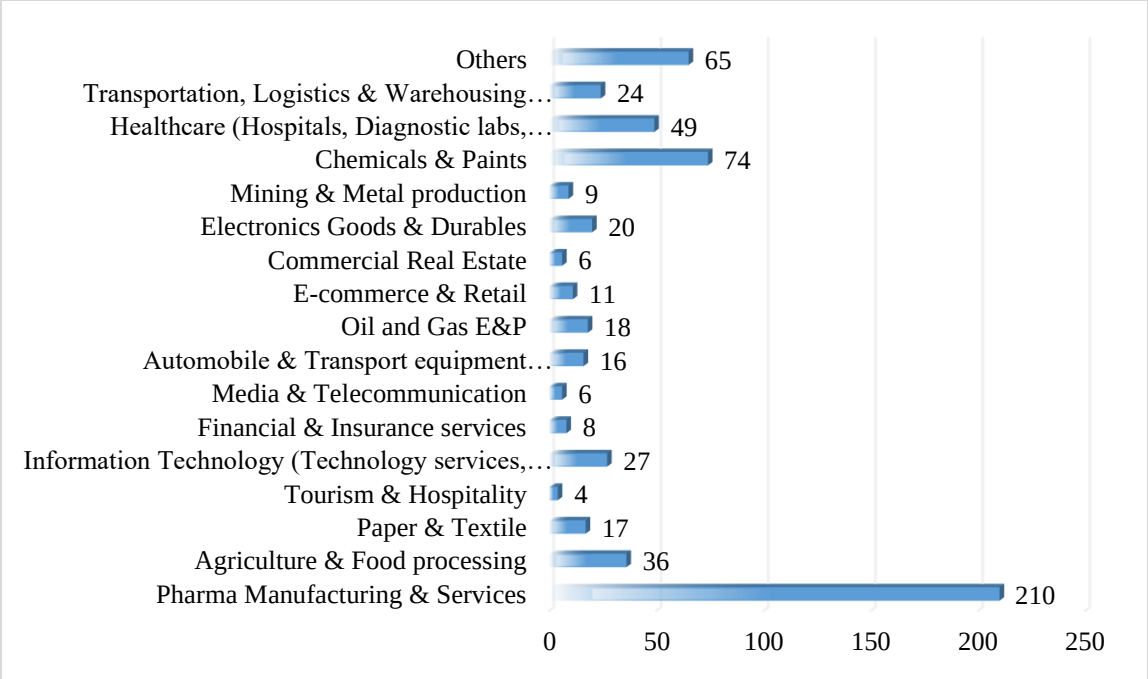

Figure 4.8: What is the Industry Your Organization Operates?

The above figure 4.8 shows the industries these organizations operate. Pharma Manufacturing & Services is the most common industry, making up 37.6% of all firms. Then, 4.2% is represented by Chemicals & Paints, 3.0% by healthcare, and 4.5% by Information Technology. To a lesser extent, other businesses like agriculture and food processing, electronics, logistics and warehousing services, transportation, and agriculture are also represented. An additional number of businesses (11.8%) fall under the category of "Others," suggesting that a wide range of industries are represented in the sample.

Table 4.10: Supply Chain digitalization and Sustainability orientation maturity levels as compared to your Industry.

		Emerging	**Developing**	**Leading**
Supply Chain Core Performance Maturity	**Frequency**	46	159	125
	Percent	13.9	48.2	37.9
Supply Chain Digitalization Maturity	**Frequency**	83	157	90
	Percent	25.2	47.6	27.3

Supply Chain Sustainability Maturity	**Frequency**	72	146	112
	Percent	21.8	44.2	33.9
Overall Supply Chain Maturity	**Frequency**	47	169	114
	Percent	14.2	51.2	34.5

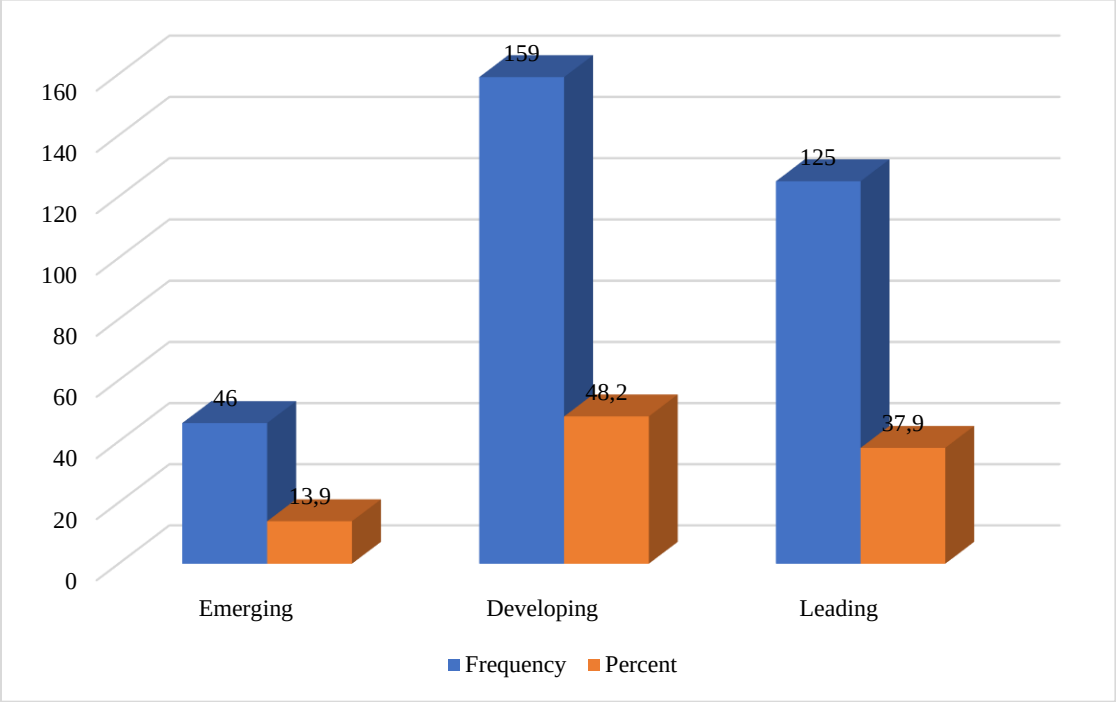

Figure 4.9: Supply Chain Core Performance Maturity

In the above figure Levels of supply chain core performance maturity are displayed. The majority of organizations—48.2%—are in the "Developing" stage, which is followed by the "Leading" stage—37.9%—and the "Emerging" stage—13.9%. This suggests that a considerable portion are advanced, a smaller portion are still in the early stages of development, and many have a moderate level of maturity.

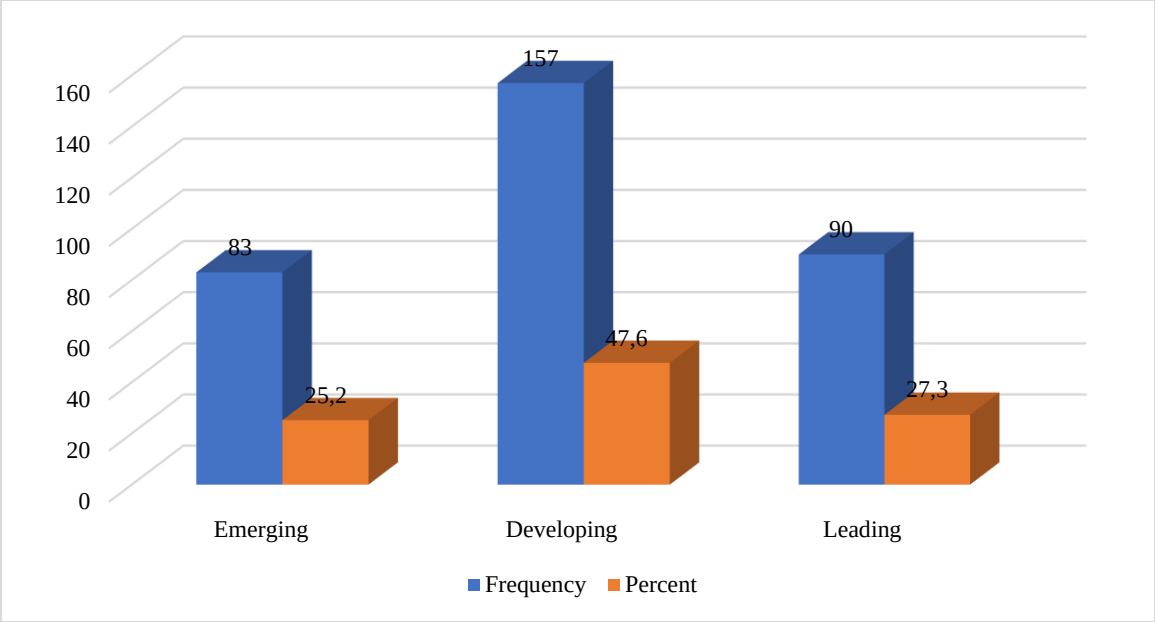

Figure 4.10: Supply Chain Digitalization Maturity

The above figure 4.10 shows the data of the expressions the supply chain digitization maturity levels within enterprises. There is a prevailing tendency towards intermediate digitalization maturity, with the majority (47.6%) in the "Developing" stage, followed by 27.3% in the "Leading" stage and 25.2% in the "Emerging" stage.

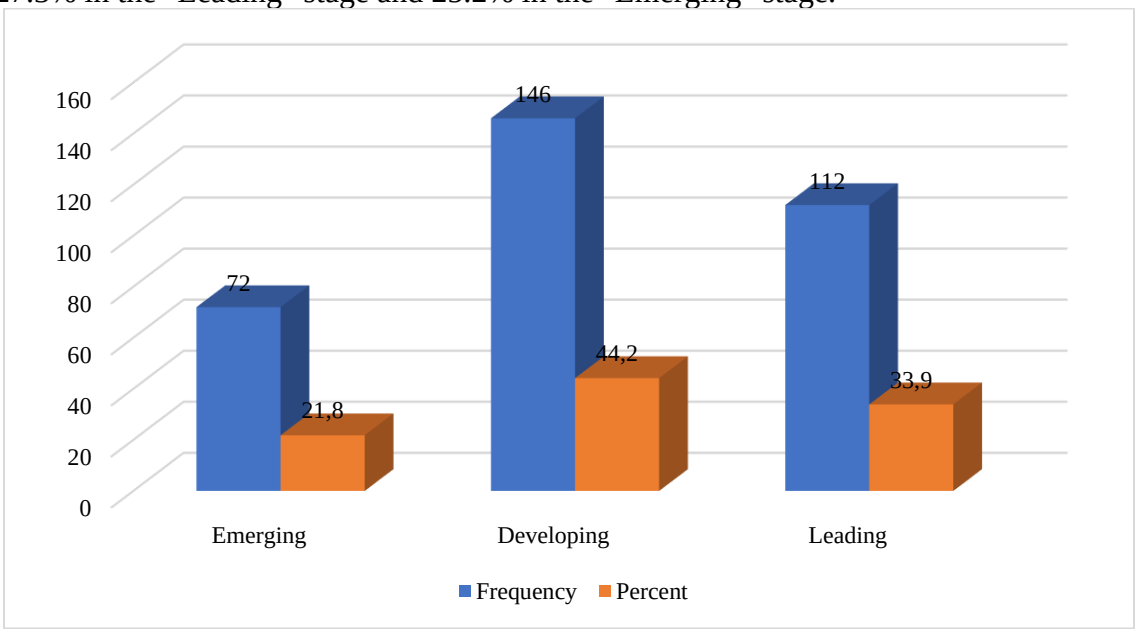

Figure 4.11: Supply Chain Sustainability Maturity

The above figure 4.11 shows the supply chain sustainability maturity levels within organizations. There is a tendency towards moderate to high sustainability maturity, with the majority (44.2%) in the "Developing" stage, followed by 33.9% in the "Leading" stage and 21.8% in the "Emerging" stage.

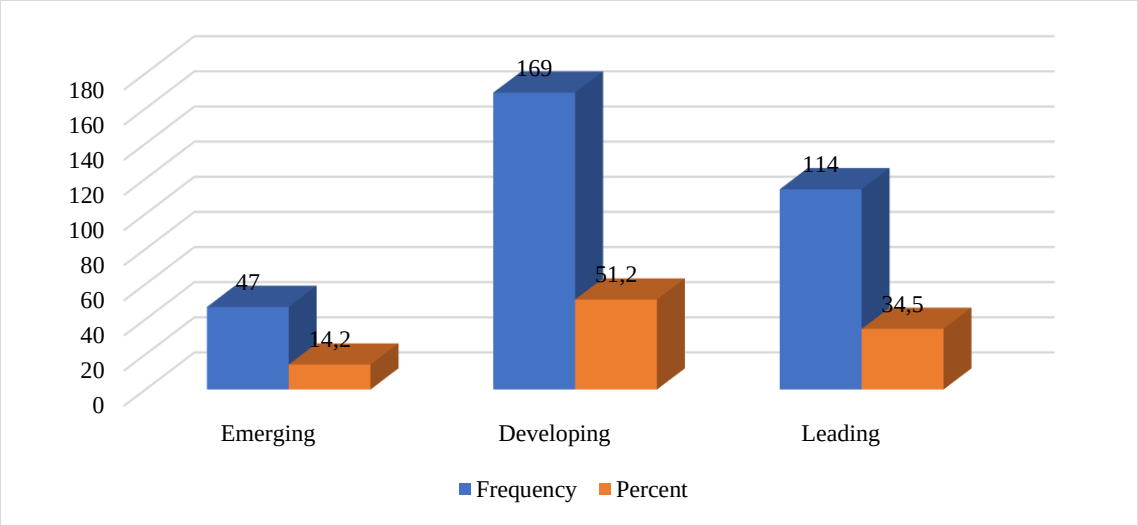

Figure 4.12: Overall Supply Chain Maturity

In the above figure, 4.12 shows the data of the supply chain maturity levels across all organizations are displayed. There is a general trend towards moderate to high maturity levels, with the majority (51.2%) in the "Developing" stage, followed by 34.5% in the "Leading" stage and 14.2% in the "Emerging" stage.

Table 4.11: Supply Chain Digitalization & Sustainable supply Chain initiative in your organization?

		Not so Critical	**Critical**	**Very Critical**
Customer Requirements	**Frequency**	69	105	156
	Percent	20.9	31.8	47.3
Competition Pressure	**Frequency**	81	153	96
	Percent	24.5	46.4	29.1
Management Vision	**Frequency**	59	108	163
	Percent	17.9	32.7	49.4

Regulatory & Statutory Requirements	**Frequency**	79	122	129
	Percent	23.9	37	39.1

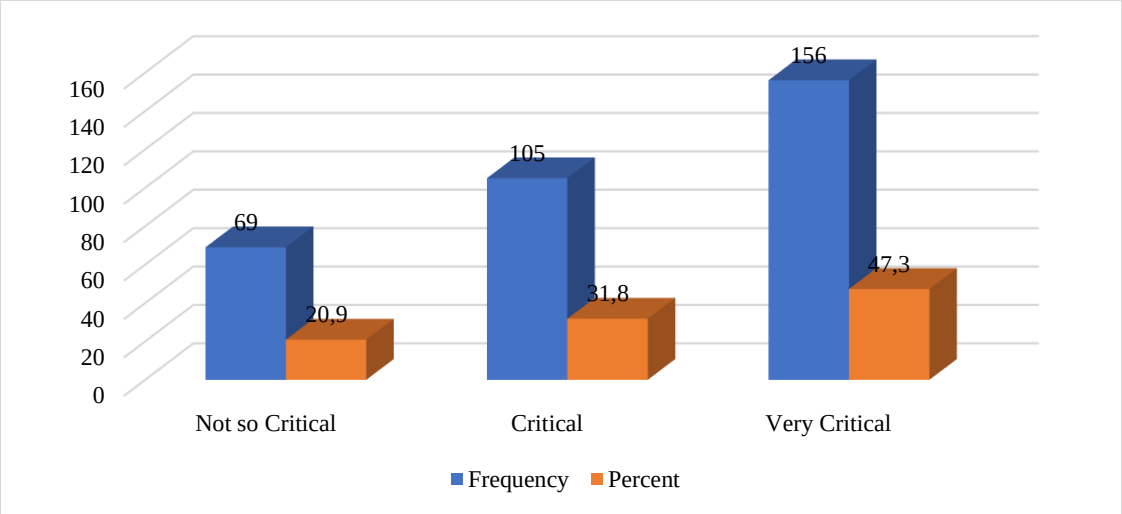

Figure 4.13: Customer Requirements

The above figure 4.13 shows the data of the Customers' requirements are highly valued, as seen by the majority (47.3%) who see them as "Very Critical," 31.8% who see them as "Critical," and 20.9% who see them as "Not so Critical."

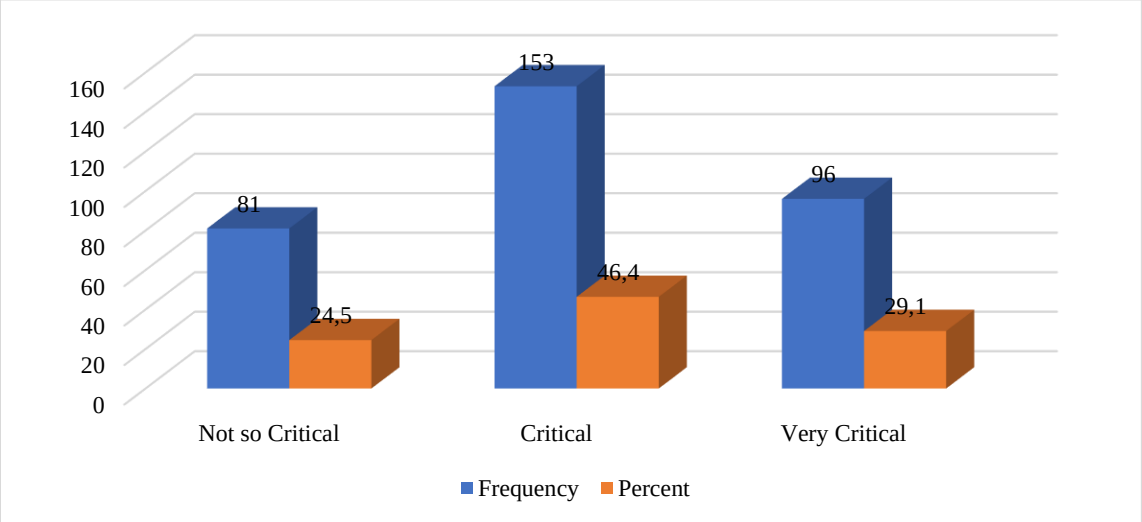

Figure 4.14: Competition Pressure

The above figure 4.14 shows the data on the competition pressure the maximum value is shown by the majority 46.4% of respondents find it "Critical," followed by 29.1% who find

it "Very Critical," and 24.5% who find it "Not so Critical." This suggests that responders have a good understanding of the competitive environment.

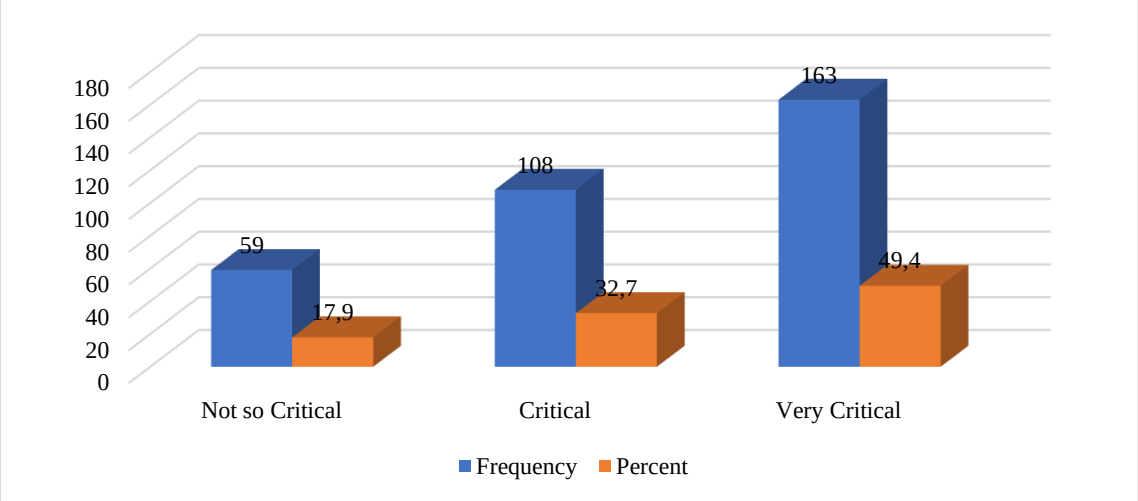

Figure 4.15: Management Vision

The above figure, 4.15 presents the data of the significance of management vision in the organization. The majority 49.4% of respondents think it's "Very Critical," followed by 32.7% who think it's "Critical," and 17.9% who think it's "Not so Critical." This proves how highly effective leadership and strategic direction are valued.

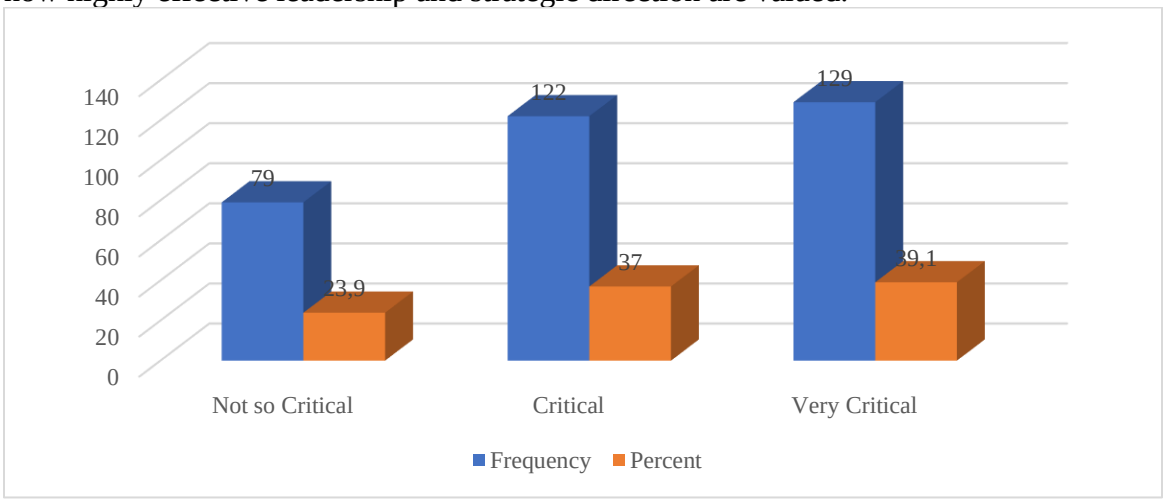

Figure 4.16: Regulatory & Statutory Requirements

The above figure 4.16 presents the data on the significance of statutory and regulatory wants within organizations. Significantly, 39.1% of people think they are "Very Critical,"

followed by 37.0% who think they are "Critical," and 23.9% who think they are "Not so Critical." This suggests a keen understanding of regulatory duties and a focus on compliance.

Table 4.12: Digitalization in the supply Chain functions of your organization?

		Not so Critical	Critical	Very Critical
Procurement	**Frequency**	76	118	136
	Percent	23	35.8	41.2
Planning	**Frequency**	68	123	139
	Percent	20.6	37.3	42.1
Logistics	**Frequency**	71	134	125
	Percent	21.5	40.6	37.9
Warehousing & Distribution	**Frequency**	85	118	127
	Percent	25.8	35.8	38.5

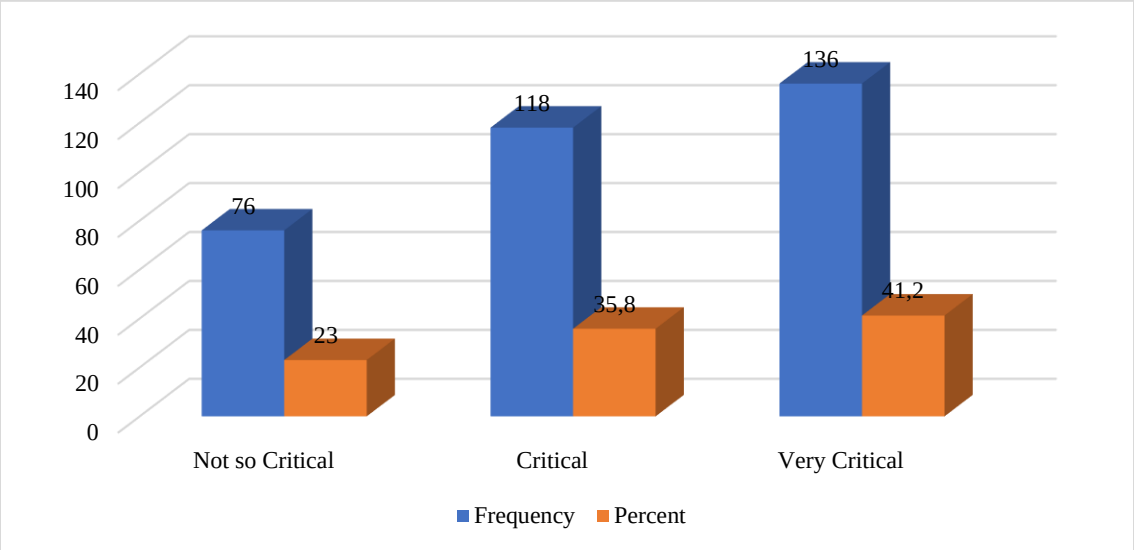

Figure 4.17: Procurement

The above figure 4.17 shows the data on Procurement according to the majority 41.2% of respondents think it's "Very Critical," 35.8% think it's "Critical," and 23.0% think it's "Not

so Critical." This emphasizes how crucial effective procurement methods and procedures are to the smooth running of businesses.

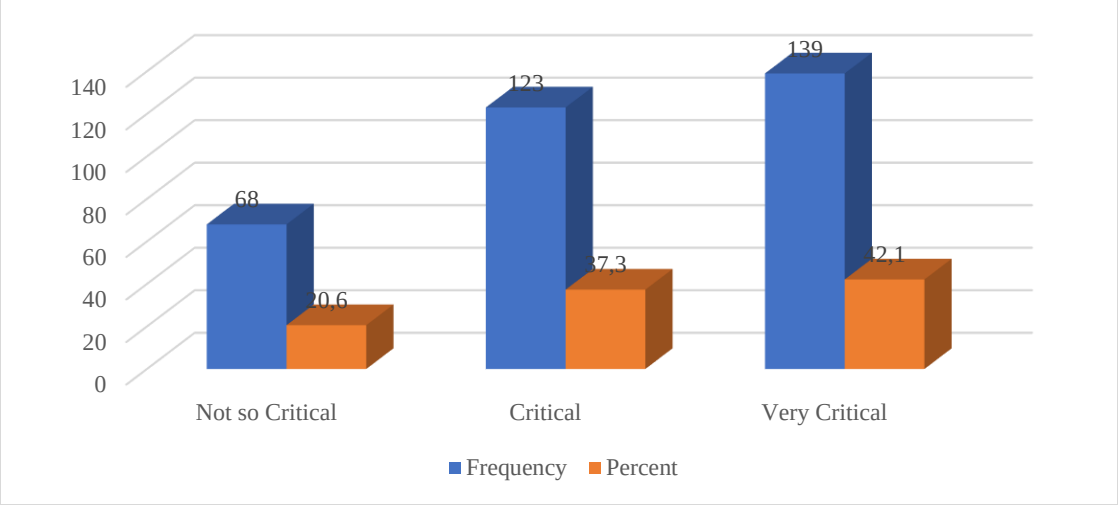

Figure 4.18: Planning

The above figure 4.18 presents the data of the planning is to businesses. 42.1% of respondents think it's "Very Critical," followed by 37.3% who think it's "Critical," and 20.6% who think it's "Not so Critical." This demonstrates how important efficient planning procedures are to the smooth running of businesses.

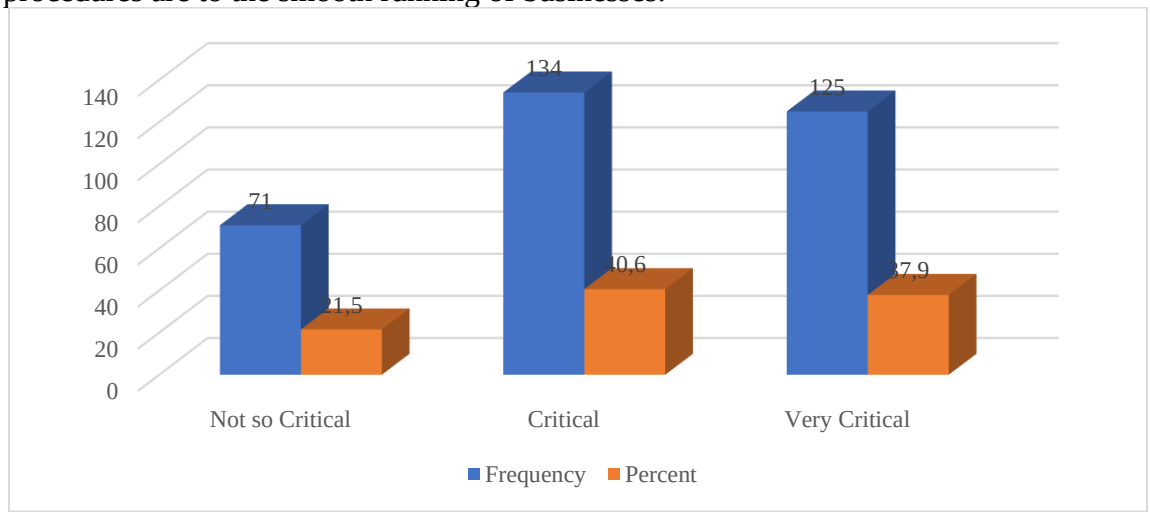

Figure 4.19: Logistics

In the above figure, 4.19 shows the data on the importance of logistics in organizations is displayed. Significantly, 40.6% of respondents rate it as "Critical," closely followed by

37.9% who rate it as "Very Critical," and 21.5% who rate it as "Not so Critical." This emphasizes how important effective logistics management is to the way businesses operate.

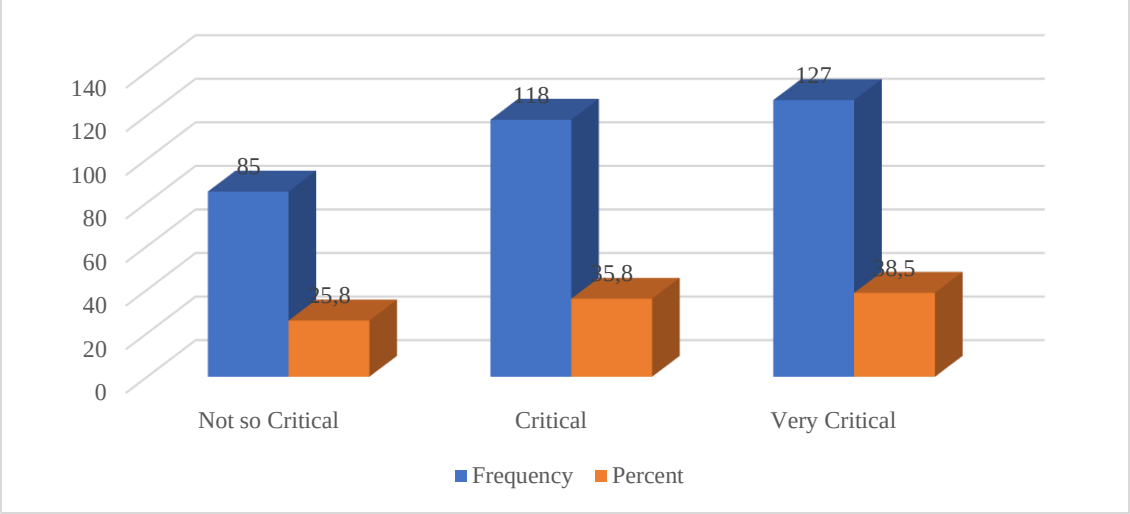

Figure 4.20: Warehousing & Distribution

The above figure 4.20 shows the significance of distribution and warehousing within businesses. 38.5% of respondents think it's "Very Critical," followed by 35.8% who think it's "Critical," and 25.8% who think it's "Not so Critical." This highlights how important effective distribution and warehousing procedures are to the functioning of businesses.

Table 4.13: Sustainability initiatives in the supply Chain functions of your organisation?

		Not so Critical	**Critical**	**Very Critical**
Procurement	**Frequency**	72	131	127
	Percent	21.8	39.7	38.5
Planning	**Frequency**	77	140	113
	Percent	23.3	42.4	34.2
Logistics	**Frequency**	83	128	119
	Percent	25.2	38.8	36.1
Warehousing & Distribution	**Frequency**	83	130	117
	Percent	25.2	39.4	35.5

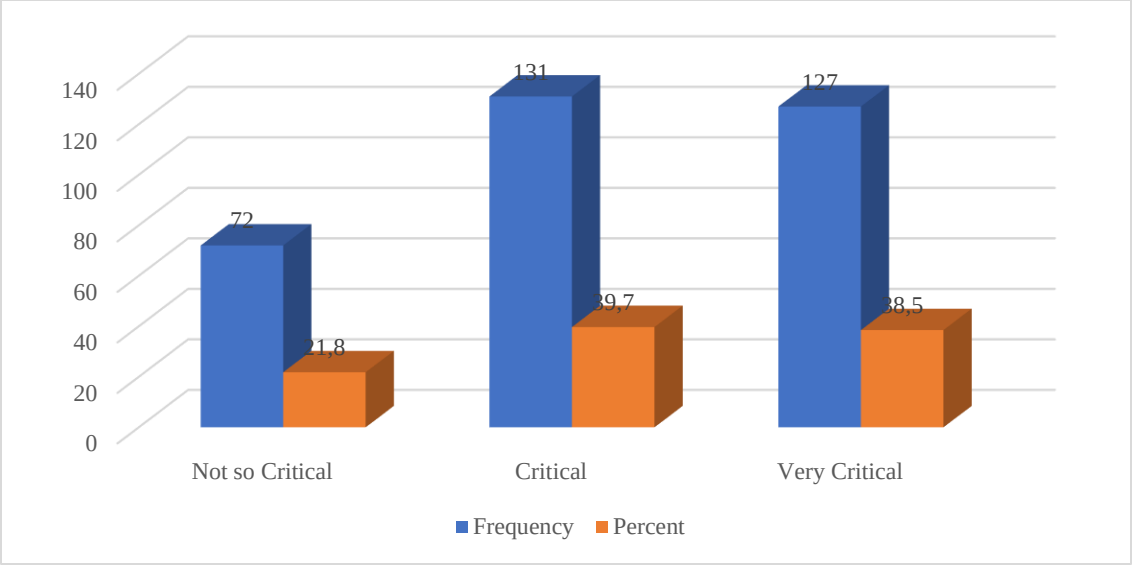

Figure 4.21: Procurement

The above Figure 4.21 shows the data on the significance of procurement in companies is shown. 38.5% of respondents regard it to be "Very Critical," closely followed by 39.7% who consider it to be "Critical," and 21.8% who view it as "Not so Critical." This emphasizes how important it is for procurement strategies to be successful in business operations.

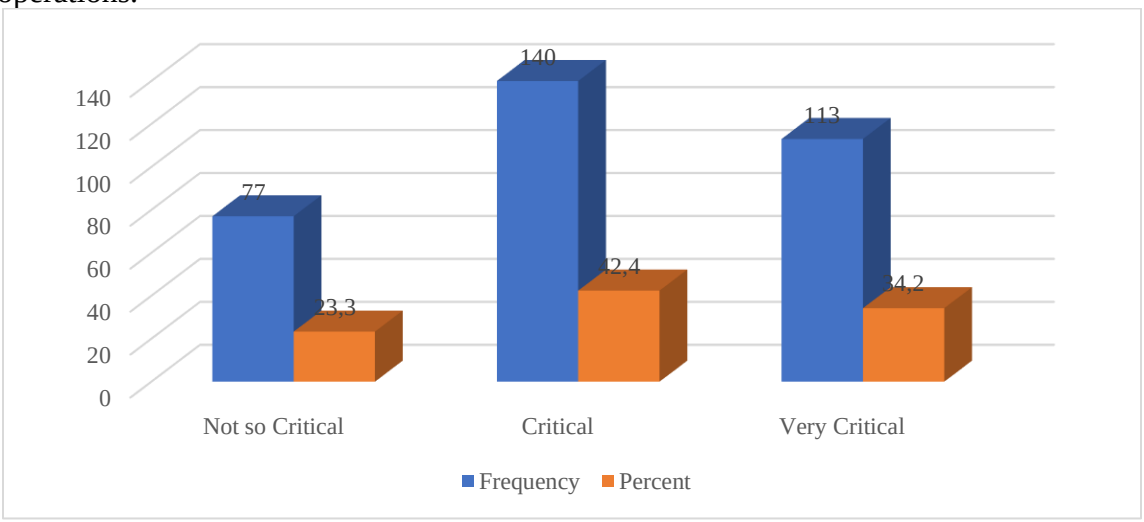

Figure 4.22: Planning

The above figure 4.22 presents the data on the Planning is important in organizations, shows. Largely, 42.4% of respondents rate it as "Critical," followed by 34.2% who rate it

as "Very Critical," and 23.3% who rate it as "Not so Critical." This emphasizes the significance of sound planning procedures for productive corporate operations.

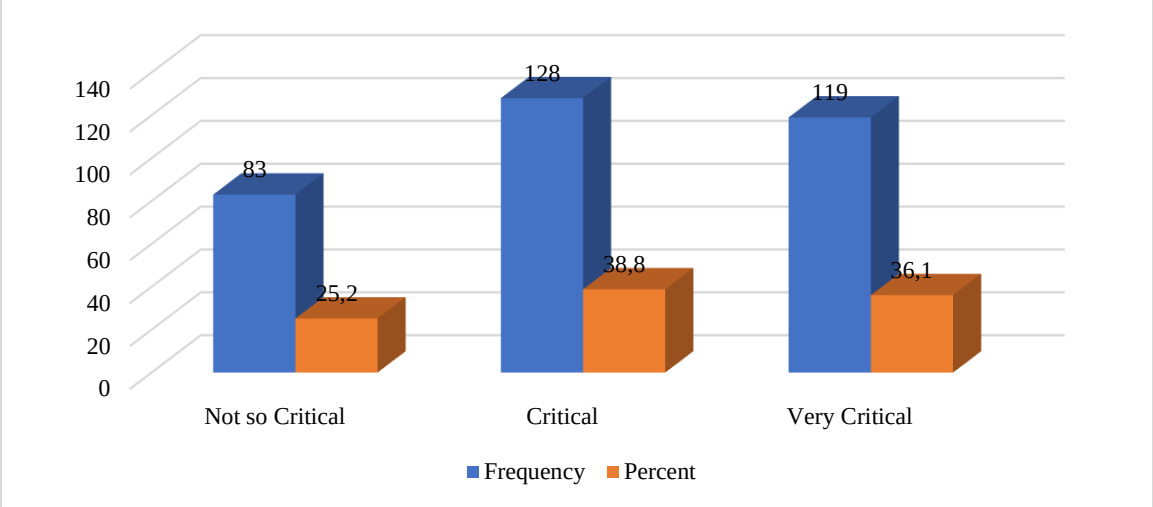

Figure 4.23: Logistics

The above figure 4.23 shows the significance of logistics to organizations. 38.8% of respondents think it's "Critical," with 36.1% thinking it's "Very Critical," and 25.2% thinking it's "Not so Critical." This emphasizes how important effective logistics management is to the way businesses operate.

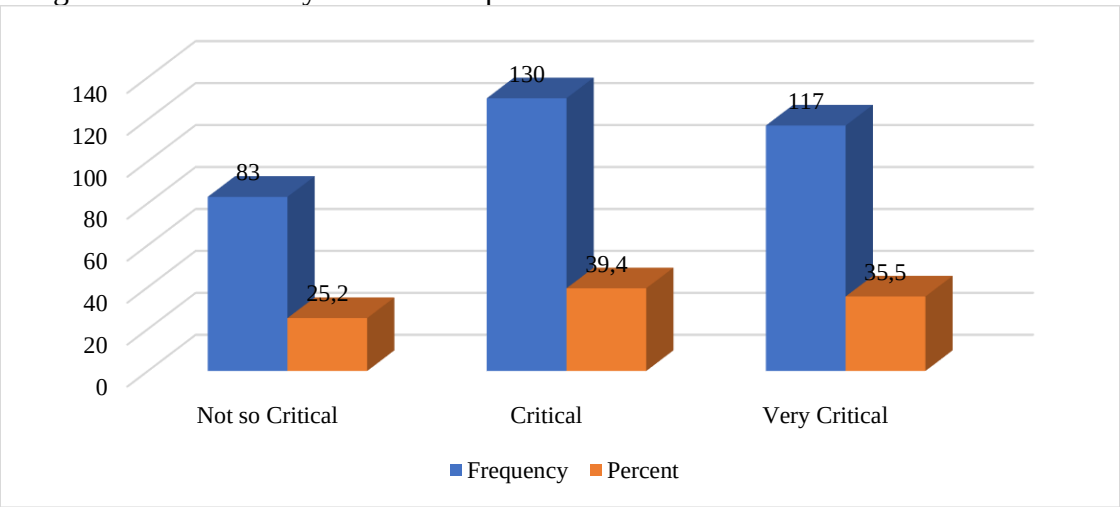

Figure 4.24: Warehousing & Distribution

The above Figure 4.24 presents the significance of distribution and warehousing within businesses. Significantly, 39.4% of respondents rate it as "Critical," followed by 35.5%

who rate it as "Very Critical," and 25.2% who rate it as "Not so Critical." This emphasizes how important effective distribution and storage procedures are to company operations.

Table 4.14: Digitalization in your supply chain?

		Not so Critical	Critical	Very Critical
Availability of Talent to Operate the Digitalised Supply Chain	**Frequency**	90	141	99
	Percent	27.3	42.7	30
Availability of Customised Digital Tools Meeting the Requirements	**Frequency**	76	158	96
	Percent	23	47.9	29.1
Internal Challenges Related to Capability & Process Standardization	**Frequency**	79	158	93
	Percent	23.9	47.9	28.2
Cost & Roi Challenges	**Frequency**	78	140	112
	Percent	23.6	42.4	33.9
Lack of Vision & Stakeholder Support	**Frequency**	118	134	78
	Percent	35.8	40.6	23.6

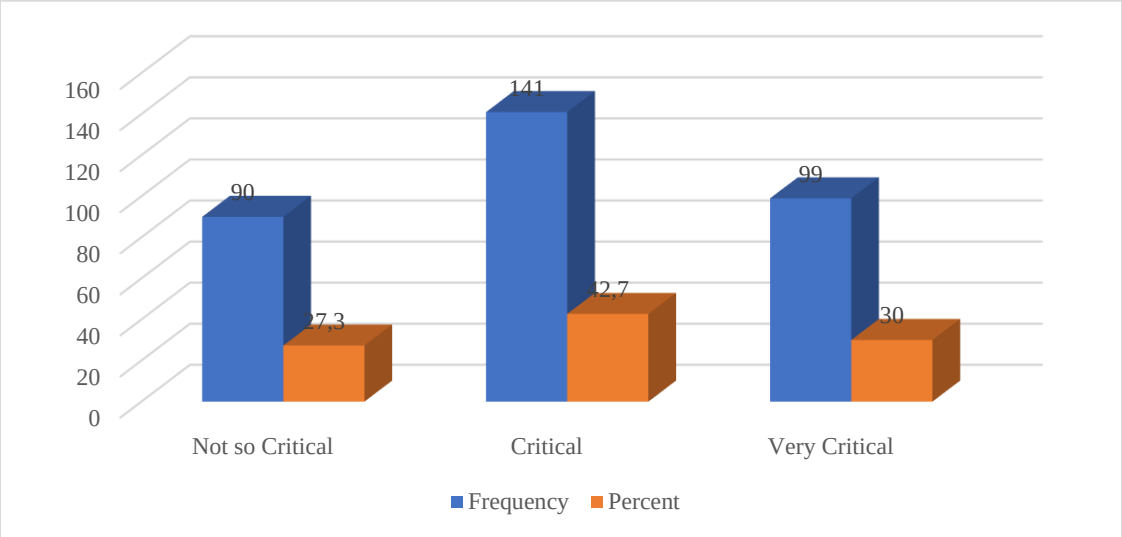

Figure 4.25: Availability of Talent to Operate the Digitalised Supply Chain

The above figure 4.25 presents the data on the availability of talent to operate the digitalized supply chain. 42.7% of respondents rate it as "Critical," followed by 30.0% who rate it as

"Very Critical," and 27.3% who rate it as "Not so Critical." This emphasizes how important having qualified staff is to efficiently manage digital supply chain processes.

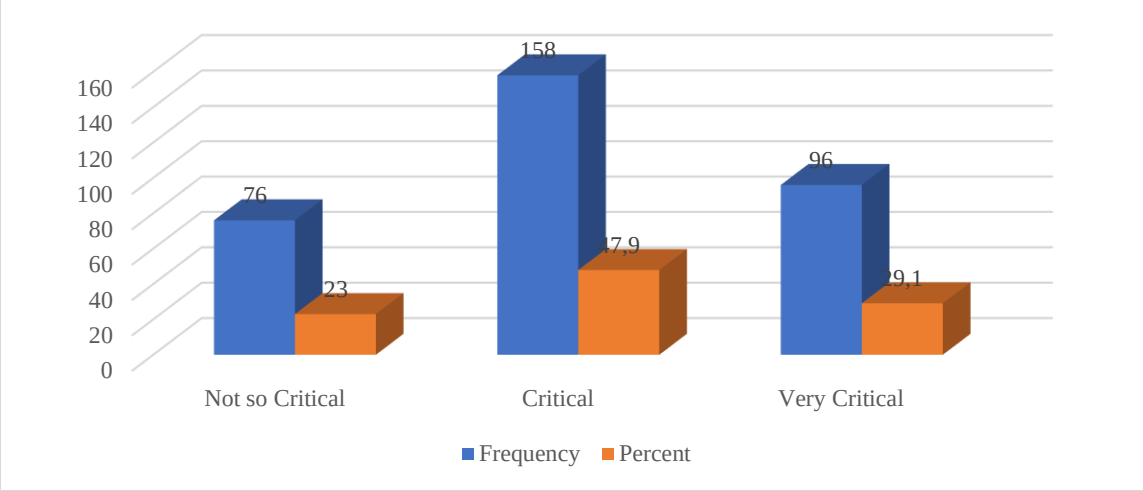

Figure 4.26: Availability of Customised Digital Tools Meeting the Requirements

The above figure 4.26 availability of customised digital tools meeting the requirements. The majority 47.9% of respondents rate it as "Critical," followed by 29.1% who rate it as "Very Critical," and 23.0% who rate it as "Not so Critical." This highlights how important customized digital solutions are to the efficient support of corporate processes.

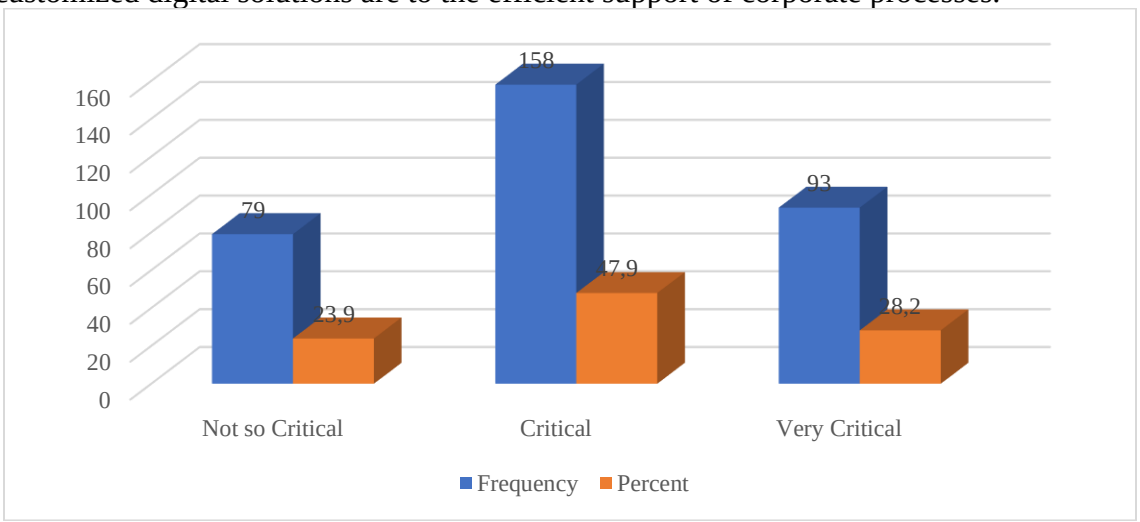

Figure 4.27: Internal Challenges Related to Capability & Process Standardization

The above figure 4.27 shows the data of the internal challenges related to capability & process standardization. The majority 47.9% of respondents rate it as "Critical," followed

by 28.2% who rate it as "Very Critical," and 23.9% who rate it as "Not so Critical." This emphasizes how crucial it is to address and standardize processes and capabilities in order to run operations efficiently.

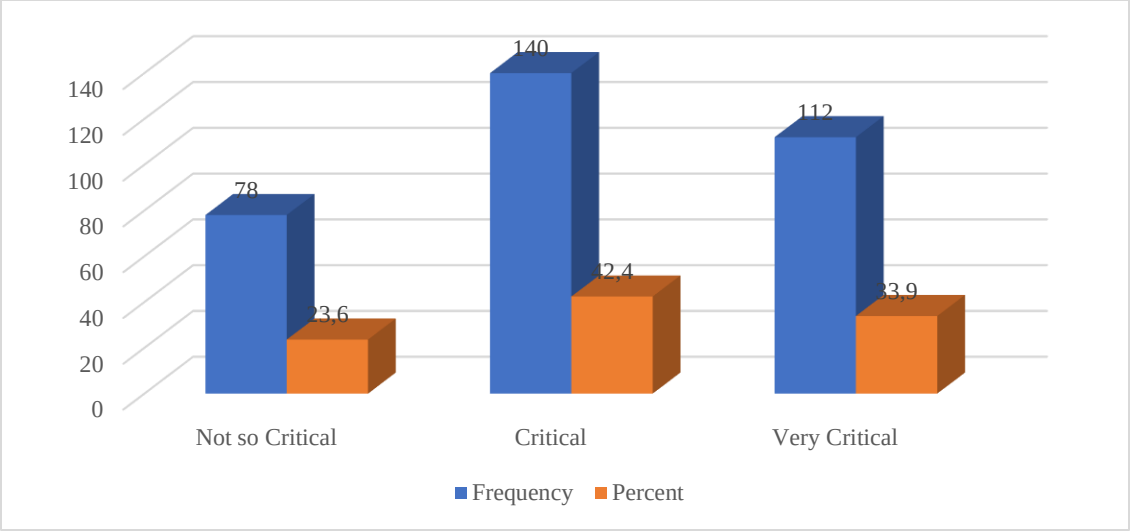

Figure 4.28: Cost & Roi Challenges

The above figure 4.28 shows the issues with cost and ROI in businesses. 42.4% of respondents rate it as "Critical," followed by 33.9% who rate it as "Very Critical," and 23.6% who rate it as "Not so Critical." This highlights how crucial it is to control expenses and have a good business case for driving strategic initiatives of Digitalization & Sustainability in Supply Chain

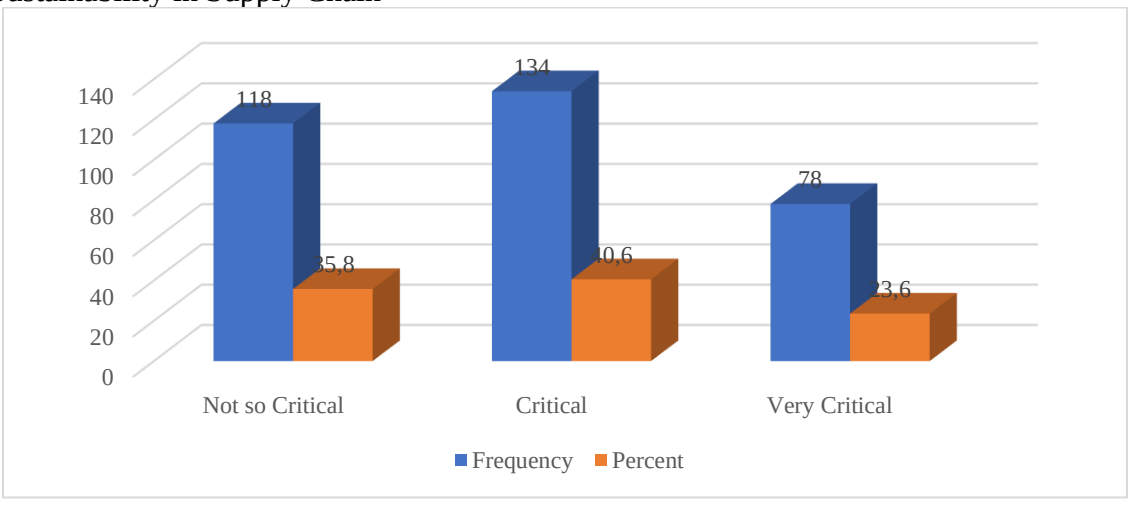

Figure 4.29: Lack of Vision & Stakeholder Support

The above figure 4.29 shows the data on the lack of vision and support from stakeholders. Significantly, 40.6% of respondents rate it as "Critical," with 23.6% ranking it as "Very Critical," and 35.8% rating it as "Not so Critical." This emphasizes how crucial stakeholder participation and a strong leadership vision are to fostering organizational success.

Table 4.15: Sustainability initiatives in your supply chain?

		Not so Critical	Critical	Very Critical
Availability of Talent to Operate the Digitalised Supply Chain	Frequency	103	136	91
	Percent	31.2	41.2	27.6
Availability of Customised Digital Tools Meeting the Requirements	Frequency	87	169	74
	Percent	26.4	51.2	22.4
Internal Challenges Related to Capability & Process Standardization	Frequency	84	174	72
	Percent	25.5	52.7	21.8
Cost & Roi Challenges	Frequency	82	144	104
	Percent	24.8	43.6	31.5
Lack of Vision & Stakeholder Support	Frequency	123	133	74
	Percent	37.3	40.3	22.4

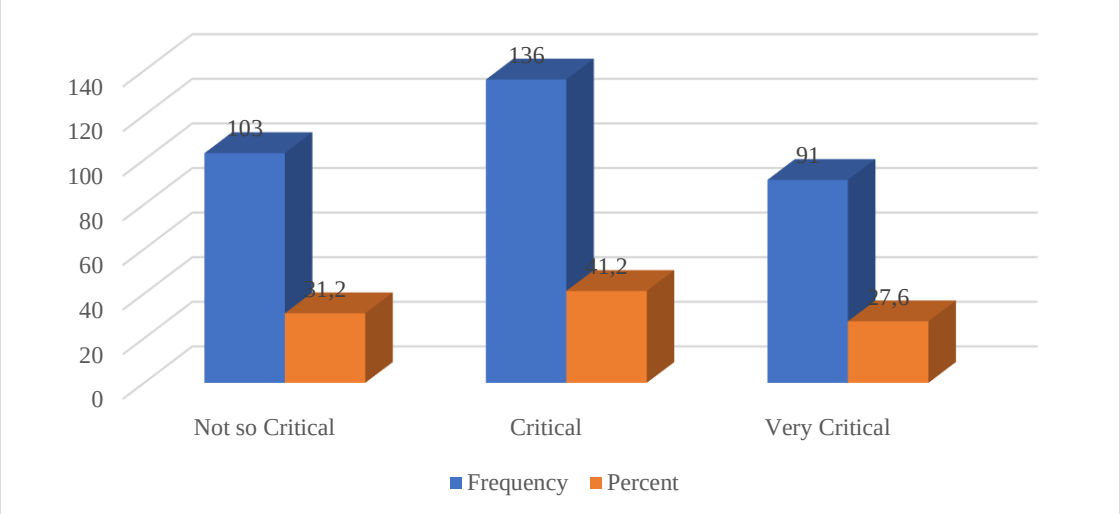

Figure 4.30: Availability of Talent to Operate the Digitalised Supply Chain

The above figure 4.30 shows the data on the availability of talent to operate the digitalized supply chain. 41.2% of respondents find it "Critical," followed by 27.6% who find it "Very Critical," and 31.2% who find it "Not so Critical." This highlights how important having qualified staff is to running digital supply chain operations efficiently.

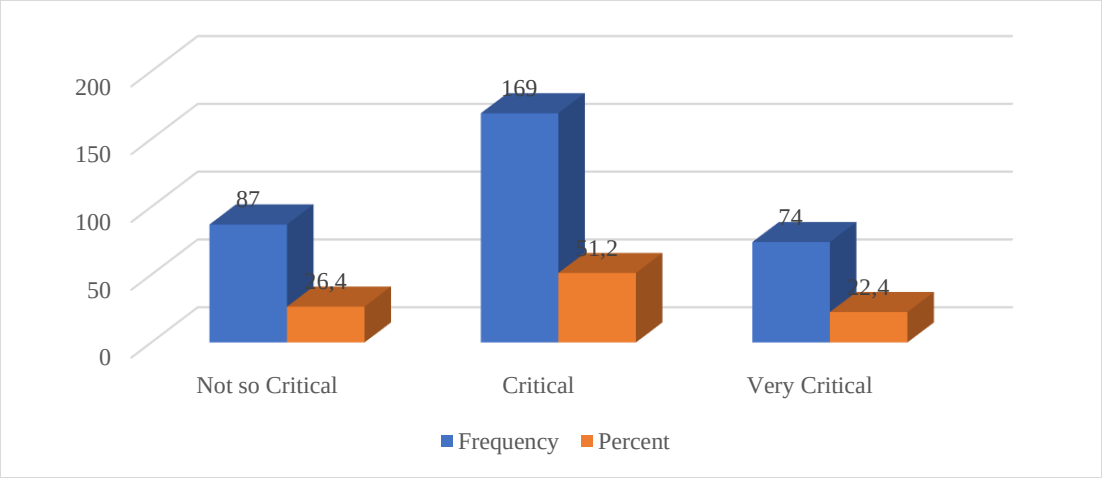

Figure 4.31: Availability Of Customised Digital Tools Meeting the Requirements

The above figure 4.31 shows the data on the availability of customised digital tools meeting the requirements. The majority 51.2% of respondents think it's "Critical," compared to 22.4% who think it's "Very Critical" and 26.4% who think it's "Not so Critical." This emphasizes how important customized digital solutions are to the efficient support of company processes.

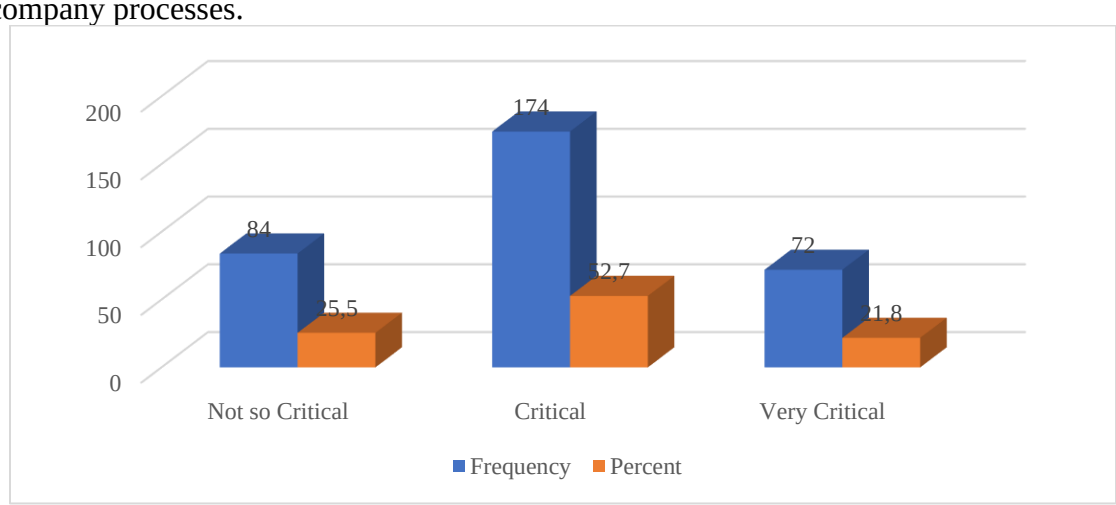

Figure 4.32: Internal Challenges Related to Capability & Process Standardization

The internal challenges related to capability and process standardization are shown in the above figure 4.32. The majority 52.7% of respondents rate it as "Critical," followed by 21.8% who rate it as "Very Critical," and 25.5% who rate it as "Not so Critical." This emphasizes how crucial it is to address and standardize processes and capabilities in order to run operations efficiently.

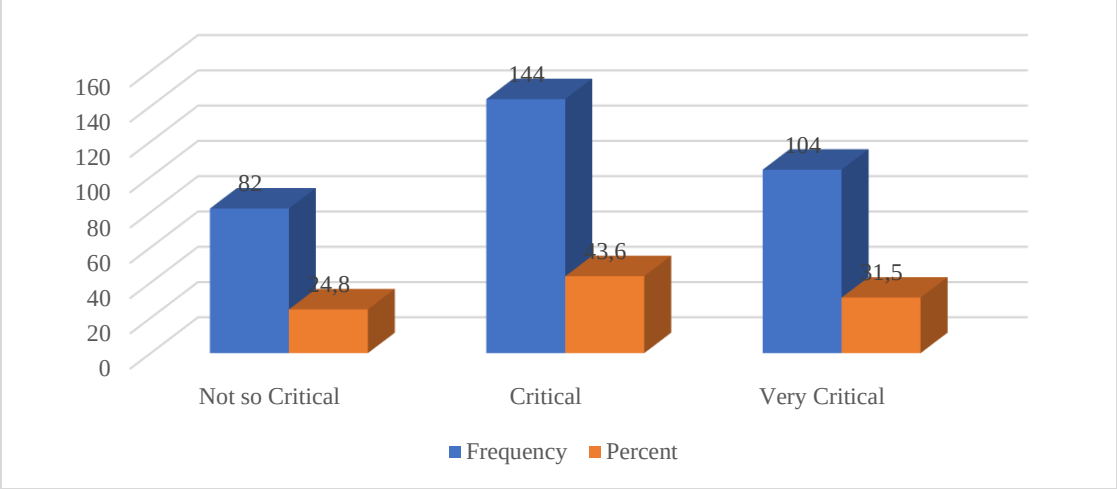

Figure 4.33: Cost & Roi Challenges

The issues with cost and ROI in the challenge are presented in the above figure 4.33. According to the majority, 3.6% of respondents find it "Critical," followed by 31.5% who find it "Very Critical," and 24.8% who find it "Not so Critical." This highlights how crucial it is to control expenses and get a good return on investment when running a business.

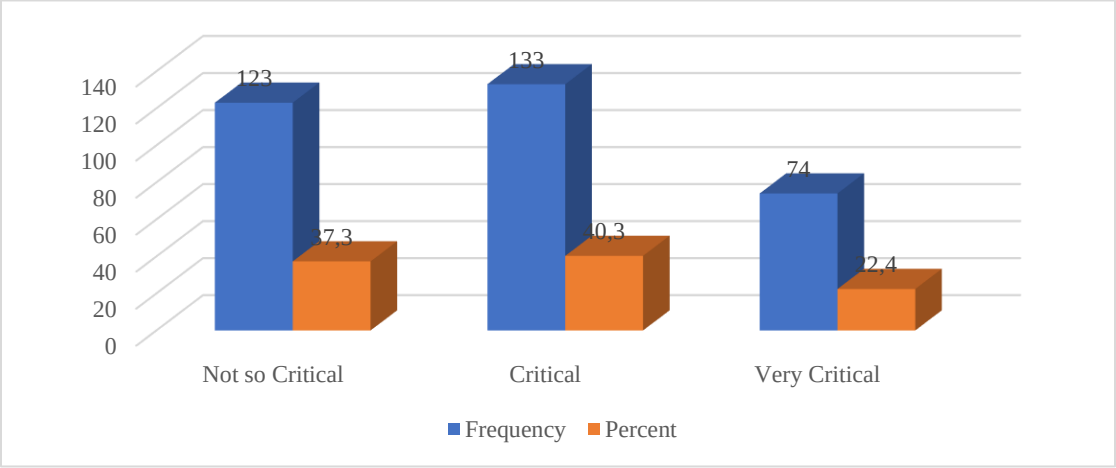

Figure 4.34: Lack of Vision & Stakeholder Support

The above figure 4.34 expresses worry regarding organizations' lack of vision and support from stakeholders. 40.3% of respondents think it's "Critical," with 22.4% thinking it's "Very Critical," and 37.3% thinking it's "Not so Critical." This emphasizes how crucial stakeholder participation and a strong leadership vision are to fostering organizational success.

Table 4.16: Supply Chain digitalization & Sustainability initiatives?

		Not so Critical	Critical	Very Critical
Government And Educational Institutions to Design Vocational Skills Curriculum Driving Supply Chain Digitalization & Sustainability in Academics	Frequency	73	132	125
	Percent	22.1	40	37.9
Industry Collaboration for On-The-Job Training	Frequency	58	125	147
	Percent	17.6	37.9	44.5
Internal Job Transfer and Upskilling	Frequency	77	143	110
	Percent	23.3	43.3	33.3

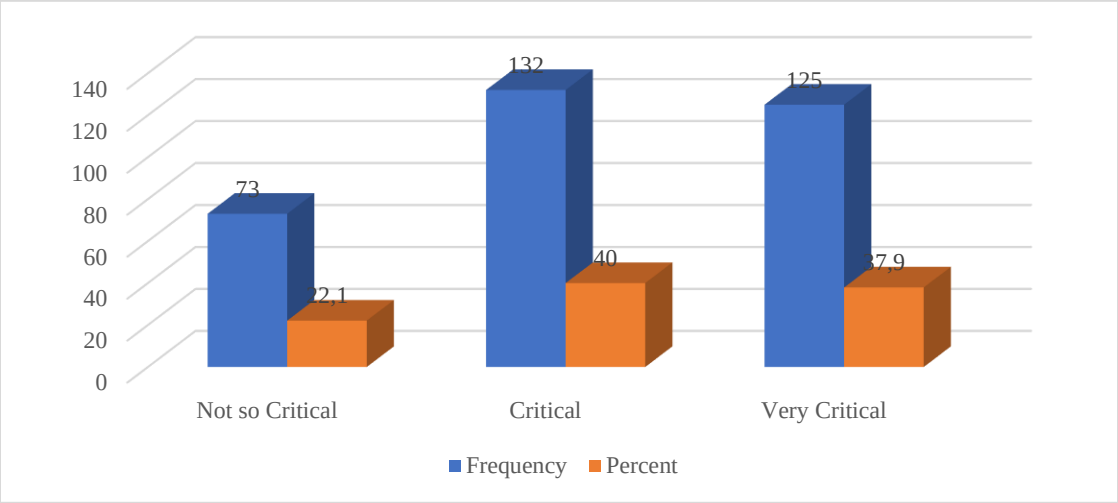

Figure 4.35: Government and Educational Institutions to Design Vocational Skills Curriculum Driving Supply Chain Digitalization & Sustainability In Academics

As the above Figure 4.35 presents the data of the government and educational institutions that must prioritise supply chain digitalisation and sustainability while developing vocational skill curricula. 40.0% view it as critical, 37.9% as very critical, and 77.9% consider it critical or very critical. This underscores the critical role that education plays in educating professionals for the problems of the modern supply chain.

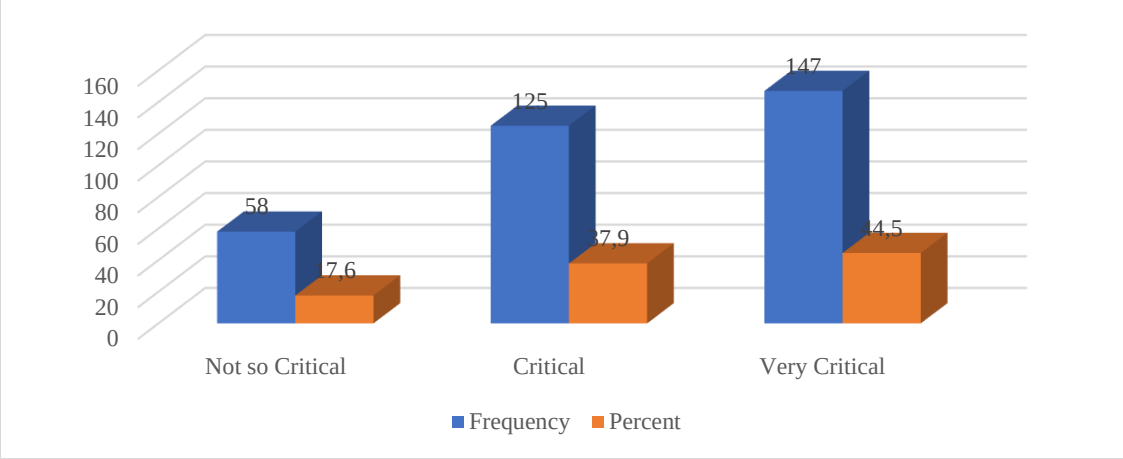

Figure 4.36: Industry Collaboration for On-The-Job Training

The above figure 4.36 presents the data of the industry collaboration for on-the-job training. 82.4% of respondents think it is crucial or extremely critical, compared to 37.9% who think it is critical and 44.5% who think it is very critical. This emphasizes how important industry relationships and practical experience are to professional development.

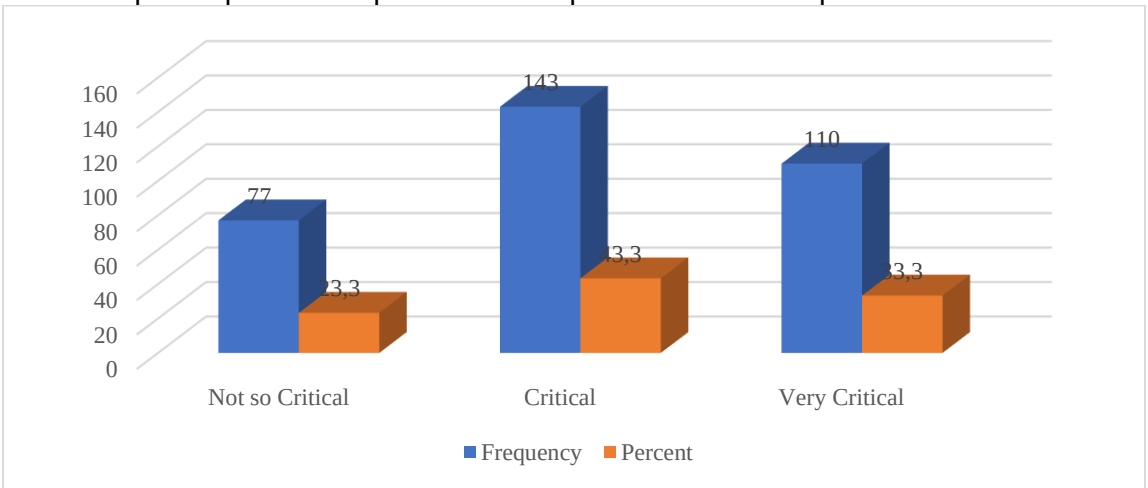

Figure 4.37: Internal Job Transfer and Upskilling

The significance of internal job transfers and upskilling within companies is emphasized in the above figure 4.37. Most people, 76.6%, believe it to be critical or very critical; 43.3% believe it to be critical, and 33.3% believe it to be extremely critical. This demonstrates how important internal talent development and mobility are in addressing changing company requirements.

Table 4.17: Supply Chain Employee digital literacy and upskilling

		Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
Our Company Provides Sufficient Training Opportunities for Employees To Improve Their Digital Skills.	**Frequency**	37	47	99	92	55
	Percent	11.2	14.2	30	27.9	16.7
Our Existing Supply Chain Employees Have Adopted Well with Digital Skills And Able To Perform Satisfactorily	**Frequency**	31	60	91	110	38
	Percent	9.4	18.2	27.6	33.3	11.5
Our Existing Supply Chain Employees Are Finding Value and Better Job Satisfaction Post-Implementation of Supply Chain Digitalization Initiatives	**Frequency**	28	50	100	105	47
	Percent	8.5	15.2	30.3	31.8	14.2
	Frequency	33	58	108	86	45

Our Company Offers Continuous Learning Programs to Keep Employees Updated on Digital Advancements to Ensure Relevance and Effectiveness	**Percent**	10	17.6	32.7	26.1	13.6
Growth And Recognition Are Provided to Employees Who Actively Engage in Digital Upskilling Efforts.	**Frequency**	27	44	96	106	57
	Percent	8.2	13.3	29.1	32.1	17.3

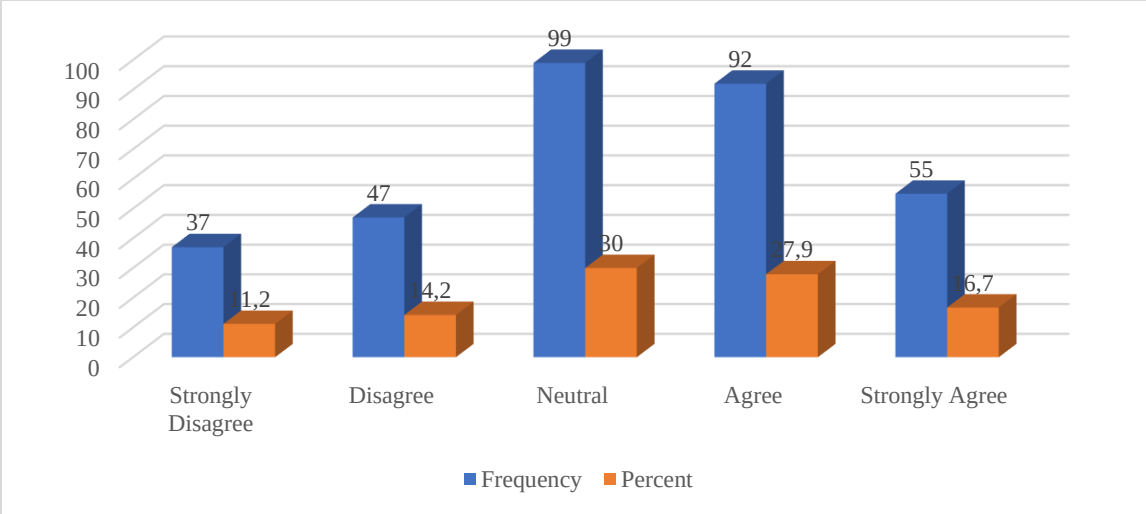

Figure 4.38: Our Company Provides Sufficient Training Opportunities for Employees To Improve Their Digital Skills.

The above figure 4.38 shows how staff members feel about the company's training programs for enhancing digital abilities. In all, 44.6% agree or strongly agree that there is enough training provided; of those, 27.9% agree and 16.7% strongly agree. Regarding the suitability of training opportunities for improving digital skills, there are differing views, with 25.4% of respondents being indifferent and 30.6% disagreeing (14.2%) or strongly disagreeing (11.2%).

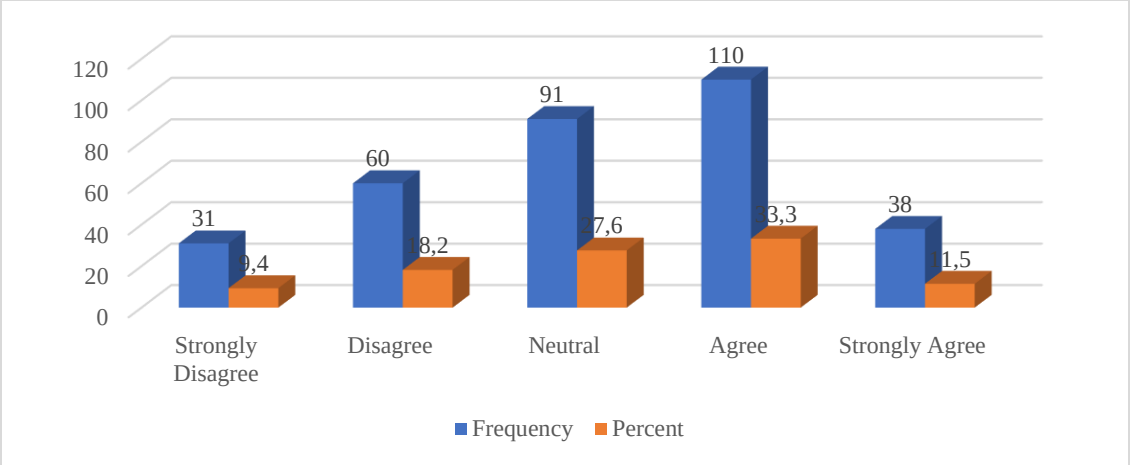

Figure 4.39: Our Existing Supply Chain Employees Have Adopted Well to Digital Skills and Are Able To Perform Satisfactorily

The above Figure 4.39 shows the data that reflects employee perceptions of how well-performing current Supply Chain employees are using digital abilities. Employee performance and adaptability to digital abilities have been rated favourably by 44.8% of respondents overall, with 33.3% agreeing and 11.5% strongly agreeing that employees have done so. Regarding the performance and digital preparedness of Supply Chain staff, 27.6% are neutral, and 27.6% either disagree (18.2%) or strongly disagree (9.4%).

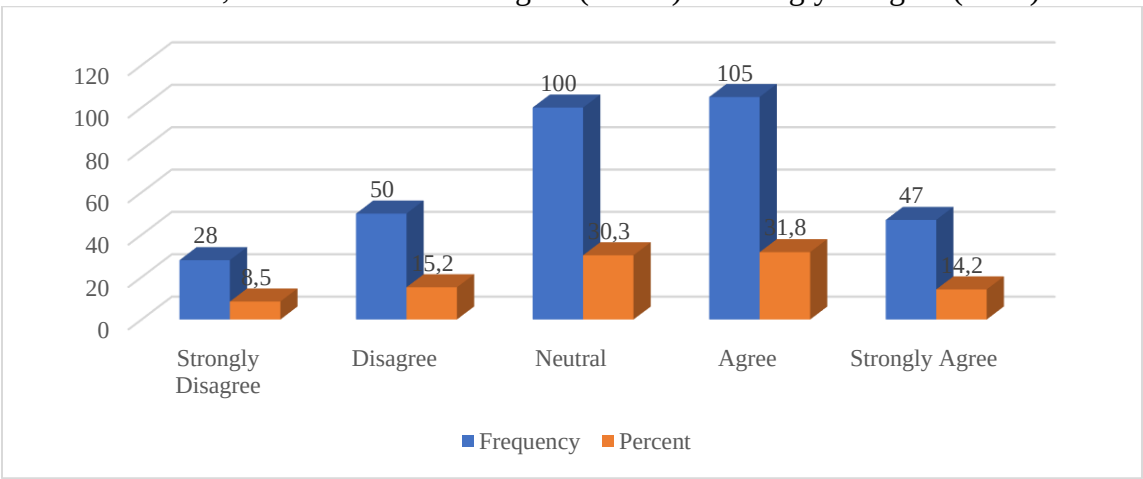

Figure 4.40: Our Existing Supply Chain Employees Are Finding Value And Better Job Satisfaction Post-Implementation Of Supply Chain Digitalization Initiatives

As the above figure 4.40 shows employee opinions on the benefits and job satisfaction of supply chain digitalization projects are not uniform. 30.3% are neutral, while 23.7% either

disagree or strongly disagree, and 46% agree or strongly agree, with 31.8% agreeing and 14.2% strongly agreeing.

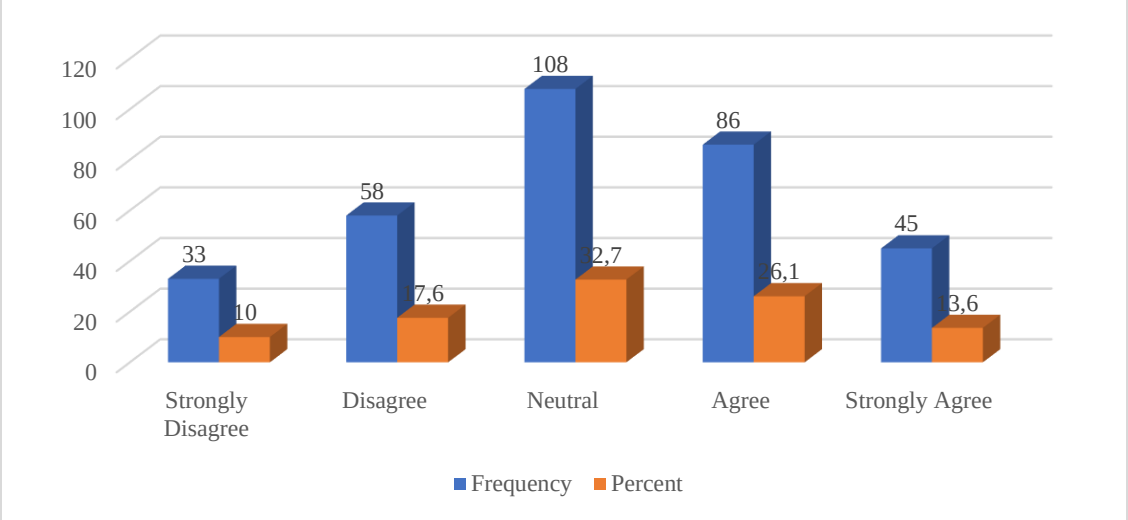

Figure 4.41: Our Company Offers Continuous Learning Programs To Keep Employees Updated On Digital Advancements To Ensure Relevance And Effectiveness

The above figure 4.41 shows the data on the displays of employees' varying opinions regarding the value of ongoing education initiatives in keeping them abreast of technological developments. While 26.1% agree and 13.6% strongly agree, 28% either disagree or strongly disagree, and 32.7% are neutral, 39.7% agree or strongly agree.

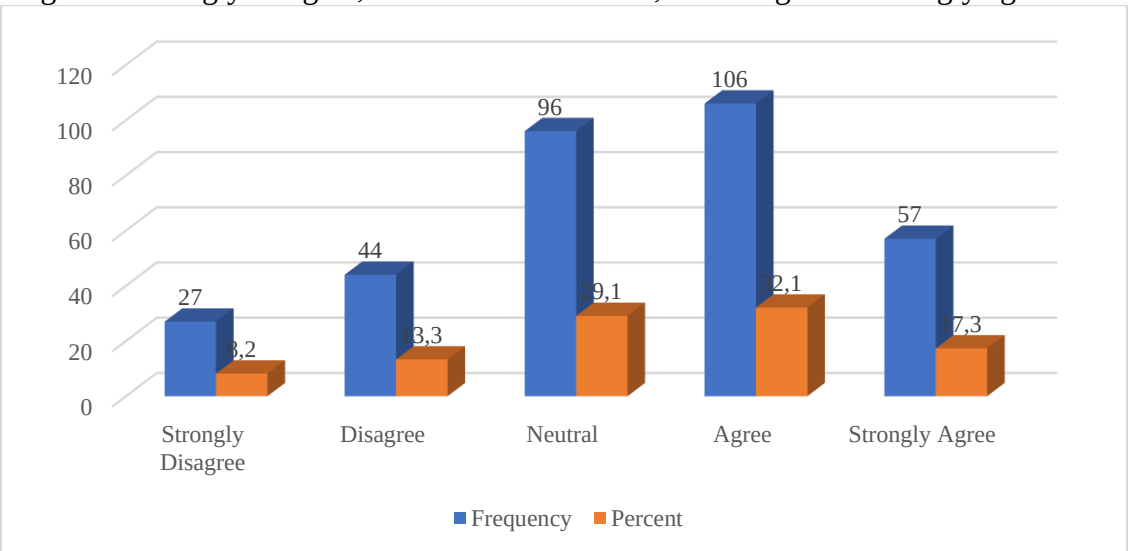

Figure 4.42: Growth and Recognition Are Provided to Employees Who Actively Engage In Digital Upskilling Efforts

According to the above figure, 4.42 employees who participate in digital upskilling initiatives are given opportunities for progress and recognition. With 32.1% agreeing and 17.3% strongly agreeing, a total of 49.4% either agree or strongly agree. There are differing views regarding the relationship between digital upskilling and growth/recognition chances, as evidenced by the fact that 29.1% of respondents are indifferent and 23.5% disagree (13.3%) or strongly disagree (8.2%).

Table 4.18: Supply Chain Employee motivation and engagement in sustainability initiatives

		Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
Our organization provides opportunities & training for employees to participate in sustainability-related projects or committees.	**Frequency**	27	38	101	106	58
	Percent	8.2	11.5	30.6	32.1	17.6
Our existing Supply Chain employees are driving Sustainability initiatives with same intensity as their core supply Chain role	**Frequency**	24	48	104	100	54
	Percent	7.3	14.5	31.5	30.3	16.4
Our existing Supply Chain employees are finding value and better job satisfaction in driving Supply Chain Sustainability initiatives	**Frequency**	23	38	101	117	51
	Percent	7	11.5	30.6	35.5	15.5
Sustainability goals are integrated into individual performance evaluations and goal-setting processes.	**Frequency**	23	46	93	116	52
	Percent	7	13.9	28.2	35.2	15.8
Our organization actively seeks employee input when developing or revising sustainability policies and initiatives.	**Frequency**	25	29	92	126	58
	Percent	7.6	8.8	27.9	38.2	17.6

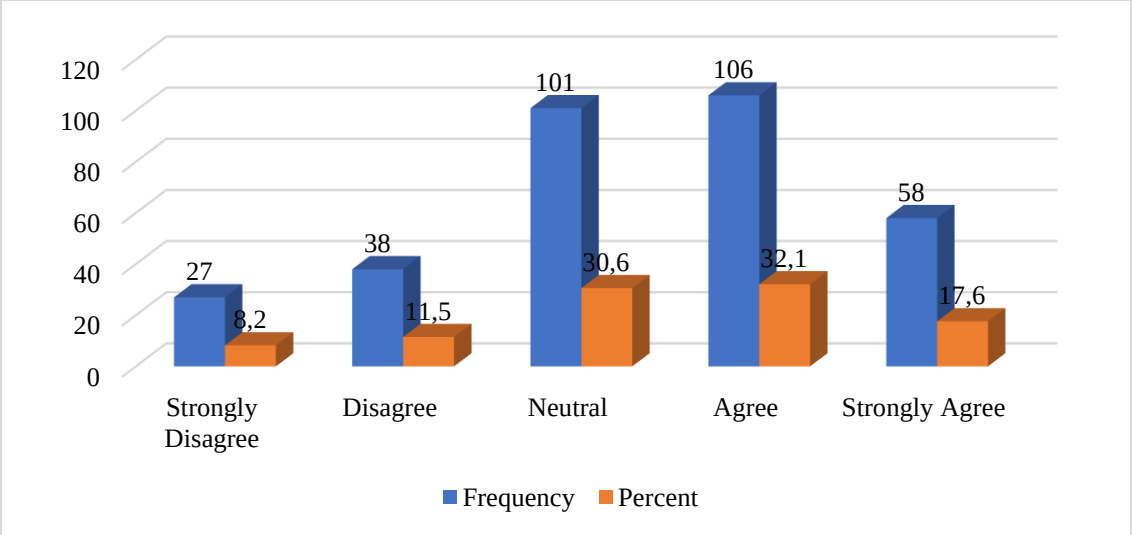

Figure 4.43: Our Organization Provides Opportunities & Training For Employees To Participate In Sustainability-Related Projects Or Committees

The Above figure 4.43 shows that the company gives staff members the chance to join committees or projects pertaining to sustainability as well as training in doing so. 32.1% of respondents agree, and 17.6% strongly agree, for a total of 49.7% who either agree or strongly agree. In contrast, 19.7% disagree (11.5%) or severely disagree (8.2%) with the amount of opportunity and training offered for sustainability initiatives or committees, while 30.6% are neutral. These results show that attitudes on the subject are not unanimous.

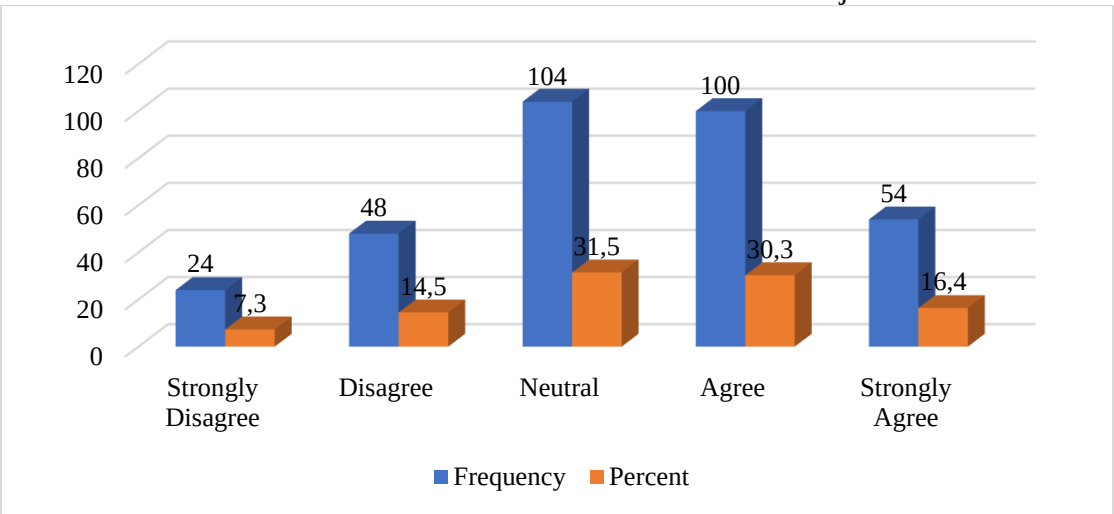

Figure 4.44: Our Existing Supply Chain Employees Are Driving Sustainability Initiatives with The Same Intensity As Their Core Supply Chain Role

Rendering in the above figure 4.44 shows the data of the current supply chain workers are not putting the same amount of effort into sustainability projects as they do into their primary supply chain responsibilities. With 14.5% disagreeing and 7.3% severely disagreeing, a total of 46.7% either disagree or strongly disagree. In the meantime, 46.7% either agree (30.3%) or strongly agree (16.4%), with 31.5% remaining neutral. This suggests that employees' involvement and intensity in promoting sustainability activities varies.

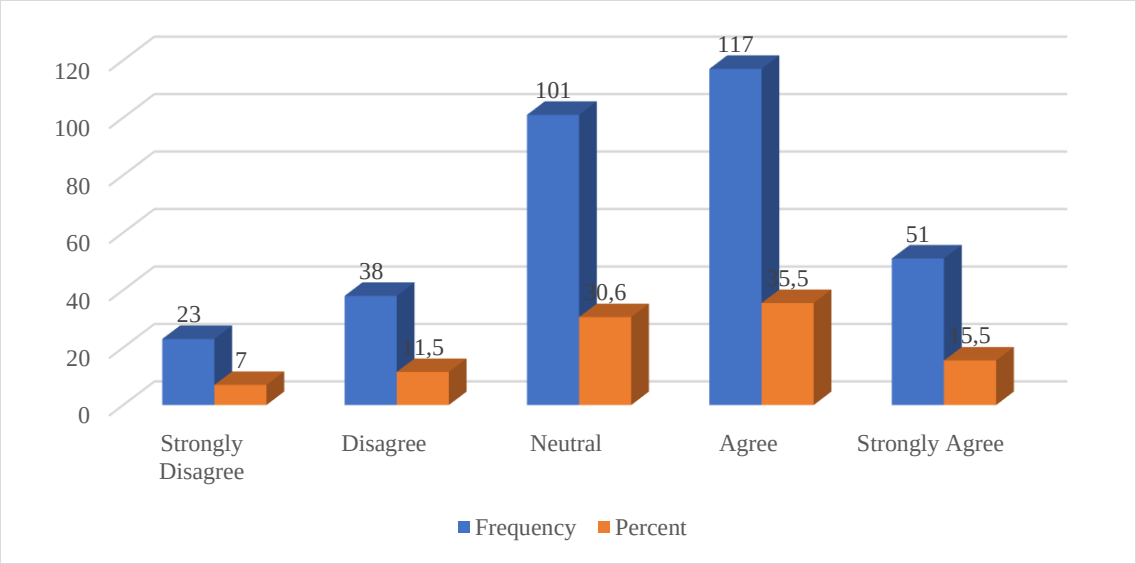

Figure 4.45: Our Existing Supply Chain Employees Are Finding Value and Better Job Satisfaction In Driving Supply Chain Sustainability Initiatives

According to the above figure 4.45 shows the data of our existing supply chain employees finding value and better job satisfaction in driving supply chain sustainability initiatives. A total of 51% agree or strongly agree, with 15.5% strongly agreeing and 35.5% agreeing. In contrast, 18.5% disagree (11.5%) or strongly disagree (7.0%), while 30.6% are neutral, reflecting a range of views regarding the perceived benefits and job satisfaction of leading sustainability projects.

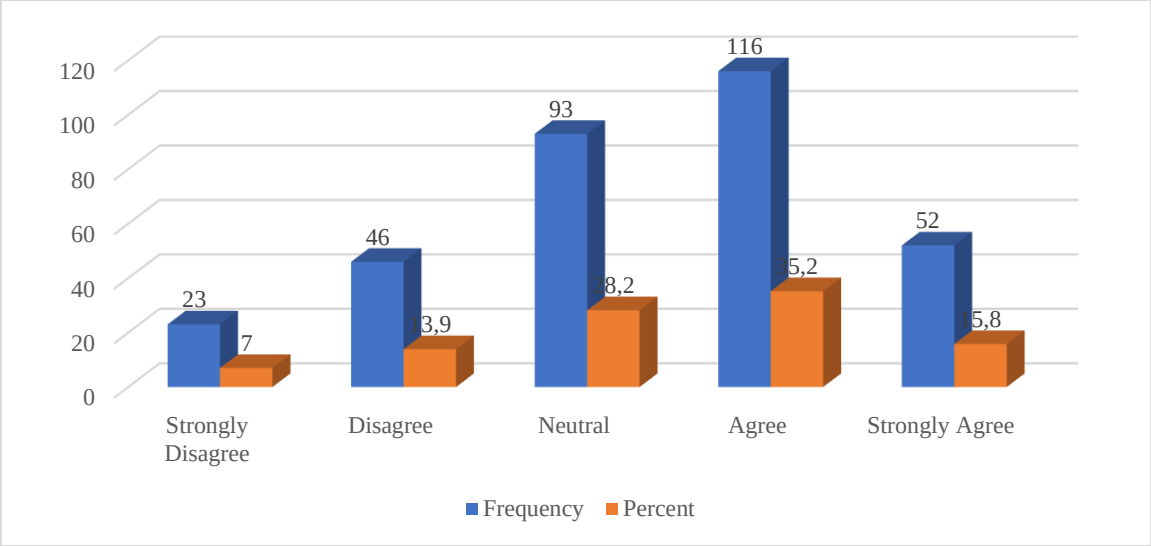

Figure 4.46: Our Organization Actively Seeks Employee Input When Developing Or Revising Sustainability Policies And Initiatives

The above figure 4.46 presents the data of the company frequently soliciting employee feedback when creating or updating its sustainability programs and regulations. A total of 51% agree or strongly agree, with 15.8% strongly agreeing and 35.2% agreeing. In contrast, 20.9% disagree (13.9%) or strongly disagree (7.0%), while 28.2% are indifferent, demonstrating a range of communication and involvement in the creation and modification of sustainability policies.

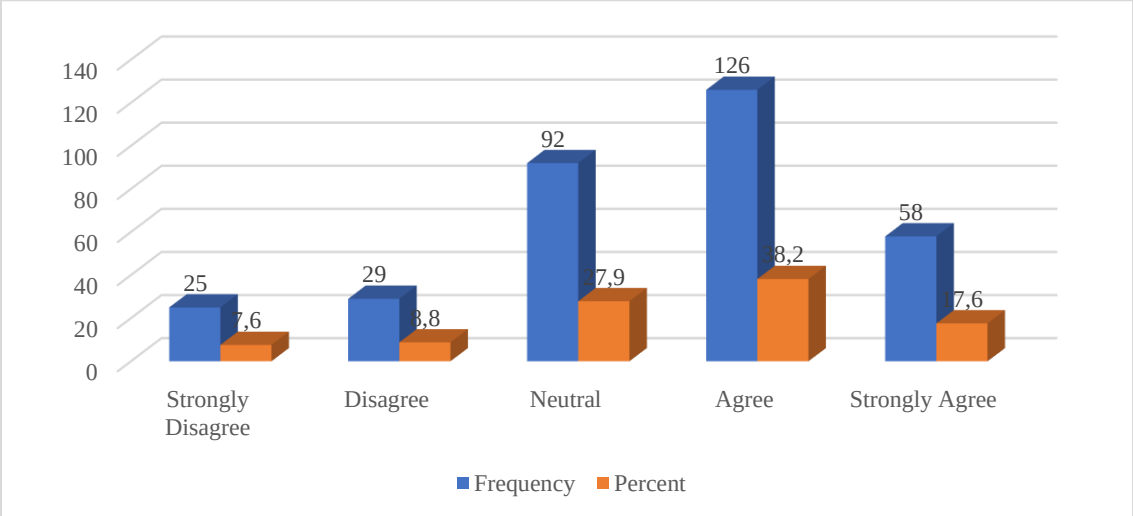

Figure 4.47: Our Organization Actively Seeks Employee Input When Developing or Revising Sustainability Policies And Initiatives.

The above figure 4.47 shows that while creating or updating sustainability policies and programs, the company regularly solicits employee feedback. 38.2% of respondents agree, and 17.6% strongly agree, making up the total of 55.8% who either agree or strongly agree. Regarding employee participation in the creation and updating of sustainability policies, there is generally a positive feeling, as seen by the 19.1% who strongly disagree (7.6%) and the 27.9% who are neutral.

Table 4.19: Organizational Performance

		Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
Our organization is driving impactful Supply Chain Digitalisation and Sustainability initiatives	**Frequency**	20	36	113	108	53
	Percent	6.1	10.9	34.2	32.7	16.1
Our organization's ability to meets its financial targets has improved post Supply Chain Digitalisation and Sustainability focus as compared to earlier	**Frequency**	20	46	94	120	50
	Percent	6.1	13.9	28.5	36.4	15.2
Our organization is able to effectively manages resources and controls costs post implementation of Supply Chain Digitalisation and Sustainability initiatives	**Frequency**	17	44	103	121	45
	Percent	5.2	13.3	31.2	36.7	13.6
	Frequency	18	37	117	112	46

Our company is able to effectively manages risks and mitigate potential threats post implementation of Supply Chain Digitalisation and Sustainability initiatives	**Percent**	5.5	11.2	35.5	33.9	13.9
Our company is able to engage and retain employees better post implementation of Supply Chain Digitalisation and Sustainability initiatives	**Frequency**	22	47	109	109	43
	Percent	6.7	14.2	33	33	13
Our organization has a strong leadership team that drives success and innovation in implementation of Supply Chain Digitalisation and Sustainability initiatives	**Frequency**	21	40	93	113	63
	Percent	6.4	12.1	28.2	34.2	19.1
Our organization has gained competitive advantage over competitors post implementation of Supply Chain Digitalisation and Sustainability initiatives	**Frequency**	23	37	106	107	57
	Percent	7	11.2	32.1	32.4	17.3
	Frequency	29	47	110	92	52

Our organization is able to command premium from customers post implementation of Supply Chain Digitalisation and Sustainability initiatives	**Percent**	8.8	14.2	33.3	27.9	15.8

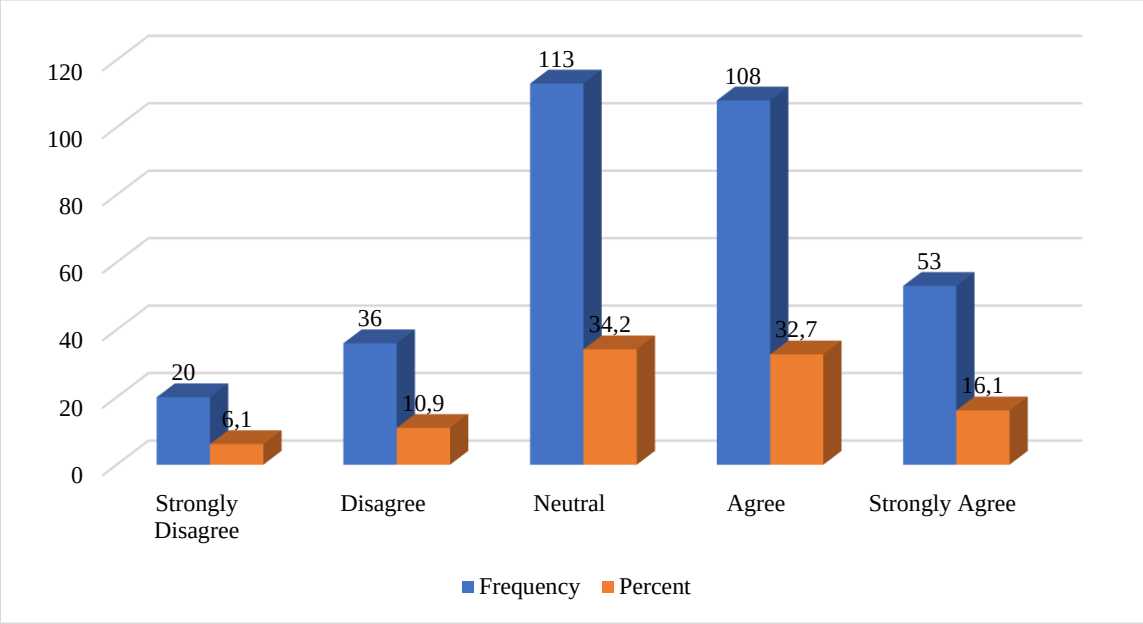

Figure 4.48: Our Organization Is Driving Impactful Supply Chain Digitalisation And Sustainability Initiatives

The Above figure 4.48 indicates that the company is leading activities related to sustainability and supply chain digitalization that have a significant impact. With 32.7% agreeing and 16.1% strongly agreeing, a total of 48.8% agree or strongly agree. Regarding the effect of the organization's actions in these areas, 34.2% of respondents are neutral, and 17% disagree (10.9%) or strongly disagree (6.1%).

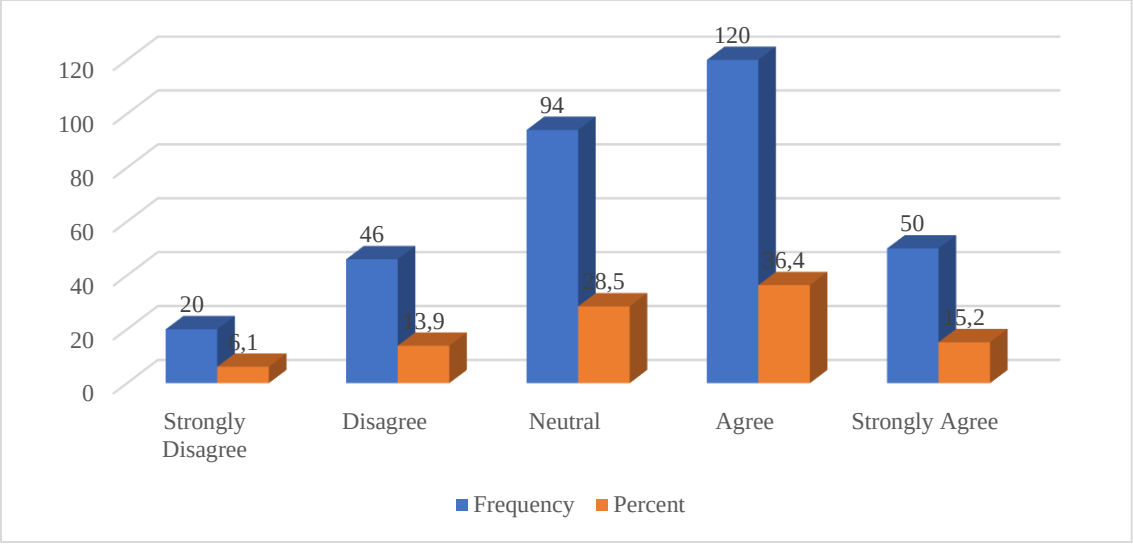

Figure 4.49: Our Organization's Ability To Meet Its Financial Targets Has Improved Post-Supply Chain Digitalisation And Sustainability Focus As Compared To Earlier

The above figure 4.49 shows the data in comparison to before Supply Chain Digitalization and Sustainability emphasis, the organization's capacity to reach its financial goals has improved. With 36.4% agreeing and 15.2% strongly agreeing, a total of 51.6% either agree or strongly agree. Regarding the effect of these activities on financial performance, attitudes are divided, with 28.5% being neutral and 20% disagreeing (13.9%) or severely disagreeing (6.1%).

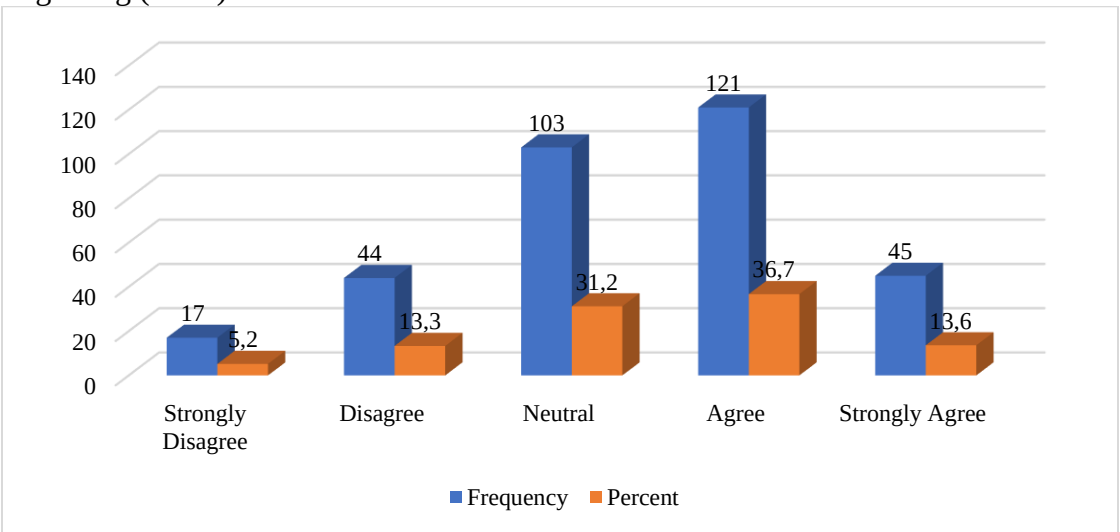

Figure 4.50: Our Organization Can Effectively Manage Resources and Control Costs Post-Implementation of Supply Chain Digitalisation and Sustainability Initiatives

The above figure 4.50 shows that following the adoption of initiatives related to supply chain digitalization and sustainability, the firm can effectively manage resources and control costs. Thirty-six percent strongly agree and thirty-seven percent agree, for a total of fifty.3% agree or strongly agree. In contrast, 18.5% disapprove (13.3%) or severely disagree (5.2%) with resource management and cost control following these initiatives, while 31.2% are neutral.

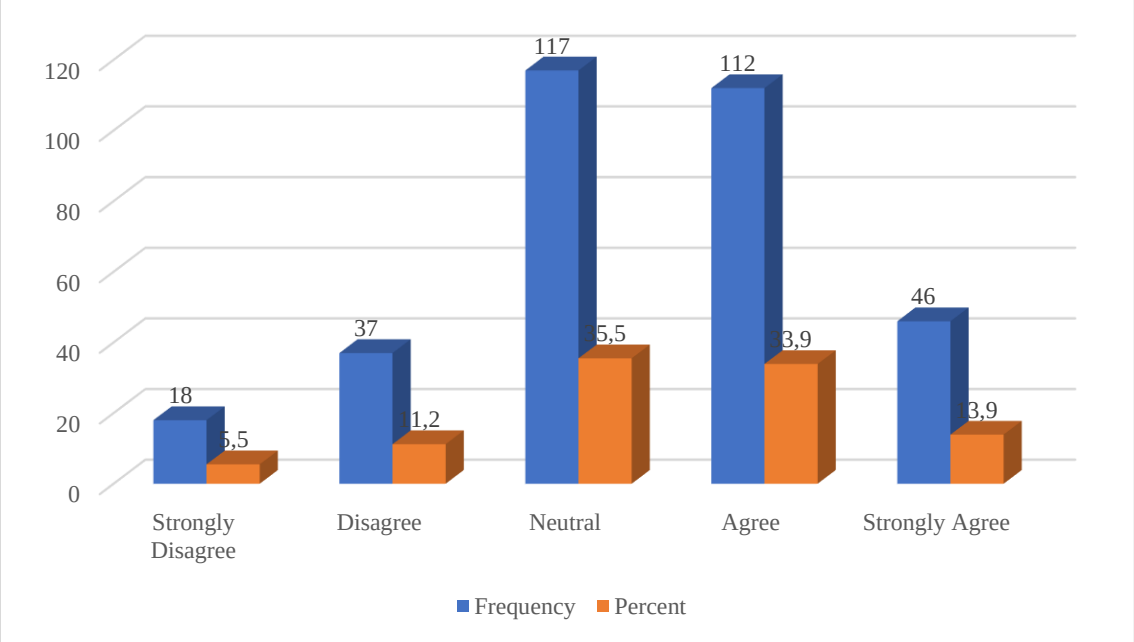

Figure 4.51: Implementation of Supply Chain Digitalisation and Sustainability Initiatives

The above figure 4.51 presents the opinions about how Supply Chain Digitalization and Sustainability programs are being implemented. 16.7% disagree or strongly disagree, compared to a total of 47.8% who agree or strongly agree. In the meantime, 35.5% are undecided, indicating differing views regarding the success of implementation.

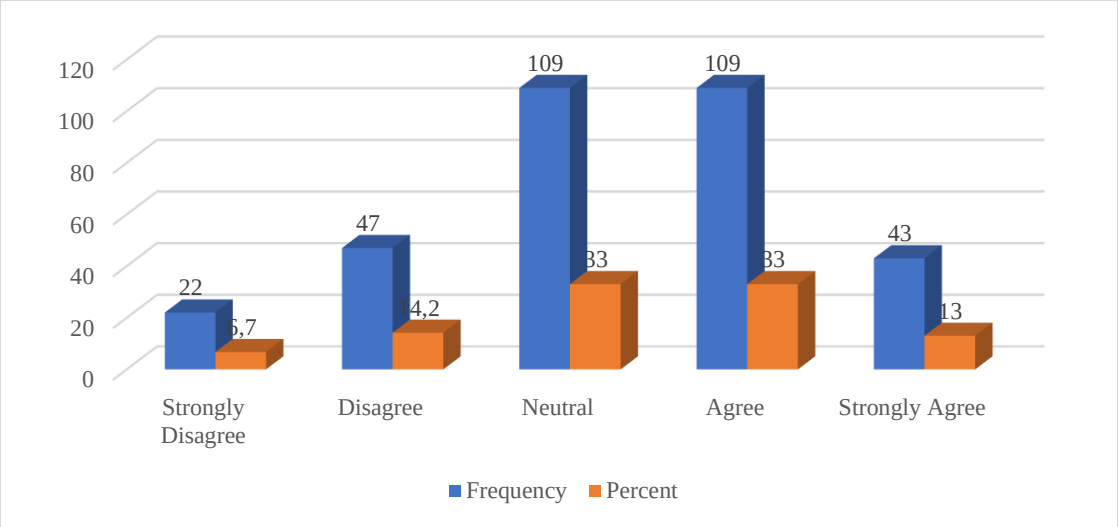

Figure 4.52: Our Company Can Engage and Retain Employees Better Post-Implementation of Supply Chain Digitalisation and Sustainability Initiatives

There are differing views shown in Figure 4.52 regarding whether the company's efforts to digitalize the supply chain and promote sustainability have benefited employee engagement and retention. While 33% are neutral, 20.9% disagree or strongly disagree, and 46% agree or strongly agree.

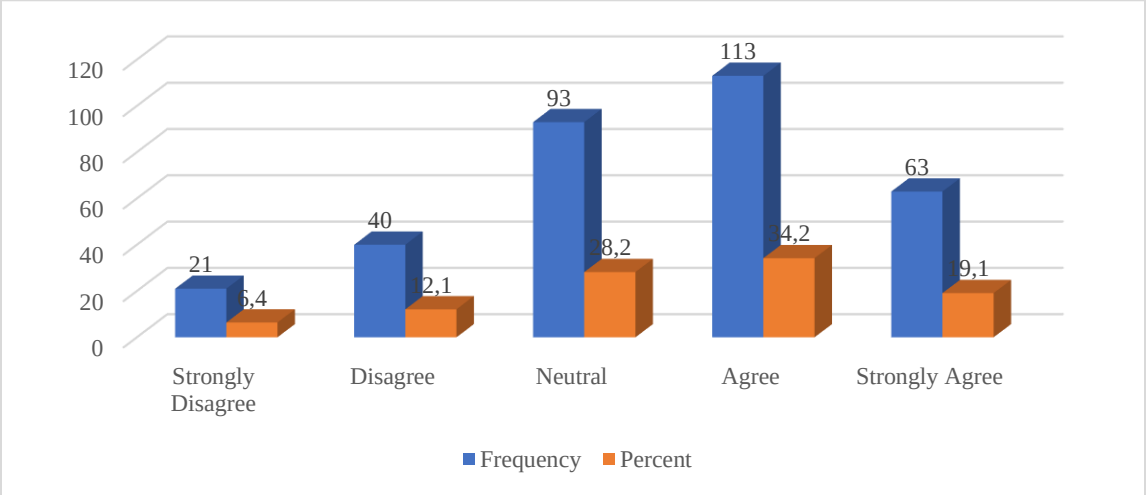

Figure 4.53: Our Organization has a Strong Leadership Team That Drives Success And Innovation In The Implementation Of Supply Chain Digitalisation And Sustainability Initiatives

The above figure 4.53 shows the data on the effectiveness of the leadership team in fostering creativity and success when executing Supply Chain Digitalization and

Sustainability projects. Together, 53.3% of respondents agree or strongly agree, compared to 18.5% who disagree or strongly disagree. Different opinions on the influence of the leadership on these activities are evident from the 28.2% who are neutral.

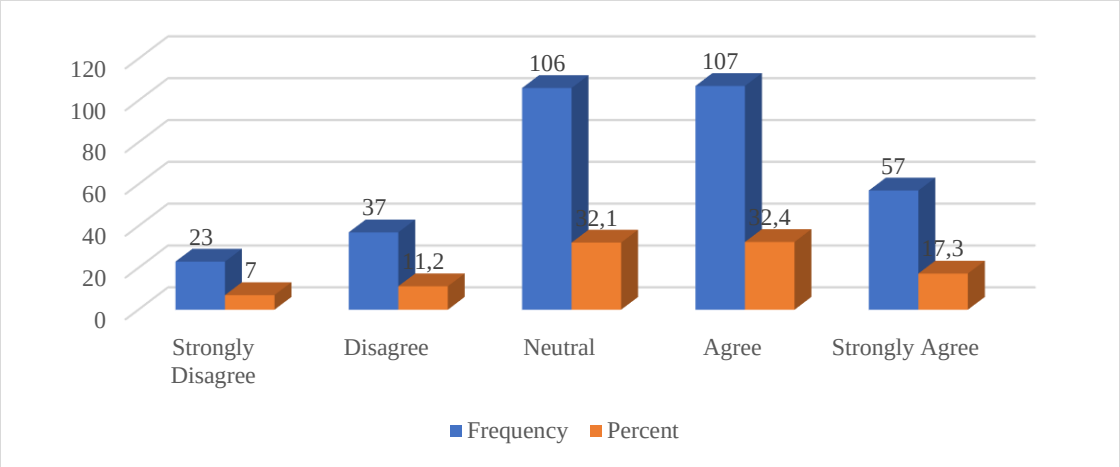

Figure 4.54: Our Organization Has Gained Competitive Advantage Over Competitors Post Implementation of Supply Chain Digitalisation and Sustainability Initiatives

The above figure 4.54 shows the data that our organization has gained a competitive advantage over competitors' post-implementation of supply chain digitalization and sustainability initiatives, 49.7% of respondents agreed or strongly agreed. In the meantime, 18.2% disagree or strongly disagree, while 32.1% are neutral.

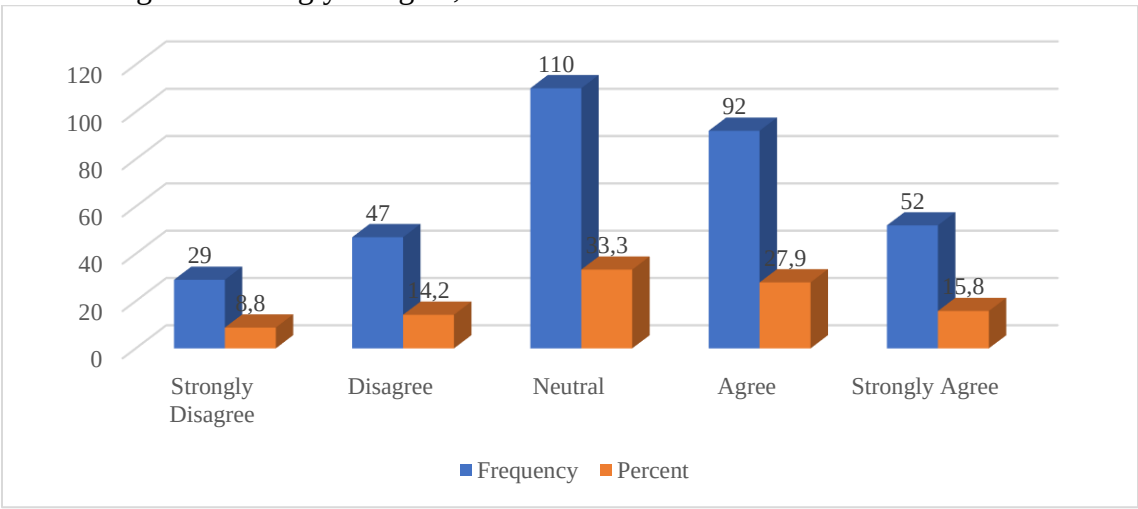

Figure 4.55: Our Organization Can Command a Premium from Customers Post-Implementation Of Supply Chain Digitalisation And Sustainability Initiatives

The above Figure 4.55 presents a range of opinions about the company's capacity to charge more to consumers after Supply Chain Digitalization and Sustainability projects are put into place. While 23% disagree or strongly disagree, a total of 43.7% agree or strongly agree. In the meantime, 33.3% are undecided, indicating differing perspectives regarding how these activities would affect price and customer perception.

4.3 Descriptive Statistics

Table 4.20: Descriptive Statistics

	N	Mean		Std. Deviation
	Statistic	Statistic	Std. Error	Statistic
Supply Chain digitalization and Sustainability	330	2.6030	.02989	.54298
Employee digital literacy and upskilling	330	3.5242	.06087	1.10581
Employee motivation and engagement in sustainability initiatives	330	3.6515	.05782	1.05029
Organizational Performance	330	3.6606	.05596	1.01656

The above table represents the expressive statistics for the variables indicating that, on average, respondents rated Supply Chain Digitalization and Sustainability the lowest (mean of 2.6030), followed by Employee Digital Literacy and Upskilling (mean of 3.5242), and then Employee Motivation and Engagement in Sustainability Initiatives (mean of 3.6515), with Organizational Performance receiving the highest rating (mean of 3.6606). The standard deviations show there is relatively little variability in the ratings for Supply Chain Digitalization, Sustainability, and Administrative Performance, while there is

slightly more variability in the ratings for Employee Digital Literacy and Upskilling and Employee Motivation and Engagement in Sustainability Initiatives.

4.4 Hypotheses Testing

4.4.1 Hypothesis 1

- **$H0_1$:** There is no significant relationship between supply chain digitalization and sustainability and employee digital literacy and upskilling.
- **H_1:** There is a significant relationship between supply chain digitalization and sustainability and employee digital literacy and upskilling.

Table 4.21: Correlations

			Supply Chain digitalization and Sustainability	Employee digital literacy and upskilling
Spearman's rho	Supply Chain digitalization and Sustainability	Correlation Coefficient	1.000	.094
		Sig. (2-tailed)	.	.089
		N	330	330
	Employee digital literacy and upskilling	Correlation Coefficient	.094	1.000
		Sig. (2-tailed)	.089	.
		N	330	330

The above table represents the Spearman's rho correlation constant between Supply Chain Digitalization and Sustainability and Employee Digital Literacy and Upskilling is 0.094, with a p-value of 0.089 (2-tailed), founded on a sample size of 330. This commends a weak positive correlation between the two variables, which is not statistically significant at the

0.05 significance level. Therefore, there is no strong evidence to suggest a significant relationship between supply chain digitization and sustainability and employee digital literacy and upskilling in this dataset.

4.4.2 Hypothesis 2

- **$H0_2$:** There is no significant relationship between supply chain digitalization and sustainability and employee motivation and engagement in sustainability initiatives.
- **H_2:** There is a significant relationship between supply chain digitalization and sustainability and employee motivation and engagement in sustainability initiatives.

Table 4.22: Correlations

			Supply Chain digitalization and Sustainability	Employee motivation and engagement in sustainability initiatives
Spearman's rho	Supply Chain digitalization and Sustainability	Correlation Coefficient	1.000	.069
		Sig. (2-tailed)	.	.209
		N	330	330
		Correlation Coefficient	.069	1.000

	Employee motivation and engagement in sustainability initiatives	Sig. (2-tailed)	.209	.
		N	330	330

The above table represents the Spearman's rho association coefficient between Supply Chain Digitalization and Sustainability and Employee Motivation and Appointment in Sustainability Initiatives is 0.069, with a p-value of 0.209 (2-tailed), founded on a sample size of 330. This specifies a very weak positive correlation between the two variables, which is not statistically significant at the 0.05 significance level. Therefore, there is no strong evidence to suggest a significant relationship between supply chain digitization and sustainability and employee motivation and appointment in sustainability initiatives in this dataset.

4.4.3 Hypothesis 3

- **$H0_3$:** There is no significant impact of employee digital literacy and upskilling, influenced by digitization and sustainability of supply chain, on the organisational performance.
- **H_3:** There is a significant impact of employee digital literacy and upskilling, influenced by digitization and sustainability of supply chain, on the organisational performance.

Table 4.23: Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	360.885			
Final	128.049	232.836	1	.000
Link function: Logit.				

The above table represents the model fitting information table designates the effectiveness of the logistic regression model in forecasting the outcome variable. The original model with only the intercept has a -2 Log Likelihood of 360.885. Once the predictors are included, the -2 Log Likelihood decreases significantly to 128.049. The Chi-Square value of 232.836, with 1 degree of freedom, is highly significant (p-value = .000). This substantial reduction in the -2 Log Likelihood and the significant Chi-Square value designate that the final model provides a significantly better fit to the data compared to the intercept-only model, confirming that the predictors meaningfully contribute to explaining the variance in the outcome variable.

Table 4.24: Goodness-of-Fit

	Chi-Square	**Df**	**Sig.**
Pearson	622.973	15	.000
Deviance	82.961	15	.000
Link function: Logit.			

The above table representing the goodness-of-fit statistics for the logistic regression model specifies that both the Pearson Chi-Square and the Deviance are significant (p-value = .000) with 15 degrees of freedom. The Pearson Chi-Square value of 622.973 and the Deviance of 82.961 suggest that the model does not fit the data well, as a good-fitting perfect would have non-significant goodness-of-fit statistics. This implies that there may be unexplained variability in the data or that the model might be missing important predictors or interactions.

Table 4.25: Pseudo R-Square

Cox and Snell	.506
Nagelkerke	.541
McFadden	.256

Link function: Logit.

The above table represents the Pseudo R-Square values for the logistic reversion model, which indicate moderate to substantial explanatory power. The Cox and Snell value is 0.506, the Nagelkerke value is 0.541, and the McFadden value is 0.256. These values suggest that the model explains a significant portion of the variance in the outcome variable, with the Niekerk value indicating that about 54.1% of the variance is explained by the model. Overall, these values found that the model has a reasonable level of explanatory power.

Table 4.26: Parameter Estimates

		Estimate	**Std. Error**	**Wald**	**df**	**Sig.**	**95% Confidence Interval**	
							Lower Bound	**Upper Bound**
Threshold	[OP = 1.00]	1.659	.418	15.755	1	.000	.840	2.478
	[OP = 2.00]	3.627	.415	76.365	1	.000	2.813	4.440
	[OP = 3.00]	6.349	.509	155.666	1	.000	5.351	7.346
	[OP = 4.00]	9.019	.617	213.597	1	.000	7.810	10.229
Location	EDL_U	1.917	.142	183.306	1	.000	1.640	2.195
Link function: Logit.								

The above table represent the parameter estimates for the logistic deterioration model reveal that all thresholds and the predictor variable EDL_U (Employee Digital Literacy and Upskilling) are highly significant, with p-values less than 0.001. The thresholds for Organizational Performance (OP) increase consistently, representative higher likelihoods of agreeing with higher levels of performance as the thresholds move from 1.00 to 4.00. Specifically, the estimates for OP range from 1.659 to 9.019, showing a strong positive association. The estimate for EDL_U is 1.917, with a 95% confidence interval of [1.640, 2.195], suggesting that higher employee digital literacy and upskilling significantly increase the odds of higher organizational performance categories.

4.4.4 Hypothesis 4

- **$H0_4$:** There is no significant impact of employee motivation and engagement in sustainability initiatives, influenced by supply chain digitization and sustainability, on the organisational performance.
- **H_4:** There is a significant impact of employee motivation and engagement in sustainability initiatives, influenced by supply chain digitization and sustainability, on the organisational performance.

Table 4.27: Model Fitting Information

Model	**-2 Log Likelihood**	**Chi-Square**	**df**	**Sig.**
Intercept Only	365.140			
Final	91.097	274.043	1	.000
Link function: Logit.				

The above table represents the indicating that the final logistic deterioration model with predictors has a much lower -2 Log Likelihood of 91.097 associated with the intercept-only model's -2 Log Likelihood of 365.140. This substantial decrease suggests that the final model provides a significantly better fit to the data. The Chi-Square value of 274.043 with

1 degree of freedom is highly significant ($p < 0.001$), indicating that the final model is statistically significant in explaining the variance in the outcome variable. Overall, these results advise that the predictors in the final model contribute significantly to predicting the outcome variable, providing a better fit than a model with just the intercept.

Table 4.28: Goodness-of-Fit

	Chi-Square	**Df**	**Sig.**
Pearson	324.642	15	.000
Deviance	48.184	15	.000
Link function: Logit.			

The above table represents the goodness-of-fit statistics for the logistic regression model, indicating that both the Pearson Chi-Square and the Deviance are significant ($p < 0.001$) with 15 degrees of freedom. This suggests that the model does not fit the data well, as a good-fitting model would have non-significant goodness-of-fit statistics. The Pearson Chi-Square value of 324.642 and the Unconventionality value of 48.184 indicate a lack of fit, signifying that there may be unsolved variability in the data or that the model might be missing important predictors or interactions

Table 4.29: Pseudo R-Square

Cox and Snell	.564
Nagelkerke	.602
McFadden	.301
Link function: Logit.	

The above table represents the Pseudo R-squared standards for the logistic reversion model, indicating a strong explanatory power. The Nagelkerke value of 0.602 suggests that the model explains about 60.2% of the variance in the outcome variable, which is moderately high. The Cox and Snell value of 0.564 also indicates a good fit, while the McFadden value

of 0.301 suggests a decent fit. These values collectively validate that the model has a good level of explanatory power, suggesting that the included predictors are effective in explaining the variation in the outcome variable.

Table 4.30: Parameter Estimates

		Estimate	**Std. Error**	**Wald**	**df**	**Sig.**	**95% Confidence Interval**	
							Lower Bound	**Upper Bound**
Threshold	[OP = 1.00]	2.423	.464	27.321	1	.000	1.514	3.332
	[OP = 2.00]	4.842	.490	97.578	1	.000	3.881	5.803
	[OP = 3.00]	7.852	.596	173.638	1	.000	6.685	9.020
	[OP = 4.00]	10.620	.708	225.178	1	.000	9.233	12.007
Location	M_ESI	2.268	.160	200.410	1	.000	1.954	2.582
Link function: Logit.								

The above table represents the parameter estimates for the logistic regression model indicate that all thresholds and the predictor variable M_ESI (Employee Motivation and Engagement in Sustainability Initiatives) are highly significant ($p < 0.001$). The thresholds for Organizational Performance (OP) increase consistently, indicating a higher likelihood of agreeing with higher levels of presentation as the thresholds move from 1.00 to 4.00. Specifically, the estimates for OP range from 2.423 to 10.620, showing a strong positive

association. The estimate for M_ESI is 2.268, with a 95% confidence interval of [1.954, 2.582], suggesting that higher employee motivation and appointment in sustainability creativities significantly increase the odds of higher organizational performance categories.

4.5 Summary of the Findings

The findings of this study provide valuable insights into the complex interplay between supply chain digitalization, sustainability, employee development, and organizational performance. Initially, the study sought to explore the relationship between supply chain digitalization and sustainability with employee digital literacy and upskilling. The results suggest that while there is a positive correlation between these variables, the relationship is not statistically significant. This implies that simply digitalizing supply chain processes and integrating sustainability measures does not necessarily lead to a marked improvement in employee digital literacy or their upskilling. This finding highlights the need for organizations to implement targeted training programs and initiatives that directly address the skill gaps created by digital transformation and sustainability efforts, rather than relying on the transformation itself to drive employee development.

The study also sought to establish the relationship between; supply chain digitalisation and sustainability with employee attitudes and involvements towards sustainability. As with the first result it is again only a very weak positive association which is not significant at the 5 percent level. This suggests that in spite of the obvious enablers such as digitalization and sustainability leading to favourable cultures that may support engagement in sustainability initiatives, there is still no guarantee that the work place employee will be motivated or engage more in sustainability initiatives. Leadership support, organizational sanction and incentives might be other key variables that an organization has to factor in, to influence employee participation in these schemes. The

findings underscore the importance of a holistic approach that combines digitalization and sustainability efforts with strong human resource strategies to foster a motivated and engaged workforce.

On the other hand, the study reveals significant findings regarding the impact of employee digital literacy and upskilling on organizational performance. The results demonstrate that as employees develop their digital skills and undergo upskilling, driven by supply chain digitalization and sustainability, there is a notable positive impact on organizational performance. This indicates that investments in employee development, particularly in enhancing digital capabilities, can yield substantial benefits for organizations. It reinforces the idea that in a rapidly digitalizing world, organizations that prioritize and invest in building the digital competencies of their workforce are better positioned to achieve superior performance outcomes. This finding emphasizes the critical role of human capital in driving the success of digital and sustainable supply chains.

Similarly, the study establishes that motivation and engagement of the employees in sustainability practices does affect the organizational performance. Due to advancement in technology and subsequent supply chain digitalization, the sustainability initiatives create ways for ensuring the motivation of the employees in order to increase organizational performance. This then highlights the need for the enhancement of organizational culture that supports sustainability, and where sustainability is seen as something more than a tick-box exercise but as one that is at the very heart of what the organization stands for and supports. Based on the research, it was discovered that only genuine employee stakeholders fully participate in the promotion of sustainability and are more productive to the organisation.

In summary, the findings of this study highlight the nuanced relationships between supply chain digitalization, sustainability, employee development, and organizational

performance. While digitalization and sustainability alone may not directly enhance employee skills or engagement, their true value emerges when combined with strategic human capital initiatives that foster employee development and motivation. Organizations that successfully integrate these elements are likely to see significant improvements in performance, driven by a skilled, motivated, and engaged workforce.

4.6 Conclusion

In conclusion, this research highlights the need for an integrated strategy integrating supply chain digitalization and sustainability for increased effectiveness in organizational operations. Thus, despite digitalization and sustainability trends being identified as having a quite moderate direct effect on enhancing employee digital literacy, upskilling, and motivation, the importance of relevant and targeted human capital activities emerged. It is as a result of these that this study established that there is a strong correlation between digital transformation, sustainability and performance, particularly if staff development and involvement are integrated. This implies that organizations must strive to do much more than embracing and practicing technological and sustainable measures; practicing organizational learning and development, training and motivating employees are crucial. Thus, they can release the value of human capital and achieve better performance in more digital and sustainable supply chains. In conclusion, the study shows that human capital management as well as technology have a great impact on the sustainability that modifies competitiveness in the ever-evolving business environment.

CHAPTER V:

DISCUSSION

5.1 Discussion

Human capital is crucial in advancing digital and sustainability-oriented supply chains. Skilled employees drive the adoption of technologies like AI and IoT, which improve efficiency and reduce waste. Expertise in sustainable practices is also essential for minimizing environmental impact and aligning with sustainability goals. Investing in ongoing training ensures the workforce adapts to technological and regulatory changes, supporting both operational efficiency and long-term sustainability.

The survey of the Organizational Supply chain different aspects such as the core performance, digital, sustainable, and overall maturity percentage shows that most of the organization are still at the Developing stage. What this suggests is that the vast majority of organizations are on a developmental trajectory that is moving them in the direction of maturity, but which has not positioned them at the cutting edge. The most presented stage, in all dimensions, is the "Developing," which indicates that companies have advanced to a mid-point of maturity, and exhibit constant progress. However, 30 % of the organizations has also done a 'Leading' work particularly for the core performance and sustainability suggesting that even though there are some organizations practicing high end of standards in compliance, there are others that are in the process of building firm compliance capabilities. Furthermore, another group of organizations can be recognized in the "Emerging" category in all the areas that represent the initial stage in the supply chain management regulation. Taken together, the overall picture outlined here is one where most of the firms are keen on improving their supply chain management in specific fashion and where a significant portion of them has already reached high maturity, particularly in terms

of core functionality and sustainability of the supply chain, and others are in the process of constant growth and evolution of their practices in the field. Therefore, the information derived from the conceptual review of supply chain digitalization, and sustainable supply chain programs enhances the understanding of the fact that organizations offer various degrees of concern to different factors.

Though competition pressure is also seen as important, more numbers of respondents consider it as ‘Critical’ rather than ‘Very Critical’ which means that competition may not be the only factor for these initiatives. Lastly, the regulatory and statutory requirement is deemed important a lot by the respondents even though the majority of the respondents evaluated it as a "Somewhat Critical” and “Very Critical”. This shows that the respondents are aware of the importance of compliance and the general need to adhere to regulators requirements in as much as they are basics important that enables sustainable practice within the supply chain. Taken collectively, these results point to a balanced perspective, with emphasis put on both customer requirements and management’s entrepreneurial spirit and the impact of competition and regulations. The investigation of digitalization in different supply chain tasks in organizations shows awareness about the significance of that factor for organizations completely. A greater number of the respondent’s regard procurement as 'Very Critical’ demonstrating that adequate procurement practices are crucial for the effective functioning of supply chains. Lastly, planning surfaces as another important strategic role; this is so since the greater proportion of the responses provided listed planning as ‘Very Critical’ suggesting that effective planning is critical in achieving improved levels of supply chain operations and flexibility.

Logistics is also considered to be similarly important with a significant proportion of the respondents categorising it as either “Critical” or “Very Critical.” Last, warehousing and distribution are also considered as essential elements; in fact, it has been observed that

a large number of respondents have categorized both aspects as either ‘Very Critical’ or ‘Critical’; This underlines the importance of efficient warehousing and distribution process plays in dictating the efficacy of the supply chain.

Discussing sustainability initiatives across the functional supply chain activities, the significance becomes clear that encompasses organizations’ management to incorporate the concepts of sustainability. A notable area of focus is procurement which has had a closely contested ‘Very Critical’ and ‘Critical’ responses highlighting the centrality of sustainable procurement approaches to sustaining the overall business. Such a balance implies that while there is a very high level of commitment regarding sustainable procurement among many organisations, there are others that are in the process of integrating better practices in the procurement sustainability.

They also identify planning as another critical function, with most of the respondents linking it as “Critical.” This shows how important it is for companies to have well-analyzed planning to support operations and deliveries of corporation prospects. Logistics and warehousing & distribution functions also have a high concern of sustainability since most of the respondents seen it either “Critical” or “Very Critical”. This is due to the fact that logistics and distribution functions are crucial in sustainable management where the company is able to manage its carbon footprints and other resources. Altogether, these findings demonstrate that, in general, organizations are still in the process of gradual improvement of sustainable development across organization functions while indicating that such improvement could be improved with respect to supply chain functions and, especially, in relation to the correspondence of key processes to the objectives of sustainable development.

Digitalization of supply chains is considered to be affected by various factors and the analysis reflects this. Talent available for operating the digitalized supply chain is

primarily viewed as “Critical” by the respondents, which state worries about dearth of skilled manpower in handling digital systems. Equally important is the provision of specific digital tools that organisations need as more than a third of the respondents acknowledged this aspect. This means that customised digital tools are essential for managing enterprise activities, and for achieving a high level of digitization. Internal challenges related to capability and process standardization also emerge as significant concerns, with a majority rating them as "Critical." This suggests that organizations need to focus on standardizing processes and enhancing capabilities to streamline operations effectively. Internal change management to drive digital transformation will be very crucial for success. Cost and ROI challenges are similarly viewed as critical, reflecting the need for organizations to manage expenses carefully and ensure a positive return on investment in their digitalization efforts. Finally, the lack of vision and stakeholder support is identified as a considerable barrier to successful digitalization. While a significant portion of respondents acknowledges it as "Critical," the relatively high percentage of those who see it as "Not so Critical" indicates a potential divide in perceptions. This highlights the importance of strong leadership and active stakeholder engagement in driving digital transformation initiatives.

While the results highlight the novelty and potential the industry holds for digitalizing and making supply chains more sustainable, the importance of education was identified as critical steps toward achieving both goals. Education networks and government agency player a crucial role in upgrading vocational curricula for the present-day supply chain professional, with a heightened focus on the fact that the present/tailored curricula, should incorporate such factors such as digitization and sustainability. On the same regard, the working relationship within industry to facilitate on job experience is accorded the same value as academic training to signify that experience is as critical aspect of the learning process. Promotion from within and training and development in

organizations are also equally considered important, which show the constant need for developing and reskilling the talent to fulfil new and dynamic organizational needs.

Concerning digitalization of work processes, there is awareness of the returns that come with adequate training to engage with change, although responses differ in terms of the sufficiency of the available training. A sizable number of employees appear to be comfortable with the skills obtained in digital format while others seem to have a neutral or even less positive outlook on their performance after the main process of digitalization. Further, skills development and training, especially the so-called continuous learning programs, are regarded as crucial in the knowledge-based economy where digital technology is the age's defining characteristic, although its importance is seen in varying ways across the workforce.

Similar to sustainability strategies at the supply chain level, measures regarding supply chain sustainability similarly attracts bipolar responses. Despite the apparent benefits and employee satisfaction many of the organisation's representatives get from such initiatives, there is no consensus as to the level of involvement in these activities or the correlation between that and the basic supply chain functions. In addition, the integrated communications of sustainability and sustainability goals, into the performance assessment frameworks, and the open participation of employee for the formulation of different policies are valued but not necessarily by all. Lastly, the role of supply chain digitalization and sustainability efforts is considered optimistic to help organizations deliver change impacts, financial improvements, resources' management and gain competitive advantages while there is some doubt about the supply chain initiatives' efficiency as well as organizations' awareness of them.

Evaluation of the hypotheses demonstrate that the digitalization and sustainability of the supply chain have cross-sectional effects on essential organisational aspects. In the

case of Hypothesis 1, the study did not establish a significant link between the supply chain digitalization and sustainability and employees' digital literacy and upskilling. This means that digital improvements in the chain of supply do not significantly affect employees' digital ability or their channels to develop this ability. Dispelling Hypothesis 2, the analysis proved that supply chain digitalization and sustainability have no effect on the levels of motivation and engagement of employees in sustainability programs. What this has an implication on is the notion that Information and Communication Technology (ICT) investments aimed at repositioning the supply chain for sustainability has little effect on the level of employees' engagement in sustainability initiatives. Hypothesis 3 tested the interaction between digital literacy, digital upskilling, and supply chain digitalization on organizations' efficiency. The research revealed that it is indeed valid; which in other words meant that positive correlation is present, which in this case denotes that raising digital literacy and upskilling can make an impact on the improvement of the organizational performance. In Hypothesis 4, the measurement concluded that engagement in sustainability concept motivates employees and in turn enhances the organizational performance. This also points that for employees who are highly motivated and actively engaged in sustainability practices it yields greater organizational efficiency and effectiveness. Concisely, although supply chain digitalization and sustainability appear to have slight effects on the employees' skills and motivation, they meaningfully augment the organizational performance of employee's digital literacy and engagement on sustainability.

5.2 Discussion of Research Question One

How does the level of digitalization in procurement, logistics, and warehousing affect overall supply chain digitalization?

The level of digitization in procurement, logistics, and warehousing has emerged as a key competitive differentiator and opportunity to transform the supply chain in the modern world. Cloud computing, IoT and big data analytics make it possible to track and control processes in real-time, which is so important for decision-making and performance improvement. For instance, IoT devices can detect the state of the goods during transportation while data analytics can be used in the management of stocks by forecasting changes in demand. The results show that both IoT and AI are the closest technologies related to the autonomy and predictive power of future supply chain expectations (Wang *et al.*, 2022).

In addition, purchasing through a digital procurement platform also means that the purchasing is more transparent and can be better controlled, which also makes the management of the supplier and costs easier. These platforms allow organizations to outsource different tasks like order processing and invoicing, allowing firms to focus on other key activities. Blockchain technology has emerged as a revolutionary force in reshaping supply chain management, providing innovative solutions to age-old security, transparency, traceability, and authenticity challenges (Afrin and Pathak, 2023).

However, the level of digitalization is different in different industries and geographical locations because of the availability of infrastructure, government policies, and organizational structures. In comparison, developing regions' leading organizations are gradually integrating progressive digital innovation, Integrating digital technologies also facilitates the development of innovative solutions to societal challenges (Karthick *et al.*, 2017)(Dingler and Enkel, 2016). This digital divide highlights the need for tailored strategies that address specific barriers to digitalization in different contexts.

In conclusion, the digital revolution in procurement, logistics, and warehousing is very advantageous and has deep impacts on efficiency, transparency, and customer

satisfaction. Nevertheless, these technologies are still implemented variably across the regions; thus, there is a need to address the digital divide's issue to guarantee that all the supply chain members leverage technology's opportunities.

5.3 Discussion of Research Question Two

What is the effect of supply chain digitalization on employee digital literacy and upskilling?

The digitalization of the supply chain leads to a change and development of the contour of employees and their training needs; in other words, is that it revolutionizes their digital aptitude and readiness. So, when organizations expand digital applications in their supply systems through AI, machine learning, and blockchain, employees need to acquire new skills. This transition underlines one of the major trends in the workplace, which is to learn and develop constantly in order to work with new tools and systems. Digital literacy is an important and evolving concept that has an influence on the status of the current and future workforce as the labour market is being transformed globally by the implementation of digital technology (Vrana, 2016).

Furthermore, the integration of digital technologies in supply chain networks has forced the organizations to fund a lot of upskilling initiatives. Training activities aim to ensure that the workers are prepared for the technical knowledge needed for the new systems with respect to tasks in organizations. For instance, mentions that today's business organizations are paying much attention to availing and enhancing the human capital digital literacy for purposes of sustaining the growth of innovation. Upskilling focuses on improving current employees' skill sets so they can advance in their jobs and find different roles and opportunities within the company (Alexander S. Gillis, 2023). Nonetheless, digitalisation's effects on employee skills are not generalised across sectors or regions. Although there are some examples of industries that have developed and adopted extensive

training programs, several obstacles hide behind them, including the lack of funds and high fluctuation of employees' interest in training.

In conclusion, the digitalization of supply chains has a profound influence on employee digital competencies and capability improvement. On the one hand, it increases the demand for new skills and competencies with the help of training and development programs on the other side. To tap into the potential of digitalization fabulously, organizations need to consider the imbalance of training and development along with the resources that are required to make employees ready for the digitally dominating world.

5.4 Discussion of Research Question Three

How does the environmental impact of supply chain operations influence the level of supply chain sustainability?

Supply chain sustainability has gradually shifted focus to analyzing the effect of supply chain-related activities on the environment. Global supply networks involving the procuring of raw materials, processing, transport, intermediate distribution, and delivery to the end consumer bear tremendous impacts that threaten the environment through pollution, natural resource exploitation, and production of general wastes. Detailed production, transportation, and storage of all these commodities, however, have led to the formulation of enormous environmental issues. Presently, global warming, ranging from large-scale emissions of greenhouse gasses, forms one of the most important factors causing environmental degradation. Governments, action groups and companies are asking for measures to counter this threat (Dekker, Bloemhof and Mallidis, 2012).

Furthermore, many value-creation activities in supply chains entail great amounts of energy usage, toxicity of chemical substances and adverse impacts on health and pollution. These impacts have, however, been felt by companies, hence adopting cleaner production techniques and the use of renewable energy resources. The circular economy is

most frequently depicted as a combination of reduce, reuse and recycle activities, whereas it is oftentimes not highlighted that CE necessitates a systemic shift. The further find that the definitions show few explicit linkages of the circular economy concept to sustainable development(Kirchherr, Reike and Hekkert, 2017).

The effect of environmental impact on supply chain sustainability does not only lie within the actual operations of the supply chain but also within the expectations of the stakeholders and the requirement of conformity to certain standards. Consumers and investors are now placing pressure on firms and organizations, demanding them to disclose more information about their firms' environmental impacts and performance, thereby forcing firms to include sustainability issues in their strategic management agendas. Governments and international bodies are also imposing stricter regulations on emissions and resource usage, drivers of SSCM for the implementation of sustainability practices(Saeed and Kersten, 2019b).

In conclusion, the environmental factors affecting supply chain operations greatly affect the sustainability of such systems. Thus, there are the principles of eco-responsible supply chain management, like green logistics, cleaner production, and circular economy, that help reduce the negative impacts on the environment and improve the competitiveness of Canadian firms. This is especially important because more attention and demand from stakeholders, as well as regulations, drive companies to ensure more sustainability in their supply chain management.

5.5 Discussion of Research Question Four

What is the relationship between supply chain sustainability and employee motivation and engagement in sustainability initiatives?

Employees are also increasingly becoming an important link in relations between supply chain sustainability and employees' motivation/engagement with sustainability

initiatives. Organizational employees are critical in implementing sustainability initiatives since they are directly involved in operational processes and hold power in outcomes affecting environmental and social sustainability. Research suggests that when companies prioritize sustainability, the current job satisfaction level among the respondents is favorable, and morale is low since the respondents had a high intention to quit their current jobs (Naing, 2023).

Additionally, organizations that integrate their employees in sustainability projects like green teams or sustainability training uphold a sustainability culture within workplaces. This involvement, in turn, not only increases the level of involvement and participation of the employees but also increases their organizational commitment because of the perceived similarity between the organization's goals and the personal values and beliefs of the human resource.

However, it is also crucial to understand that the influence of sustainability on the motivation and engagement of the employees depends on the following factors: the company's true commitment to sustainability, and the level of employees' participation in sustainability initiatives. (Baheshtifar and Zare, 2012) Perceived organizational support is theorized to indirectly impact employee attitudes and behaviors by creating a sense of obligation within individuals. Employees can also feel motivated towards sustainability if they believe that their company values sustainability and is receptive to their opinion.

In conclusion, it is evident that there is a positive correlation between the state of supply chain sustainability and the level of employee motivation and engagement in sustainability activities. This is because organizations with sustainability strategies and engagement from employees are likely to have a dedicated staff. However, the organizations should ensure that their sustainability efforts are not only genuine but also

communicated well, involving the employees to actively engage and participate in the fulfilment of the company's sustainability efforts.

5.6 Discussion of Research Question Five

How do the supply chain digitalization influence organizational performance, specifically in terms of employee digital literacy and upskilling?

The literature on supply chain digitalization highlights its effects on employee digital competencies, which are crucial for organizational effectiveness. Technology like automation, data analytics, IoT, and others are gradually being incorporated into businesses; thus, the need for employees with digital skills to make optimum use of these technologies. Employees with high digital literacy are better equipped to optimize digital systems, improve efficiency, and contribute to innovation within the organization. Similarly, (Martínez-Peláez *et al.*, 2023) explored the technologies that can support MSMEs in their sustainability goals, and emphasizes the significance of stakeholders in achieving a successful digital transformation journey.

Upskilling development programs, which are efforts to enhance the skills of employees, play a critical role in preparing the workforce for new technological environments. These programs also create awareness towards development as well as tenacity of their employee besides developing them to counter new challenges that may arise within their working area. Furthermore, digital literacy, also known as upskilling, can help improve the levels of engagement and satisfaction in employees so that they are more competent and useful in their job positions. This engagement can result in low turnover rates and high commitment, which are so important in ensuring a skilled, stable and productive workforce.

In conclusion, there is considerable profound impact on the organizational performance resulting from the employee's digital literacy and upskilling envisaged by

Supply Chain Digitalization. Besides, these variables boost the efficacy of operations and innovativeness besides increasing employees' commitment and organizational adaptability. Organisations that focus on improving digital skills and keeping their knowledge up to date as to the advancements in the field of digital technology are likely to gain the competitive edge required for survival in the contemporary business world.

5.7 Discussion of Research Question Six

To what extent does employee motivation and engagement in sustainability initiatives, driven by supply chain sustainability efforts, impact organizational performance?

The integration of sustainability and ethics in modern supply chain management emphasizes the need for organizations to align their operations with environmental and social responsibilities (Oluwafunmilayo Esan, Funmilayo Aribidesi Ajayi and Olufunke Olawale, 2024). Employees are more and more of their sustainability integrated into the employee value proposition of organizations, and they are ready to be committed to organizations that put the environment and social values as their key priorities. Whenever companies involve employees in decision-making processes identifying sustainability goals like waste reduction, energy-saving, or community involvement, then the workers' morale is boosted.

Also, interested employees become decision-makers on sustainability and drive positive change within the organization by enhancing efficiency. They are more likely to identify and adopt green issues that encourage proper waste management, resource optimization and operations management. The proliferation of sustainability engagement among employees in the organization is also backed by the CSR practice; the organizational performance relationship is consistent with CSR. Thus, the established line of thought suggests that business organizations may be considered more sustainable and

have better stakeholders' perceptions if they are genuinely committed to sustainability. This, in turn, brings in the talent, customers and investors who are more sensitive to ethics and sustainability issues pertaining to the corporate world. The quality, comparability, and credibility of information are enhanced by internal and external audit procedures that verify the accuracy of this information or the extent to which practices are being followed(Eccles, Ioannou and Serafeim, 2014b).

In conclusion, since employee engagement in sustainability initiatives enhances motivation and due to the positive relationship between employee practices and a sustainable supply chain, organisational performance is highly influenced. Employees' high motivation leads to increased innovation, productivity, and consequently, improved corporate image, which are essential for competitiveness and sustainability in the long run. As a result, sustainability becomes a significant embracing of a company's core strategies and, at the same time, an engagement of employees; subsequently, it may help attain improved organizational performance and a beneficial impact on the workforce.

CHAPTER VI:

SUMMARY, IMPLICATIONS, AND RECOMMENDATION

6.1 Summary

This study explores the interconnectedness between supply chain digitalization and sustainability, and their effects on employee digital literacy, upskilling, motivation, engagement, and overall organizational performance. The research involves a sample of 330 respondents and employs various statistical methods to analyse these relationships.

The first area of focus is the relationship between supply chain digitalization and employee digital literacy and upskilling. The findings suggest a weak positive correlation that is not statistically significant, indicating that supply chain digitalization does not strongly influence or depend on employee digital literacy and upskilling. Similarly, the study examines the connection between supply chain sustainability and employee motivation and engagement in sustainability initiatives, finding a very weak and statistically insignificant relationship. The study then investigates the impact of employee digital literacy and upskilling on organizational performance through ordinal regression analysis. The analysis demonstrates that while the model significantly fits the data, there is some unexplained variability. Nevertheless, the model shows moderate to substantial explanatory power, indicating that employee digital literacy and upskilling contribute significantly to higher organizational performance. The impact of employee motivation and engagement in sustainability initiatives on organizational performance is analysed. The regression model indicates a significant fit, with strong explanatory power, suggesting that employee motivation and engagement in sustainability initiatives play a crucial role in enhancing organizational performance.

The analysis shows how the trends such as digitalization and sustainability in supply chain management impact on the organizational performance and engagement. Digitalization of activities in procurement logistics, warehouse using IoT, cloud computing and big data analytics reduce risk and increases the effectiveness in decision making of the supply chain. For instance, the IoT devices help monitor the real-time location of the goods, whereas data analytics helps in efficient management of the stocks. Nevertheless, industries and regions differ as for the level of digitalization because of infrastructure and policies and, therefore, need versus barriers should be addressed individually.

Digitalization also forces organizational expectation of higher employee digital competence and training the workers continuously. The changes that modern technologies bring forward to organizations, for instance, Artificial Intelligence and Blockchain are new skills that employees must possess in order to manage and operate them. This trend extends to the need for mastering technologies in the workforce where, continuous learning is required for the relevant changes to be made. However, the main issues including but not limited to inadequate funding for the project and lack of enough enthusiasm among the employees for training must be accorded adequate attention to optimize the impact of digitalization. Environmental impact of supply chain is another important feature that is worthy of consideration when it comes to the ability of the supply chain to sustain business. Purchasing of materials and transporting products among the different global supply networks exert tremendous environmental impacts that have led to rising attention towards green operations. Values such as sustainable procurement are now forming part of companies' strategies owing to the pressure from stakeholders and the rising importance of the environmental accountability of organizations. Sustaining employees and their engagement to sustainability programs are imperative for organizational performance. Because sustainability projects are often difficult to implement when employee buy-in is

not collected, the act of participation in these projects creates a culture of sustainability, as well as enhances the commitment level of the organization to the projects. The sustainability and success of those initiatives will only work if the company is really and truly put its commitment on sustainability and the involvement of the employees.

The study also highlights the positive relationship between supply chain digitalization, employee upskilling, and organizational performance. As companies adopt new technologies a digitally competent workforce is required and through upskilling programs, improving the organizational competency and employee satisfaction is achieved. This results into a better flow of operations, creativity and gain of competitive advantage in the market. Last but not the least, sustainability when implemented in supply chain management improves organisational performance especially in case of motivating employees. Such firms enhance their performance and reputation since engaging employees in activities that will enhance sustainability leads to better staff morale, high productivity, and better corporate image. The evidence suggests that sustainability should in fact be positioned at the heart of the firm's strategic agenda and become its guide to future competitiveness and prosperity.

Overall, the study provides valuable insights into how supply chain digitalization and sustainability initiatives affect employee capabilities and organizational success. It highlights the importance of fostering employee development and engagement in sustainability practices to achieve better organizational outcomes. The findings underscore the need for companies to invest in digital literacy and sustainability initiatives to drive performance improvements.

6.2 Implications

6.2.1 Theoretical Implications

The theoretical implications of this study offer significant contributions to the existing body of literature on supply chain management, digitalization, and sustainability, as well as their impacts on employee capabilities and organizational performance. This research builds on these gaps of knowledge to further explore the impact of digital transformation and sustainability strategies on supply chain on employee's digital literacy, upskilling, motivation and engagement and subsequent organisational performance.

The results of this study show that supply chain digitalisation does not have a significant impact on the employee digital readiness and learning as suggested by the weak positive relationship. This CA is therefore in contrast with some of the existing literature that has location digitalization as a key avenue for developing employee skills. For instance, in a study done by (Prajogo and Olhager, 2012) clearly alludes to how digital technologies in supply chains enhance new competencies with the employees in organizations by providing them easy access to digital tools and processes. Consequently, the current research suggests that having implemented these technologies may not be adequate; it has to be accompanied by a clear approach to training and development of the employees in order to afford these benefits.

Likewise, the low relationship between supply chain sustainability and employees' motivation and participation towards sustainability is incongruous with the established scholarly literature. Likewise (Glavas and Kelley, 2014) have explained that there are numerous benefits of sustainability which include enhancing the level of employee engagement and motivation due to the development of a match between business objectives and personal principles and beliefs. This seemingly implies that moderation of the relationship between sustainability and engagement may also depend on other aspects

including; organizational culture, communication initiatives and general overtures of the sustainability endeavor.

The results of the study show that the employee's digital literacy, and the upskilling due to supply chain digitalisation have a positive impact on the organisational performance. The above finding supports the RBV of the firm whereby having distinct resources and capabilities such as superior digital skills yield competitive benefits (Barney, 1991). They also encourage the dynamic capabilities theory whereby an organisation has to ensure that its people are continually trained to fit the technological advancement (Teece, Pisano and Shuen, 1997). The moderate to substantial efficiency of the model means that more attention should be paid to the employment processes and the focus on the further education of the employees to achieve the organizational goals.

In addition, the present research acknowledges that organizational performance is boosted by motivation by the employees in sustainability. This concurs with the triple bottom line whereby it is validated that social and ecological sustainability also yield economic returns. The denotative robustness of this regression model shows that companies with active employee commitment to sustainability initiatives shall expect better performance returns. This is inline with earlier work done by (Eccles, Ioannou and Serafeim, 2014a), whereby the following positive effects of sustainability practices on financial performance are evident; operational efficiency, innovation, and customer relations.

Therefore, the specified study advances the theoretical body of knowledge regarding the relationships between digital supply chain, supply chain sustainability, employees' readiness, and organizational outcomes. Sustainability, it is the call for integrated approach and not just merely exclusive to technology advancement but employee enhancement and real sustainability initiatives to boost organization's

performance. The implications of this enhance the extant literature and provide an avenue for directions for research and application in supply chain domain.

6.2.2 Managerial Implications

The key findings of this research offer valuable pointers for managers interested in using of digital and sustainability activities to improve organisational performance in the supply chain. The results reaffirm the necessity for a systematic and purposive approach towards the adoption and sustainment of technologies and interventions with special focus on the significance of specific training and communication programs for employees.

The first is the weak positive association between digitizing the supply chain and the employees' digital readiness and training needs imply that digitizing the supply chain alone is not enough. Managers need to possess the fact that digital transformation initiatives should come coupled with well-formulated training and development frameworks. This finding is in contrast to research by (Prajogo and Olhager, 2012), where they describe exploitive digital tools to have a natural ability to develop new competencies. Hence, managers should ensure there is provision for learning within their organizations so that employees are able to develop enhanced jovial competencies in digital proficiency. In this way, organizations can benefit as much as possible from CIO-mediated digital technologies to achieve competitive advantage.

The findings in this study show a poor linkage between supply chain sustainability and the engagement of the workers in sustainability efforts; in this case the concern deviates from the findings by (Glavas and Kelley, 2014). That is why it would be beneficial to underline that the existence of sustainability initiatives is not sufficient to increase the level of engagement. Mainly, managers have to create sustainable organizational culture truly. In order to promote sustainable work practices and to help employees understand the significance of sustainability the organization needs to apply effective communication

techniques. Further, sustainability activities can only be driven through when the employees have a realization that the measures being taken are real and are in harmony with the organizational values. There must be alignment at this level by having clear and open policies, clear communication on policies, and giving active participation of employees to sustainability initiatives.

By use of methods in this study on the role of digital literacy and upskilling for the employees, it was seen that performance of the organization was boosted. This supports the resource-based view (RBV) and the theory known as dynamic capabilities which both encourage the expansion of specific capabilities as the source of competitive advantage. Managers should ensure that they invest more on various digital literacy programs and training. In this way, such actions should be continuous and have the possibility of response to new technologies. Creating and maintaining culture focused on learning and improvement can help to prevent organizations' workforce being obsolete and unable to adopt new technologies.

Therefore, the findings suggest a strong positive relationship between the level of employee motivation and engagement in sustainability initiatives for organisational performance, and thus underpin the triple bottom line concept that embraces the social and environmental sustainability as having a positive impact on the economic bottom-line. These observations are supported by (Eccles, Ioannou and Serafeim, 2014a) and they demonstrated that sustainable practices improve operational excellence, product differentiation, and customer engagement. Managers should, therefore, not see sustainability as a compliance or governance issues or some sort of organizational obligation but as a micro-what tool for enhancing performance. People can be motivated for sustainability efforts at work and this could improve the performances on overall results.

The analysis of this study underscores the interactions as well as the major considerations when it comes to the processes of realizing the opportunities of digitalization and sustainability strategies. This paper agrees with other research that the findings for Kiva should not be seen as direct gains for component businesses. Such an adoption means that managers have to work closely to ensure that the technology is implemented in tandem with credible training and real sustainability efforts. This way would make sure that the employees are well trained as well as are fully committed to the success of the organization.

Therefore, this study offers a practical implication for managers who seek to obtain optimal value from the supply chain digitalization strategies and sustainability efforts. These improvements can be attained if organizations focus on the development of their employees and if they engage them in sustainability in a real sense. In other words, one can postulate that the highly sustainable organization has aligned technology advancement with continuous learning and has a fake sustainability culture. Besides, such a profound approach enriches the theoretical framework of the existing knowledge and provides a clear plan for managers in the sphere of supply chain management.

6.3 Recommendations for Future Research

The following recommendations can be considered by the future research in the further studies in this domain:

- There is need for further studies to validate the effects of current and technologically advanced solutions such as blockchain, artificial intelligence, and machine learning on supply chain management and accountability. Studying how these applications can be deployed within different fields and geographically might provide guidance to address present obstacles, improve data protection, and act faster in real time.

- Future research could look at the trends in digital literacy development from the employees' perspective and the carryover effects on employee engagement and productivity. The proposed work could capture the dynamics of incremental training and development initiatives and how they relate to the patterns of the employees' receptiveness to technology upgrades; delineate the impact of training and development interventions over time and evaluate the net effects of organizational investment in its employees to commit to technology change.
- The same approach of comparative analyses in other industries would give a clear understanding on how sustainability initiatives within sector impact on the supply chain management. The future research could investigate those practices, problems, and opportunities that are related to sustainable development and find the success factors in improving environmental and operational performance of industries such as manufacturing, retail, health care industries, etc.
- Subsequent studies should establish and compare cultural differences of various regions on the deployment of digital as well as sustainable practices among their supply chains. Researching organisational cultural values, the regulations and the expectations that customers have could prove useful for better understanding how digitalisation and sustainability initiatives can have higher acceptance in cultures that are resonant with those regions, and therefore, be more effective.
- Further research should aim at identifying cost-effectiveness of sustainable investments in supply chain especially in the area of renewable energy and green logistics. Future research could pursue the ways in which such investments are financially beneficial, and how long it takes for a company's investment in sustainability to pay itself back; this data would be useful in helping sustainability

managers identify the kinds of sustainability projects that are most valuable to their organizations.

- It could explore how the consumer behaves, their choices and influence on the adoption of sustainable principles in the supply chain. Future research could uncover how consumer demand for such sustainable products impacts organisational policies and supply chain management practices and provide relevant recommendations on how supply chain would effectively adapt to consumers' changing expectations that have spear headed the sustainability campaigns.
- It could explore the impact of continuous evolution of digital technologies with limited impact period and how fast organizations can transition from one technology to next level of technologies ensuring effective utilization and ROI of existing technology?
- It could explore the impact and challenges associated with fragmented needs and requirements of various sustainability principles across various industries and regions. How organizations can be equipped and encouraged to drive the transformation journey without loosing out on commercial sustainability

6.4 Conclusion

The findings of the study are complex interconnections between the variables of supply chain digitalization, sustainable supply chain and the resultant capability of the employees and the overall performance of the organization. Although the research revealed that there is no strong positive relationship between digitalized human resource management and changing digital literacy and upskilling among employees or between sustainability and improving employees' motivation and engagement, the result indicates that HRM needs to provide structured training and implement effective engagement

strategies while digitalizing the working environment. The data analysis shows that the level of digital literacy and sustainability measures is positively related to organisational performance, which corresponds to such theories as the resource-based view and the triple bottom line. Hence, it can be proposed that while going digital and sustainable is a good start, going green and digital with the ability of constant knowledge creation and application for the sustainable development of businesses, is the way forward. One is advised to continually train and develop the employees as well as promote the culture of sustainability in organizations so as to depict high performance and earn sustainable organizational returns. The interplay between human capital, digitalization, and sustainability is vital to the future of supply chain management. Organizations that effectively integrate these elements will be better equipped to navigate the evolving business landscape, enhance their competitive advantage, and contribute to broader sustainability goals. Future research should continue to explore these dynamics, particularly in the context of emerging technologies and shifting consumer expectations.

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APPENDIX A:

SURVEY COVER LETTER

Dear Friends,

Greetings🙏 I am Chandan Shirbhayye, a supply chain professional with more than 2 decades of experience and a *Doctoral Research Scholar* at *Swiss School of Business Management, Geneva*.

I extend this invitation for you to take part in my *research study* titled

"Role of Human Capital in Digitalised and Sustainability oriented Supply Chains".

Link for the survey: 👇

https://forms.gle/7mRapUhGib9PjFLN8

Your participation in completing this survey is pivotal for the advancement of my research and will take approximately 10 minutes of your time.

Incase you cannot provide the necessary feedback, I request you to please share within your network to help me with necessary responses.

All data collected will be used exclusively for research purpose only ensuring strict confidentiality and anonymity.

My sincere Gratitude🙏 for your time and valuable inputs as well as support.

Please let me know if you would like to discuss or share any additional points related to my research study

Regards,

Chandan Shirbhayye| +91-9022992896 | chandan2@ssbm.ch

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APPENDIX B:

QUESTIONNAIRE

DEMOGRAPHIC PROFILE:

1. **Name of the Participant:**
2. **Name of the organization (Optional):**
3. **Participant's total years of Supply Chain work experience**
    a. 0-5
    b. >5 – 10
    c. >10 – 15
    d. >15 – 20
    e. >20 – 25
    f. >25
4. **Participant's Designation:**
    a. Lower Management (Mgmt. Trainee to Manager)
    b. Middle management (>Manager to General Manager)
    c. Top Management (> General Manager to CXO)
    d. Board Member & Promoters
    e. Prefer not to say
5. **Operating Region of Organization (Multiple Choice):**
    a. India
    b. China
    c. Japan
    d. Korea
    e. Rest of APAC
    f. EU

g. UK

h. USA

i. Rest of World

6. What was last year Revenue (million USD) of your organization?

a. <=50

b. >50 – 100

c. >100 – 250

d. >250 – 500

e. >500 – 1000

f. >1000 – 1500

g. >1500 - 2000

h. >2000

7. What is the employee strength (On-rolls) of your organization?

a. 0-100

b. >100 – 500

c. >500 – 1000

d. >1000 – 3000

e. >3000 – 5000

f. >5000 – 7500

g. >7500 – 10000

h. >10000

8. What is the Supply Chain (Logistics, Procurement, distribution, Planning & Warehousing) employee strength (On- Rolls) of your organization?

a. 0-10

b. >10 – 30

c. >30 – 50

d. >50 – 150

e. >150

9. Years your organization has been operating since inception?

a. 0-5

b. >5 – 10

c. >10 – 15

d. >15 – 20

e. >20 – 50

f. >50

10. What is the industry your organization operates? (Multiple Choice with drop down):

a. Pharma Manufacturing & Services

b. Agriculture & Food processing

c. Paper & Textile

d. Tourism & Hospitality

e. Information Technology (Technology services, Software & Hardware)

f. Financial & Insurance services

g. Media & Telecommunication

h. Automobile & Transport equipment Manufacturing

i. Oil and Gas E&P

j. E-commerce & Retail

k. Commercial Real Estate

l. Electronics Goods & Durables

m. Mining & Metal production

n. Chemicals & Paints

o. Healthcare (Hospitals, Diagnostic labs, Equipments)

p. Transportation, Logistics & Warehousing services

q. Others

RESEARCH QUESTIONS:

11. **Please rate your Supply Chain digitalization and Sustainability orientation maturity levels as compared to your Industry.** *(Rate each option on Scale of 1- Emerging, 2 - Developing & 3 – Leading)***.**

Sr. No	Factors	1	2	3
A	Supply Chain core performance maturity			
B	Supply Chain Digitalization maturity			
C	Supply Chain Sustainability maturity			
D	Overall Supply Chain maturity			

12. **What are key factors driving Supply Chain Digitalization & Sustainable supply Chain initiative in your organization?** *(Rate each option on Scale of 1- Not so Critical, 2 - Critical & 3 - Very Critical).*

Sr. No	Factors	1	2	3
A	Customer Requirements			
B	Competition Pressure			
C	Management Vision			
D	Regulatory & Statutory Requirements			

13. **Please rate the scope of Digitalization in the supply Chain functions of your organization?** *(Rate each option on Scale of 1- Not so Critical, 2 - Critical & 3 - Very Critical)***.**

Sr. No	Functions	1	2	3
A	Procurement			
B	Planning			
C	Logistics			
D	Warehousing & Distribution			

14. **Please rate the scope of driving Sustainability initiatives in the supply Chain functions of your organisation?** *(Rate each option on Scale of 1- Not so Critical, 2 - Critical & 3 - Very Critical)***.**

Sr. No	Functions	1	2	3
A	Procurement			
B	Planning			
C	Logistics			
D	Warehousing & Distribution			

15. **What are the key challenges for driving Digitalization in your supply chain?** *(Rate each option on Scale of 1- Not so Critical, 2 - Critical & 3 - Very Critical).*

Sr. No	Factors	1	2	3
A	Availability of Talent to operate the Digitalised supply Chain			
B	Availability of Customised digital tools meeting the requirements			
C	Internal challenges related to Capability & Process Standardization			

D	Cost & ROI Challenges			
E	Lack of Vision & Stakeholder support			

16. **What are the key challenges for driving Sustainability initiatives in your supply chain?** *(Rate each option on Scale of 1- Not so Critical, 2 - Critical & 3 - Very Critical).*

Sr. No	Factors	1	2	3
A	Availability of Talent to operate the Sustainable supply Chain			
B	Availability of relevant inputs and proper framework to drive Sustainability in your Industry			
C	Internal challenges related to Capability & Process Standardization			
D	Cost & ROI Challenges			
E	Lack of Vision & Stakeholder support			

17. **Which can be the top initiative to improve the talent availability for Supply Chain digitalization & Sustainability initiatives?** *(Rate each option on Scale of 1- Not so Critical, 2 - Critical & 3 - Very Critical).*

Sr. No	Factors	1	2	3
A	Government and Educational institutions to Design vocational skills curriculum driving Supply Chain digitalization & sustainability in academics			

B	Industry collaboration for On-the-Job training			
C	Internal Job transfer and Upskilling			

18. Supply Chain Employee digital literacy and upskilling

(Rate the below Given statements from 1 to 5: as, 1: Strongly Disagree, 2: Disagree, 3: Neutral, 4: Agree and 5: Strongly Agree)

Sr. No	**Statements**	1	2	3	4	5
A	Our company provides sufficient training opportunities for employees to improve their digital skills.					
B	Our existing Supply Chain employees have adopted well with digital skills and able to perform satisfactorily					
C	Our existing Supply Chain employees are finding value and better job satisfaction post implementation of Supply Chain digitalization initiatives					
D	Our company offers continuous learning programs to keep employees updated on digital advancements to ensure relevance and effectiveness					
E	Growth and recognition are provided to employees who actively engage in digital upskilling efforts.					

19. Supply Chain Employee motivation and engagement in sustainability initiatives

(Rate the below Given statements from 1 to 5: as, 1: Strongly Disagree, 2: Disagree, 3: Neutral, 4: Agree and 5: Strongly Agree)

Sr. No	Statements	1	2	3	4	5
A	Our organization provides opportunities & training for employees to participate in sustainability-related projects or committees.					
B	Our existing Supply Chain employees are driving Sustainability initiatives with same intensity as their core supply Chain role					
C	Our existing Supply Chain employees are finding value and better job satisfaction in driving Supply Chain Sustainability initiatives					
D	Sustainability goals are integrated into individual performance evaluations and goal-setting processes.					
E	Our organization actively seeks employee input when developing or revising sustainability policies and initiatives.					

20. Organizational Performance

(Rate the below Given statements from 1 to 5: as, 1: Strongly Disagree, 2: Disagree, 3: Neutral, 4: Agree and 5: Strongly Agree)

Sr. No	**Statements**	1	2	3	4	5
A	Our organization is driving impactful Supply Chain Digitalisation and Sustainability initiatives					
B	Our organization's ability to meets its financial targets has improved post Supply Chain Digitalisation and Sustainability focus as compared to earlier					
C	Our organization is able to effectively manages resources and controls costs post implementation of Supply Chain Digitalisation and Sustainability initiatives					
D	Our company is able to effectively manages risks and mitigate potential threats post implementation of Supply Chain Digitalisation and Sustainability initiatives					
E	Our company is able to engage and retain employees better post implementation of Supply Chain					

	Digitalisation and Sustainability initiatives					
F	Our organization has a strong leadership team that drives success and innovation in implementation of Supply Chain Digitalisation and Sustainability initiatives					
G	Our organization has gained competitive advantage over competitors post implementation of Supply Chain Digitalisation and Sustainability initiatives					
H	Our organization is able to command premium from customers post implementation of Supply Chain Digitalisation and Sustainability initiatives					

APPENDIX C:

DATASET

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	Participantâ€™s total years	Participantâ€™s	Operating Region of	What was last year	What is the employee	What is the Supply Chain	Years your organization	What is the industry your	Please rate your Supply	Please rate your Supply	Please rate your Supply	Please rate your Supply	What are key factors	What are key factors	What are key factors	What are key factors	Please rate the scope of
2	2	2	India;China;Japan;EU;UK;	4	2	1	3	Pharma Manufacturi	2	2	3	2	3	3	3	2	2
3	4	3	India	4	6	4	5	Pharma Manufacturi	3	2	1	2	3	2	3	3	2
4	4	2	India;USA	3	2	1	2	Agriculture & Food	3	2	2	2	3	3	3	3	2
5	3	2	India;China;	1	2	1	5	Others	2	2	2	2	2	1	3	1	2
6	4	3	India;China;	7	8	5	6	Chemicals &	3	3	3	3	2	2	3	3	3
7	2	2	India	2	8	4	5	Pharma Manufacturi	2	1	2	2	2	1	2	2	3
8	1	3	India	1	1	1	1	Commercial	2	2	3	2	3	3	3	3	3
9	4	3	India;Japan; Korea;Rest	8	8	5	6	Pharma Manufacturi	3	2	3	3	3	3	2	3	3
10	2	2	India	3	5	4	5	Pharma Manufacturi	2	2	3	2	3	3	3	3	3
11	1	3	India;China;Japan;Korea;	3	5	4	5	Pharma Manufacturi	3	2	2	2	3	2	3	3	2
12	5	3	India	1	2	2	5	Pharma Manufacturi	3	2	2	2	3	3	3	2	3
13	6	3	India	5	4	4	5	Pharma Manufacturing & Services;Agriculture &	2	2	2	2	3	1	2	2	3
14	4	3	India;Japan; EU;USA;Rest	2	4	2	4	Pharma Manufacturi	3	2	2	2	2	2	2	2	2
15	1	3	India;Rest of World	1	1	1	1	Information Technology (Technology	2	1	2	2	2	1	2	2	2

	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH
1	Please rate the scope of	Please rate the scope of	Please rate the scope of	Please rate the scope of	Please rate the scope of	Please rate the scope of	Please rate the scope of	What are the key	What are the key	What are the key	What are the key	What are the key	What are the key	What are the key	What are the key	What are the key	What are the key
2	2	2	2	1	1	2	2	3	3	2	2	2	2	2	2	3	1
3	3	3	2	3	2	3	2	3	3	2	2	2	3	2	2	2	3
4	2	3	2	3	2	3	2	2	2	2	1	1	2	2	2	1	1
5	2	2	2	3	2	3	3	2	3	1	3	2	3	2	1	1	2
6	3	3	3	3	3	3	3	2	2	2	1	3	1	2	2	2	2
7	3	3	3	3	3	3	3	3	3	3	2	2	2	3	2	2	1
8	3	2	2	3	3	3	2	3	2	3	2	3	3	2	2	2	3
9	3	2	2	2	2	3	3	2	3	1	2	1	2	1	1	2	1
10	2	3	3	3	3	3	3	3	3	2	2	3	3	3	3	3	3
11	2	3	2	3	2	3	3	2	2	2	2	2	2	2	2	3	2
12	3	1	1	1	1	1	1	3	3	3	3	2	3	2	3	3	1
13	3	2	2	3	2	3	2	1	1	2	2	1	1	1	2	2	1
14	2	2	2	2	2	2	2	2	2	2	2	2	1	3	2	1	3
15	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV	AW	AX	AY
1	Which can be the top	Which can be the top	Which can be the top	Please rate the Supply	Please rate the Supply	Please rate the Supply	Please rate the Supply	Please rate the Supply	Please rate the Supply	Please rate the Supply	Please rate the Supply	Please rate the Supply	Please rate the Supply	Please rate your	Please rate your	Please rate your	Please rate your
2	1	1	1	3	4	4	2	2	3	3	3	4	3	4	4	4	3
3	2	3	3	4	4	4	3	3	3	4	4	4	4	4	3	4	4
4	1	1	1	3	3	3	2	2	4	4	4	4	4	5	4	5	4
5	3	3	3	5	5	4	5	4	4	3	4	3	5	3	4	4	4
6	3	2	3	3	3	2	3	2	3	4	5	4	5	2	3	3	3
7	1	3	3	1	1	4	2	3	3	4	3	3	3	2	3	3	3
8	3	3	3	2	2	3	2	3	3	3	3	3	3	3	3	2	2
9	3	3	3	5	4	5	5	5	4	3	4	5	4	5	5	5	5
10	1	2	3	5	4	4	4	5	3	4	3	4	5	4	4	3	3
11	2	2	2	4	4	4	3	4	4	4	4	5	3	4	3	5	4
12	1	1	3	1	3	3	1	4	2	2	2	4	2	2	2	3	4
13	2	3	2	5	4	5	4	4	4	4	5	5	4	4	4	4	4
14	1	3	2	3	2	3	2	2	4	5	4	4	4	3	3	3	3
15	2	2	2	4	3	4	4	4	4	4	4	4	4	3	3	4	4

AZ	BA	BB	BC
Please rate your	**Please rate your**	**Please rate your**	**Please rate your**
3	3	3	3
3	4	3	3
5	5	5	5
4	5	5	3
2	3	3	3
3	3	3	3
3	3	3	2
4	5	5	5
3	5	3	4
3	4	4	3
1	4	2	3
4	4	4	4
3	4	4	3
4	4	3	3